MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY
(MIST)

COURSE CURRICULUM

BACHELOR OF SCIENCE IN
NAVAL ARCHITECTURE AND MARINE ENGINEERING

DEPARTMENT OF
NAVAL ARCHITECTURE AND MARINE ENGINEERING
(NAME)

JANUARY 2021

APPLICABLE FOR NAME- 9 & ONWARDS

COMMITTEE OF COURSES – NAME DEPT, MIST

The undergraduation course curriculum of the department of Naval Architecture and Marine Engineering (NAME) of Military Institute of Science and Technology (MIST) has been reviewed by the committee as mentioned below.

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CHAPTER 1
GENERAL INFORMATION

1.1 Introduction to MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT) and other foreign institutions of science and technology. With a view to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) that promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. The motto of MIST is ―Technology for Advancement. Founded on 19 April 1998, MIST started its journey on 31 January 1999 by offering a four-year bachelor's degree on Civil Engineering. Bachelor degree on Computer Science Engineering course started on 2001**.** Bachelor courses on Electrical, Electronic & Communication Engineering and Mechanical Engineering started its journey from 2003. Bachelor of Science program on Aeronautical Engineering (AE) and Naval Architecture and Marine Engineering (NAME) program were started from 2008-2009 and 2012- 2013 respectively. Besides, four new departments started their academic session from 2014-2015i.e. Nuclear Science & Engineering (NSE), Biomedical Engineering (BME), Architecture (Arch) and Environmental, Water Resources & Coastal Engineering (EWCE).

Foreign students from Sri Lanka were admitted for the first time at MIST. Presently students from Maldives, Palestine, Nepal and Ghambia are also studying in different Engineering Programs. MIST envisages creating facilities for military as well as civil students from home and abroad dedicated to pursue standard curriculum leading to Graduation Degree. As an Institution without any gender biasness, MIST is already on steady stride upholding its motto “Technology for Advancement”. MIST remains committed to contributing to the wider spectrum of national educational arena and play a significant role in the development of human resources and ardently pursuing its goal to grow into a “Centre of Excellence”. MIST has well equipped class rooms with multimedia and web camera with internet facilities and laboratories with modern equipment. The medium of instruction for all engineering programs is English. All academic programs of MIST are affiliated with the Bangladesh University of Professionals (BUP) and have close cooperation with Bangladesh University of Engineering and Technology (BUET) and Dhaka University (DU).

1.2 Vision and Mission of MIST

Vision: To be a center of excellence for providing quality education in the field of science, engineering and technology and conduct research to meet the national and global challenges.

Mission:

a. Provide comprehensive education and conduct research in diverse disciplines of science, engineering, technology and engineering management.
b. Produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet socio- economic development of Bangladesh and global needs.
c. Conduct collaborative research activities with national and international communities for continuous interaction with academician and industry.

d. Provide consultancy, advisory, testing and other related services to government, non-government and autonomous organization including personnel for widening practical knowledge and to contribute in sustainable development of the society.

1.3 Salient Features of MIST

a. Rigorous admission and selection process for best possible screening interactive sessions in the classroom.
b. Regular guest lectures and educational visits.
c. Culture of timeliness, commitment and uninterrupted curriculum.
d. Flexibility in choosing competent faculties through outsourcing.
e. Well thought-out and continuous feedback and assessment system.
f. Effective teaching through innovative method.
g. Industrial attachment for on job training.
h. Emphasis on code of conduct and dress code.
i. Focus to develop students as good human with all possible attributes of successful leader.
j. Tranquil, pollution free and secure campus life.

1.4 Location

MIST is located at Mirpur Cantonment, northwest edge of the greater Dhaka city, a hub of knowledge for the armed forces. Mirpur Cantonment is a small, calm and quiet education village and free from all possible pollution of a city life. A garland like lake with migratory birds, three sides with extended green fields in the summer and water bodies in the rainy season, whistling birds on the tree branches and overall bounty of nature adds to the already existing splendid academic atmosphere. Other neighboring academic institutions are National Defense College (NDC) and Defense Services Command and Staff College (DSCSC) – two international standard education centers.

1.5 Faculties

1.5.1 Faculty of Civil Engineering (FCE):

- Civil Engineering (CE)
- Architecture (Arch)
- Civil, Environment, Water and Coastal Engineering (CEWCE)
- Petroleum and Mining Engineering (PME)

1.5.2 Faculty of Electrical & Computer Engineering (FECE):

- Computer Science and Engineering (CSE)
- Electrical, Electronic and Communication Engineering (EECE)

1.5.3 Faculty of Mechanical Engineering (FME):

- Mechanical Engineering (ME)
- Aeronautical Engineering (AE)
- Naval Architecture and Marine Engineering (NAME)
- Industrial and Production Engineering (IPE)

1.5.4 Faculty of Science & Engineering (FSE):

- Biomedical Engineering (BME)
- Nuclear Science and Engineering (NSE)
- Department of Science (Mathematics, Physics, Chemistry) and Humanities (Only Post Graduate)

Presently MIST has 12 (twelve) departments to conduct B Sc. Engineering program under 04(four) different engineering faculties. The departments impart education basing on common objectives and outcomes set by MIST and have defined program objectives and outcomes, specific to the departments respectively.

1.6 Eligibility of Students for Admission in MIST (Subject to review each year)

The students must fulfill the following requirements:

a. **Bangladeshi Students.** Minimum qualifications to take part in the admission test are as follows:

(1) The applicant must have passed SSC / equivalent examination from Board of Intermediate and Secondary Education/Madrasa Education Board/Technical Education Board in Science Group obtaining GPA 4.00 (without fourth subject) on a 5-point scale and in HSC/Equivalent examination from Board of Intermediate and Secondary Education/Madrasa Education Board/Technical Education Board in Science group the applicant must have obtained minimum GPA 4.00 on a 5-point scale. In HSC/Equivalent and SSC/Equivalent examination: (i) the applicant passed HSC or Equivalent in must obtain minimum total grade point 17 in four subjects (Mathematics, Physics, Chemistry and English), (ii) SSC Examination (or Equivalent).

(2) The applicant must have qualified in minimum five subjects including Mathematics, Physics, Chemistry and English Language with minimum 'B' in average [i.e. A=5, B=4, C=3, D=2 & E=1, minimum required grade point=20] in GCE 'O' Level and in 'A' level/Equivalent background of Minimum 'B' grade in Mathematics, Physics and Chemistry.

(3) Applicants who have passed HSC or Equivalent examination in the current previous year must grade obtain 19 in four subjects (Mathematics, Physics, Chemistry and English).

(4) Sex: Male and Female.

b. **Foreign Students.** Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

(1) Educational qualifications as applicable for Bangladeshi civil students or equivalent.
(2) Must have security clearance from respective Embassy/High Commission in Bangladesh.
(3) Sex: Male and Female.

In the event of non-availability of foreign students, Bangladeshi civil candidates will fill up the vacancies.

1.7 Number of Seats

The highest number of seats for 04 (Four) years Bachelor Degree in Engineering programmes (Unit – A) and 5 (Five) years Bachelor Degree of Architecture programme are as follows:

Allocation of Seats

Ser	Unit	Department	Seats
1.	A	Civil Engineering (CE)	60
2.		Computer Science and Engineering (CSE)	60
3.		Electrical, Electronic & Communication Engineering (EECE)	60
4.		Mechanical Engineering (ME)	60
5.		Aeronautical Engineering (AE)	50
6.		Naval Architecture and Marine Engineering (NAME)	40
7.		Biomedical Engineering (BME)	40
8.		Nuclear Science and Engineering (NSE)	40
9.		Civil & Environmental Engineering	60
10.		Civil & Water Resources Engineering	
11.		Industrial and Production Engineering (IPE)	50
12.		Petroleum and Mining Engineering (PME)	25
13.	B	Architecture (Arch)	25
	Total		**570**

1.8 Admission Procedure

1.8.1 **Syllabus for Admission Test.** Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (comprehension and functional) subjects of HSC examinations of all boards of secondary and higher secondary school certificates. There will be no multiple-choice type questions (MCQ). Admission test will be conducted out of 200 marks and the distribution of marks is given below:

Ser.	Subjects	Marks
a.	Mathematics	80
b.	Physics	60
c.	Chemistry	40
d.	English	20
Total		**200**

1.8.1 **Final Selection**. Students will be selected on the basis of results of the admission test. Individual choice for selection of departments will be given preference as far as possible. Minimum qualifying marks in the test is 40% for the applicants. In case of tie in the result of admission test, difference will be judged on the basis of marks obtained in Mathematics, Physics, Chemistry and English respectively in admission test.

1.8.2 **Medical Checkup**. Civil candidates selected through admission test will go for medical checkup in MIST medical center. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in medical policy of MIST will be declared unsuitable for admission.

1.9 Students Withdrawal Policy

1.9.1 General Policy of Withdrawal

The under graduate (B.Sc.) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms for Architecture programme it is planned for 3 & regular levels, comprising of 10 regular terms. It is expected that all students will earn degree by clearing all the offered courses in the stipulated time. In case of failure the following policies will be adopted:

a. Students failing in any course/subject will have to clear/pass the said course/subject by appearing it in referred examination as per examination policy. In case of students completing level-4, maximum three courses/subjects will be allowed in the referred examination (which is to be cleared within 6 years of registration).
b. Referred examination will be conducted at this institution before commencement of next level.
c. Maximum grading for supplementary examination etc. of failed subjects will be B+ as per examination policy.
d. One student can retake/reappear in a failed subject/course only twice. However, with the Permission of Academic Council of MIST, a student may be allowed for third time as last chance.
e. In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council, MIST. However, he/she has to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.
f. Minimum credit requirement for the award of bachelor's degree in Engineering (Bsc. Engg) and Architecture (B. Arch) will be decided by the respective department as per existing rules. However, the minimum CGPA requirement for obtaining a bachelor degree in engineering and Architecture is 2.20.
g. Whatever may be the cases, students have to complete the whole undergraduate Program within 06 (six) academic years from the date of registration.
h. All other terms and condition of MIST Examination Policy remain valid.

1.9.2 Withdrawal on Disciplinary Ground

a. **Unfair Means**. Adoption of unfair means may result in expulsion of a student from the programme and expulsion so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

(1) Communicating with fellow students for obtaining help in the examination.
(2) Copying from another student's script/ report /paper.
(3) Copying from desk or palm of a hand or from other incrimination documents.
(4) Possession of any incriminating document whether used or not.

b. **<u>Influencing Grades.</u>** Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

c. **<u>Other Indiscipline Behaviours.</u>** Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/programme or is considered detrimental to MIST's image.

d. **<u>Immediate Action by the Disciplinary Committee of MIST.</u>** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the Institution. In case of withdrawal/expulsion, the matter will be referred to the Academic Council, MIST for post-facto approval.

1.9.3 <u>Withdrawal on Own Accord</u>

a. **<u>Permanent Withdrawal.</u>** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.

b. **<u>Temporary Withdrawal.</u>** A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to approval of Academic Council of MIST, he will be allowed to apply fresh in future batch. If approved from the date of his/her registration.

CHAPTER 2
RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT MIST

2.1 Introduction

MIST has introduced course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

2.2 The Course System

The salient features of the Course System are as follows:

a. Number of theory courses will be generally 5 in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow relaxation in this regard. This relaxation is to be reported to Academic Council of MIST.
b. Students will not face any level repeat for failing.
c. Students will get scope to improve their grading.
d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.
e. Continuous evaluation of students' performance.
f. Promotion of student-teacher interaction and contact.

2.2.1 Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on the study of several subjects in humanities and social sciences.

2.2.2 The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science and humanities subjects; while the third and subsequent years focus on specific disciplines.

2.3 Number of Terms in a Year

There will be two terms (Spring Term I and Fall Term II) in an academic year.

2.4 Duration of Terms

The duration of each of Term I (spring) and Term II (fall) (maximum 22 weeks) may be as under

Ser	Events	Durations
1.	Classes before Mid Term	7 weeks
2.	Mid Term Vacation	1 week
3.	Classes after Mid Term	7 weeks
4.	Makeup Classes and Preparatory leave	2/3 weeks

5.	Term Final Examination	2/3 weeks
6.	Term End Vacation	1/2 week

2.5 Course Pattern and Credit Structure

The undergraduate program is covered by a set of theoretical courses along with a set of laboratories (sessional) courses to support them.

2.6 Course Designation System

Each course is designated by a maximum of four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

a. The first digit corresponds to the year/level in which the course is normally taken by the students.
b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.
c. The last digit is an odd number for theoretical courses and an even number for sessional courses.

The course designation system is illustrated as Follows:

NAME – 3 0 1 **Ship's Structure**

Course Title
Odd digit designates a theoretical
Course Reserved for departmental use
Signifies 1st Year/ 1st Level course
Department identification code

NAME - 2 0 8 **Ship Design and Drawing II**

Course Title
Even digit designates a sessional course
Reserved for departmental use Signifies
2nd Year/ 2nd Level course
Department identification code

2.7 Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. **Theoretical Courses:** One lecture per week per term is equivalent to one credit.
b. **Sessional Courses:** Credits for sessional courses is half of the class hours per week per term.
c. **Project and Thesis Courses**: Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another.

2.8 Types of Courses

The types of courses included in the undergraduate curricula are divided into the following groups:

a. **Core Courses:** In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete the entire designated core courses of his/her discipline.
b. **Prerequisite Courses:** Some of the core courses are identified as prerequisite courses for a specific subject.
c. **Optional Courses:** Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

2.9 Course Offering and Instruction

a. The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.

b. Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

2.10 Teacher Student Interaction

The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

2.11 Students' Adviser

One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

a. However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

b. For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous term. The adviser may permit the student to drop one or more courses based on previous academic performance.

2.12 Course Registration

Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

2.13 Registration Procedure

At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

2.14 Pre-conditions for Registration

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.

b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre-requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre-requisite course is found to be satisfactory.

2.15 Registration Deadline

Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

2.16 Penalty for Late Registration

Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

2.17 Limits on the Credit Hours to be Taken

2.17.1 A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

2.17.2 In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Comdt, a lesser number of credit hours to suit individual requirements. Such cases are also applicable to students of Level 4 requiring less than 15 credit hours for graduation.

2.18 Course Add/Drop

2.18.1 A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular. Dropping a course is permitted within the first four weeks of a regular term.

2.18.2 Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar's Office, where the required numbers of photocopies are made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.

2.18.1 All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

2.19 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However, application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

2.20 The Grading System

The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva-voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be given as follows:

Numerical Markings	**Grade**	**Grade Points**
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25
40% to below 45%	D	2.00
below 40%	F*	0.00
Incomplete	I	-
Withdrawal	W	-
Capstone Project/Thesis continuation	X	-

* Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA)

2.21 Marks Distribution

2.21.1 **Theory:** Forty percent (40%) marks of a theoretical course shall be allotted for continuous assessment, i.e. quizzes, home assignments, class tests, observations/ class participation and class attendance. These marks must be submitted to Office of the Controller of Examinations before commencement of final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes. Distribution of marks for a given course per credit is as follows:

Class Performance	5%
Class Test/ Assignment	20%
Mid Term Assessment (Exam / Project)	15%
Final Examination (Section A & B)	60%
Total	**100%**

2.21.2 **Sessional/Practical Examinations**: Sessional courses are designed and conducted by the concerned departments. Examination on sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the sessional courses on the basis of the followings (all or as decided by the Examination Sub-Committee):

Conduct of Lab Tests/Class Performance	25%
Report Writing/ Programming	15%
Mid-Term Evaluation (exam/project/assignment)	20%
Final Evaluation (exam/project/assignment)	30%
Viva Voce	10%
Total	**100%**

2.21.3 **Sessional Course in English**: The distribution will be as under:

Class performance/observation	10%
Written Assignment	15%
Oral Performance	25%
Listening Skill	10%
Group Presentation	30%
Viva Voce	
Total	**100%**

2.21.4 **Class Attendance**: Class attendance may be considered as a part of continuous assessment. No mark should be allotted for attending classes.

2.22 Calculation of GPA

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes n courses in a term having credits of C_1, C_2,……..C_n and his grade points in these courses are G_1, G_2,…..G_n respectively then

$$\mathrm{GPA} = \frac{\text{Grade points earned in the semester}}{\text{Credits completde in the semester}}$$

$$\mathrm{GPA} = \frac{\sum(\text{Credit hours in a course} \times \text{Grade points earned in that course})}{\text{Credits completde in the semester}}$$

$$\mathrm{GPA} = \frac{\sum_{i=1}^{n}(C_i \times G_i)}{\sum_{i=1}^{n} C_i}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes terms having total credits of TC_1, TC_2,….,TC_n and his GPA in these terms are GPA_1, GPA_2,…..GPA_n, respectively then

$$\mathrm{CGPA} = \frac{\sum_{i=1}^{n} \mathrm{TC_i} \times \mathrm{GPA_i}}{\sum_{i=1}^{n} \mathrm{TC_i}}$$

Numerical Example

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credit Ci	Grade Points	Gi	Ci*Gi
NAME 107	3.00	A+	4.00	12.00
CHEM 101	3.00	A+	4.00	12.00
PHY 101	3.00	A+	4.00	12.00
MATH 101	3.00	A+	4.00	12.00
GEBS 101	2.00	A	3.75	7.50
LANG 102	1.50	A+	4.00	6.00
ME 150	1.50	A	3.75	5.625
CHEM 122	1.50	A	3.75	5.625
SHOP 180	1.50	A+	4.00	6.00
Total	**20.00**			**78.75**

GPA = 78.75/20 = 3.9375 ≈ 3.94

Suppose a student has completed four terms and obtained the following GPA.

Level	Term	Earned Credit Hours	Earned GPA	TCi*GPAi
		TC_i	GPA_i	
1	I	20.00	3.94	78.80
1	II	21.00	3.84	80.64
2	I	20.25	3.92	79.38
2	II	20.25	3.98	80.60
Total		81.50		319.42

CGPA =319.42/81.50=3.92

2.23 Minimum Earned Credit and GPA Requirement for Obtaining Degree

Minimum credit hour requirements for the award of bachelor’s degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum CGPA requirement for obtaining a Bachelor’s degree in engineering and other discipline is 2.20.

2.24 Minimum Earned Credit and GPA Requirement for Obtaining Degree (Additional Course)

Minimum credit hour requirements for the award of bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided by the respective department (BUGS). However, at least 157 credit hours for engineering must be earned to be eligible for graduation. This must include the specified core courses. The minimum GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20. A student may take additional courses with the consent of his Advisor in order to raise GPA, but he/she may take a maximum of 15 such additional credits beyond respective credit-hours requirements for Bachelor's degree during entire period of study.

2.25 Impacts of Grade Earned

The courses in which a student has earned a 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an 'F' grade will not be counted towards his/her earned credits or GPA calculation. However, the 'F' grade will remain permanently on the Grade Sheet and the Transcript.

a. A student who obtains an 'F' grade in a core course will have to repeat that particular course. However, if a student gets an 'F' in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an 'F', he/she will not be eligible to get a grade better than 'B+' in that repeated course.

b. If a student obtains a grade lower than 'B+' in a particular course he/she will be allowed to repeat the course only once for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than 'B+' for an improvement course.

c. A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. Program.

d. If a student obtains a 'B+' or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

2.26 Classification of Students

At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Level	Credit Hours Earned	
	Engineering	**Architecture**
Level 1	0.0 to 36.0	0.0 to 34.0
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0
Level 4	More than 108.0	More than 110.0 to 147.0
Level 5	-----	More than 147.0

2.26.1 However, before the commencement of each term all students other than new batch are classified into three categories:

a. **Category 1:** This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

b. **Category 2:** This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

c. **Category 3:** This category consists of students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

2.27 Definition of Graduating Student

Graduating students are those students who will have ≤ 24 credit hour for completing the degree requirement.

2.28 Performance Evaluation

The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

2.28.1 Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists:

a. The term GPA falls below 2.20.
b. The Cumulative Grade Point Average (CGPA) falls below 2.20.
c. The earned number of credits falls below 15 times the number of terms attended.

2.28.2 All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and backlog courses, if there are any, with better grades. When the minimum GPA and credit requirements are achieved the student is again returned to good standing.

2.29 Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

2.30 Time Limits for Completion of Bachelor's Degree

A student must complete his studies within a maximum period of six years for engineering and seven years for architecture.

2.31 Attendance, Conduct and Discipline

MIST has strict rules regarding the issues of attendance in class and discipline.

2.31.1 **Attendance**: All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

2.31.2 **Conduct and Discipline**: During their stay in MIST all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

2.32 Teacher-Student Interaction

The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator (CC) is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

2.33 Absence during a Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an F grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

2.34 Recognition of Performance

As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends will be given as per existing rules and practices.

2.35 Types of Different Examinations (Subject to change for different academic session)

Following different types of final Examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. **Term Final Examination:** At the end of each normal term (after 22 wk or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. **Supplementary Examination:** It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun)/ Fall Term(Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) end break respectively. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II

c. **Improvement Examination:** It will be taken during Supplementary-I and Supplementary-II examination. Questions will be same as the question of the regular examination of that Final Examination (if any). Student can take two subjects at a time and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than 'B+' in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better then 'B+' for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i.e previous to improvement examination shall be reflected in the transcript.

2.36 Rules of Different Examinations (Subject to change for different academic session)

2.36.1 Term Final Examination. Following rules to be followed:

a. Registration to be completed before commencement of the class. A student has to register his desired courses paying registration, examination fee and other related fees.
b. Late registration will be allowed without penalty within first one week of the term.
c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.
d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.
e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

2.36.2 Supplementary Examination. Following rules to be followed:

a. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun)/ Fall Term(Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) end break respectively.
b. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.
c. No class will be conducted.
d. 40% marks on continuous assessment will be considered from previous term.
e. Highest grade of supplementary examination will be 'B+'.
f. No sessional exam will be conducted.
g. Examination will be taken on 60% marks like Term Final examination.
h. If a student fails in a course more than once in regular terms, then best one of all continuous assessment marks (40%) will be counted.

i. If anyone fails in the laboratory/sessional course, that course cannot be taken in the supplementary.

j. If any student fails in a course, he can clear the course retaking it 2^{nd} time or, he can clear the examination appearing at the supplementary examination as well. Any one fails twice in a course, can only retake it in the regular term appearing third time. But anyone fails 3^{rd} time in a course consecutively, he has to take approval of Academic Council of MIST for appearing 4^{th} time in a course and need to pay extra financial penalty. If any students fails even 4^{th} time in a course, will not be allowed to appear anymore in this same course.

k. Registration of supplementary-I exam to be done within 5^{th} wk after completion of fall term (July to Dec) and registration of supplementary-II exam to be done during Mid-Term of spring (Jan to Jun).

l. There will be no provision for add/drop courses after registration.

m. Question setting, Moderation, Result Publication will be done following the same rules of Term Final Examination as per Examination Policy.

n. Moderation of the questions for supplementary-I will be done in 5^{th} wk after completion of Fall Term (July to Dec) Final Exam and Supplementary –II with the moderation of the questions of Spring Term (Jan to Jun).

o. Separate Tabulation sheet to be made.

p. **Thesis:** If a student cannot complete the thesis in two consecutive terms, with the recommendation of supervisor, he/she may continue for next one/two term within six academic years.

2.36.3 **<u>Improvement Examination.</u>** Following rules to be followed:

a. Improvement examination is to be taken during Supplementary-I and Supplementary-II.

b. For Improvement examination, registration is to be done during the registration of Supplementary-I and Supplementary-II examination paying fees.

c. Question setting, Moderation and Result publication to be done with courses of Supplementary-I and Supplementary-II examinations.

d. Any student gets a grading below ‘B+’ and desires to improve that course; he will be allowed to appear the improvement examination for that particular course.

e. Highest grade of Improvement examination will be ‘B+’.

f. One student is allowed to appear at Improvement exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time.

2.37 <u>Irregular Graduation</u>

If any graduating student clears his/her failed course in Term-1 and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Term-1 and that student will be allowed to apply for provisional certificate.

CHAPTER 3
DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

3.1 Introduction to the program

Our Lord, Almighty, has created human being in a state of weakness, but blessed with extra ordinary divine intelligence and engineers amongst us who could perceive the need of time. In this regard, maritime related engineering is one of the important aspects in the history of civilization and ships are one of the oldest forms of transport used by human being.

Naval architecture has been an inherent part of the evolution of ships or crafts, and naval architecture and marine engineering is a very interesting branch of study. Graduates in this field of study have actually duel degrees. In one way these graduates are naval architects, and another way they are marine engineers. Study in NAME provides insight to design, to build, to operate and to maintain vessels which move just above, on or under the sea. It can be said that naval architects connect nation to nation and civilization to civilization through rivers, seas and oceans. Basically, a good naval architect is he who can acquire required knowledge of designing and building marine vehicles satisfactorily, and utilize such knowledge for the benefit of mankind.

To be prepared for the professional tasks, students of naval architecture are primarily studying hydrodynamic theories and concerned computational methods to develop efficient hull form to be operated at desired movability with minimum energy consumption. Secondly, they have to go through material science in depth to build better quality ships to be sustainable in unfriendly weather conditions at sea. As the field of naval architecture is the part and parcel of mechanical engineering, it is impossible to be a good naval architect without being a good mechanical engineer, and knowledge on mechanics, theory of machine, heat transfer, diesel engine, gas turbine, nuclear power, fuel cells, pumps, compressor, refrigeration, air- conditioning etc is absolutely essential. Moreover, machinery controls, whether it is mechanical, pneumatic or electronic, control engineering expertise for the marine engineers is also required.

Above all, today's technology is computer based and no ship is designed without the use of software. It is now the demand of the day to have upper hand on computer programming language and numerical simulations to bring forward what the graduating students are principally learning in the field of naval architecture and marine engineering. The last but not the least is the humanities and the management for efficient cost estimation, human resource management and enhancement of leadership.

3.2 Vision and Mission of the Program

a. **Vision:** To be national and international centre of excellence offering a study programme of high quality, innovation and creativity in the field of Naval Architecture and Marine Engineering.

b. **Mission:** To produce engineers and researchers with sound knowledge on fundamentals of traditional, modern and emerging areas of Naval Architecture and Marine Engineering together with innovative design abilities and managerial skills to achieve sustainable national development.

3.3 Faculty Member of NAME

a. Military Faculty Members

- Commodore M Muzibur Rahman, (E), psc, BN
- Captain Kaosar Rashid, (E), psc, BN
- Commander M Golam Mohiuddin, (E) , BN
- Lt Col Muhammad Rabiul Islam, PhD, EME
- Commander M Masum Ul Haque, (E) , BN
- Major Osman M Amin, PhD, Engrs
- Major S M Kamuruzzaman, EME

b. Civil Faculty Members

- Professor M Munir Hassan
- Assistant Professor Dr. S M Ikhtiar Mahmud
- Assistant Professor Md. Touhidul Islam
- Assistant Professor Md. Mezbah Uddin
- Lecturer Md Daluar Hussain
- Lecturer Tasmia Haque
- Lecturer Kazi Rafi Rahaman
- Lecturer Kaniza Islam
- Lecturer Mohammed Jubair Dipto
- Lecturer A S M Araf Raihan

c. Guest Faculty Members

- Former Professor Dr. Md. Sadiqul Baree, NAME department, BUET
- Former Professor Dr. Md. Reaz Hasan Khondoker, NAME department, BUET
- Professor Dr. S Reaz Ahmed, ME department, BUET
- Professor Dr. M. Rafiqul Islam, NAME department, BUET
- Professor Dr. Md. Shahjada Tarafder, NAME department, BUET
- Professor Dr. Goutam Kumar Saha, NAME department, BUET
- Professor Dr. Nayeb Md. Golam Zakaria, NAME department, BUET
- Professor Dr. Md. Mashiur Rahaman, NAME department, BUET
- Associate Professor Dr. Zobair Ibn Awal, NAME department, BUET

3.4 Facilities of the Department

The NAME department endeavors to provide its faculty members and students adequate laboratory, library and other facilities to undertake undergraduate courses. Since the engineering education is laboratory intensive, following laboratories are catered for such requirements:

(1) Computer Aided Ship Design Lab
(2) Ships Structure and Fabrication Lab
(3) Marine Machinery Lab
(4) Ship Instrument Lab
(5) Damage Control Fire Fighting and Life Saving Lab

(6) Ship Propulsion Lab
(7) Ship Resistance Lab
(8) Machine Tools Lab
(9) Model Fabrications Lab
(10) Towing tank stability Lab
(11) Marine Transportation Lab
(12) Hydrodynamics Lab
(13) Auxiliary Machinery Lab
(14) Marine Electronics Lab

In addition to above laboratories, NAME students have to undertake laboratory courses (sessional) in Physics, Chemistry, Workshop, Electrical Engineering and Civil Engineering too. If necessary undergraduate students can have the access to the facilities of other departments and centers during their project, thesis and research works.

Besides the stated laboratories, NAME department has established "Ship Design and Marine Structural Solution Center" to take the challenge of professional engineering to an eminent level.

3.5 Program-Specific Criteria

Criteria for Naval Architecture and Marine Engineering or Similar Program according to BAETE Manual 2 have been described in this paragraph. The program must prepare graduates to apply probability and statistical methods to naval architecture and marine engineering problems; to have basic knowledge of fluid mechanics, dynamics, structural mechanics, materials properties, hydrostatics, and energy/propulsion systems in the context of marine vehicles; and to have familiarity with instrumentation appropriate to naval architecture and/or marine engineering.

3.6 Program Educational Objectives (PEOs)

No	PEO Statement
PEO-1	Graduates of Naval Architecture and Marine Engineering will develop a sound knowledge on mathematical, scientific and engineering fundamentals and advanced knowledge of understanding in the sector of ship design, ship building and marine engineering including analysis techniques, design, developments and implementation methodologies to solve critical technical problems related to this field.
PEO-2	Graduates of Naval Architecture and Marine Engineering will acquire technical and communicative knowledge with professional and industry based education to build up successful professional careers in shipbuilding and maritime industries, government organizations and academia.
PEO-3	Graduates of Naval Architecture and Marine Engineering will understand sustainable engineering practice, socio-ethical values and life-long continuous learning to adapt the innovation and changes in this sector.
PEO-4	Graduates of Naval Architecture and Marine Engineering will be capable of working in the broader area of technology having the capability and responsibility of leadership and teamwork.
PEO-5	Graduates of Naval Architecture and Marine Engineering will be able to positively contribute in national and global cultural, social, technological, economic and

	educational development of society through the ethical application of their knowledge and skills.

3.7 Program Outcomes (POs)

Program Outcomes (POs) represent the knowledge, skills and attitudes the students should have at the end of a four-year engineering program. Based on the suggestion of Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Naval Architecture and Marine Engineering (NAME) program has following 12 Program Outcomes:

PO-1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem analysis: Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.

PO-3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.

PO-4. Investigation: Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

PO-5. Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6. The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO-7. Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge for sustainable development.

PO-8. Ethics: Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.

PO-9. Individual work and teamwork: Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.

PO-10. Communication: Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multi-disciplinary environments.

PO-12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

3.8 Program Educational Objectives (PEOs) and Program Outcomes (POs) Matrix

PO	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
PO-1. Engineering knowledge	√				
PO-2. Problem analysis	√	√			
PO-3. Design/development of solutions	√				
PO-4. Investigation	√				
PO-5. Modern tool usage		√			
PO-6. The engineer and society			√		√
PO-7. Environment and sustainability			√		√
PO-8. Ethics		√	√		
PO-9. Individual work and teamwork		√		√	
PO-10. Communication		√		√	
PO-11. Project management and finance		√		√	√
PO-12. Life-long learning			√		

3.9 Course Outcomes (COs)

The Course Outcomes (COs) are the resultant knowledge skills the student acquires at the end of a course. It defines the cognitive processes a course provides. Chapter five contains the detailed Learning/course Outcomes for each of the courses under the heading of Course Outcomes (COs). Faculty members are allowed to modify the Course Outcome (CO) as Continuous Quality Improvement (CQI) while conducting a course on the basis of requirements consulting with Head of the department and senior faculty members having expertise and specialization of that respective course.

3.10 Course Contents

The course contents of all courses have been described in chapter five. Faculty members are allowed to modify the course contents as a part of Continuous Quality Improvement (CQI) while conducting a course on the basis of requirements consulting with Head of the department and senior faculty members having expertise and specialization of that respective course.

3.11 Knowledge Profile, Range of Complex Engineering Problem Solving and Range of Complex Engineering Activities

Details mapping criteria for Knowledge Profile, Range of Complex Engineering Problem Solving and Range of Complex Engineering Activities has been attached as Annex-A.

3.12 Generic Skills

The graduates of the NAME program are expected to have the following generic skills:

a. Ability to apply the principles and theory of Naval Architecture and Marine Engineering knowledge to the requirements, design and development of different ship and marine systems with appropriate understanding.
b. Ability to define and use appropriate research methods and modern engineering tools.
c. Ability to apply critical thinking to solve complex engineering problems and design innovative solutions.
d. Ability to analyze real time problems and justify the appropriate use of technology.
e. Ability to work effectively as an individual, and as a member or leader of a team in diverse situations and exhibit social responsibility.

3.13 Curriculum/ Skill Mapping

The courses of NAME program are designed in such a way that the corresponding Course Outcomes (COs) contribute to the 12 Program Outcomes (POs) which eventually achieves the mission and vision of the program. Chapter five contains the mapping for each of the courses**.** However, generic curriculum/ skill mapping is shown in figure 3.1.

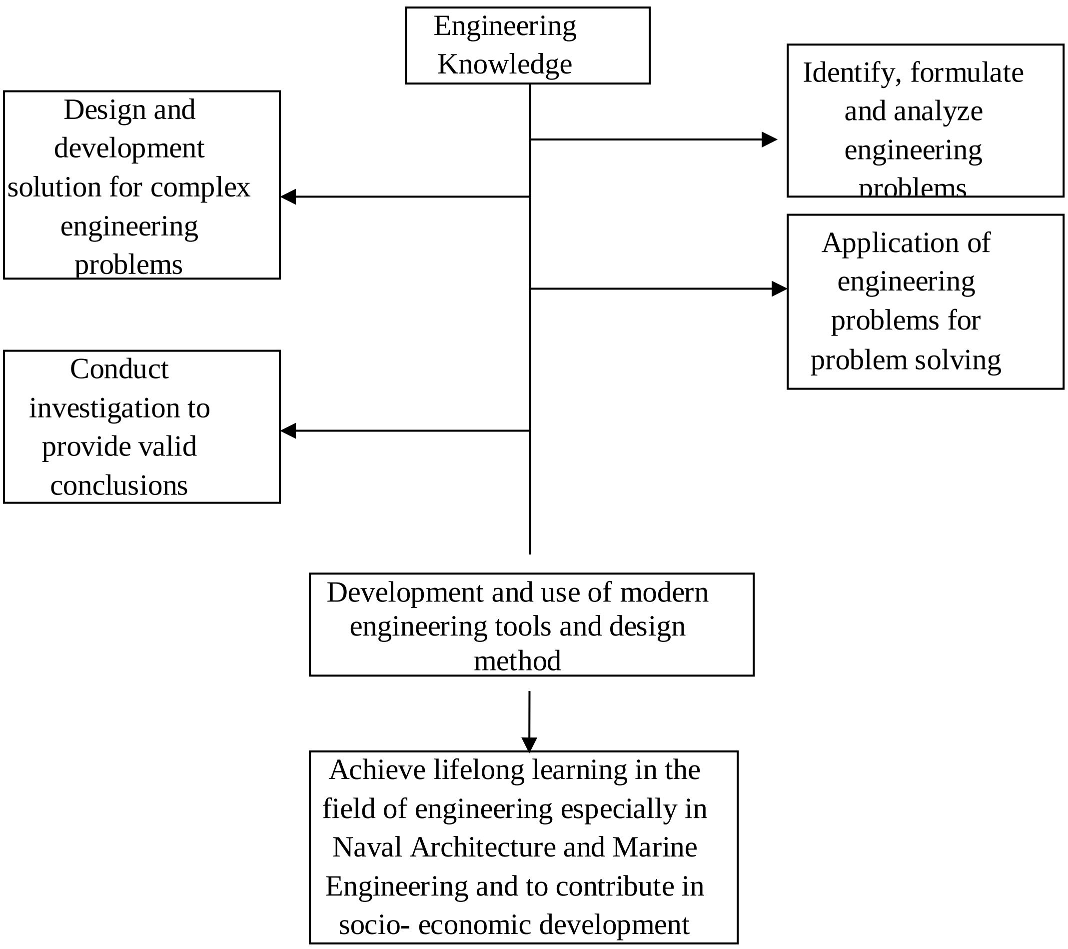

Figure 3.1: Generic Skills Mapping

CHAPTER 4
COURSE CURRICULUM OF BACHELOR IN NAME

4.1 Course Schedule

Keeping the above mentioned program outcomes, the course schedule for the undergraduate students of the Department of Naval Architecture and Marine Engineering is given below.

4.1.1. Summary of Course Curriculum

Ser	Category	No of Courses		Cr. Hr.		Total Cr. Hr.	% of Total Cr. Hr.
		Theory	Sessional	Theory	Sessional		
1	Languages/ Communicative Language	-	2	-	3.0	21.0	13.12
2	General Education	8	1	16.0	2.0		
3	Basic Science	3	2	9.0	3.0	24.0	15.0
4	Mathematics	4	-	12.0	-		
5	Interdisciplinary /Other Engineering	3	4	10.0	6.0	16.0	10.0
6	Program Core	19	17	57.0	30.0	87.0	54.38
7	Technical Electives	4	-	12.0	-	12.0	7.5
Total		**41**	**26**	**116.0**	**44.0**	**160.0**	**100**

4.1.2. Contact hours and credit hours' distribution in eight terms

Level & Term	Theory Credit Hours	Sessional Credit Hours	Total Credit Hours	Cumulative Cr. Hr.	Theory Contact Hours	Sessional Contact Hours	Total Contact Hours
1-I	14.0	6.0	20.0	20.0	14.0	12.0	26.0
1-II	15.0	6.0	21.0	41.0	15.0	12.0	27.0
2-I	15.0	5.0	20.0	61.0	15.0	10.0	25.0
2-II	15.0	4.5	19.5	80.5	15.0	9.0	24.0
3-I	16.0	4.5	20.5	101.0	16.0	9.0	25.0
3-II	14.0	6.5	20.5	121.5	14.0	13.0	27.0
4-I	13.0	6.0	19.0	140.5	13.0	9+4 wks	22+4 wks
4-II	14.0	5.5	19.5	160.0	14.0	11.0	25.0
Total	**116.0**	**44.0**	**160.0**		**116.0**	**85.0+4 wks**	**201.0 +4 wks**

4.1.3 Distribution of credit hours for different categories of courses in NAME Dept.

Category Ser.	**1**	**2**	**3**	**4**	**5**	**6**
Level Term	Languages/ Communicative Language and General Education	Basic Science and Mathematics	Interdisciplinary /Other Engineering	Program Core	Technical Electives	Total
1-I	2.0	10.5	3.0	4.5	-	20.0
1-II	1.5	7.5	4.5	7.5	-	21.0
2-I	1.5	3.0		15.5	-	20.0
2-II	2.0	3.0	7.0	7.5	-	19.5
3-I	4.0	-	1.5	15.0	-	20.5
3-II	4.0	-	-	13.5	3.0	20.5
4-I	4.0	-	-	12.0	3.0	19.0
4-II	2.0	-	-	11.5	6.0	19.5

4.2 Term Wise Distribution of Courses

LEVEL-1 TERM-1

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory Courses				
NAME 107	Introduction to Naval Architecture and Marine Engineering	3.0	3.0	Program Core
CHEM 101	Fundamentals of Chemistry	3.0	3.0	Basic Science
MATH 101	Differential Calculus and Integral Calculus	3.0	3.0	Mathematics
PHY 101	Wave Oscillation, Geometrical Optics and Modern Physics	3.0	3.0	Basic Science
GEBS 101	Bangladesh Studies	2.0	2.0	General Education
Sessional Courses				
CHEM 102	Chemistry Lab	1.5	3.0	Basic Science
PHY 102	Physics Lab	1.5	3.0	Basic Science
ME 150	Mechanical Engineering Drawing	1.5	3.0	Interdisciplinary
SHOP 180	Workshop Practice (Foundry, Welding and Machine Shop)	1.5	3.0	Interdisciplinary
Total Course (5T+4S)		**20.0**	**26.0**	

LEVEL-1 TERM-2

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 157	Hydrostatics and Stability	3.0	3.0	Program Core
NAME 177	Thermal Engineering	3.0	3.0	Program Core
CSE 115	Computer Programming Language	3.0	3.0	Interdisciplinary
MATH 103	Differential Equation and Matrix	3.0	3.0	Mathematics
PHY 113	Structure of Matter, Electricity and Magnetism	3.0	3.0	Basic Science
Sessional				
NAME 158	Basic Ship Design	1.5	3.0	Program Core
NAME 178	Thermal Engineering Lab	1.5	3.0	Program Core
LANG 102	Communicative English-I	1.5	3.0	Language
CSE 116	Computer Programming Lab	1.5	3.0	Interdisciplinary
Total Course (5T+4S)		**21.0**	**27.0**	

LEVEL-2 TERM-1

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 201	Mechanics of Structure	3.0	3.0	Program Core
NAME 205	Shipbuilding Materials and Metallurgy	3.0	3.0	Program Core
NAME 207	Ship Design	3.0	3.0	Program Core
NAME 213	Fluid Mechanics	3.0	3.0	Program Core
MATH 201	Vector Analysis, Laplace and Coordinate Geometry	3.0	3.0	Mathematics
Sessional				
NAME 208	Computer Aided Ship Design	2.0	4.0	Program Core
NAME 214	Fluid Mechanics Lab	1.5	3.0	Program Core
LANG 202	Communicative English-II	1.5	3.0	Language
Total Course (5T+3S)		**20.0**	**25.0**	

LEVEL-2 TERM-2

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 253	Marine Hydrodynamics	3.0	3.0	Program Core
ME 277	Heat Transfer	3.0	3.0	Interdisciplinary
EECE 281	Marine Electrical and Electronics	4.0	4.0	Interdisciplinary
MATH 219	Statistics, Complex Variable and Fourier Analysis	3.0	3.0	Mathematics
GELM 275	Leadership & Management	2.0	2.0	General Education
Sessional				
NAME 202	Mechanics of Structure Lab	0.75	1.5	Program Core
NAME 206	Shipbuilding Materials and Metallurgy Lab	0.75	1.5	Program Core
NAME 254	Marine Hydrodynamics Lab	1.5	3.0	Program Core
NAME 258	Stability and Machinery Layout Design	1.5	3.0	Program Core
Total Course (5T+4S)		**19.5**	**24.0**	

LEVEL-3 TERM-1

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 301	Ship Structure	3.0	3.0	Program Core
NAME 315	Ship Construction and Welding Technology	3.0	3.0	Program Core
NAME 353	Ship Resistance and Propulsion	3.0	3.0	Program Core
NAME 311	Machine Elements Design	3.0	3.0	Program Core
GEE 303	Fundamentals of Economics	2.0	2.0	General Education
GES 305	Fundamentals of Sociology	2.0	2.0	General Education
Sessional				
NAME 300	Ship Design Project	1.5	3.0	Program Core
NAME 308	Application of ship design software	1.5	3.0	Program Core
EECE 382	Marine Electrical and Electronics Lab	1.5	3.0	Interdisciplinary
Total Course (6T+2S+1P)		**20.5**	**25.0**	

LEVEL-3 TERM-2

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 307	Design of Special Ships	3.0	3.0	Program Core
NAME 309	Marine Engineering-I	3.0	3.0	Program Core
NAME 363	Numerical Methods	3.0	3.0	Program Core
GESL 311	Environment, Sustainability and Industrial Law	2.0	2.0	General Education
NAME 3XX	Optional Course 1*	3.0	3.0	Technical Electives
Sessional				
NAME 300	Ship Design Project	1.5	3.0	Program Core
NAME 310	Marine Engineering Lab-I	1.5	3.0	Program Core
NAME 354	Ship Resistance and Propulsion Lab	1.5	3.0	Program Core
GERM 352	Fundamentals of Research Methodology	2.0	4.0	General Education
Total Course (5T+3S+1P)		**20.5**	**27.0**	

* Optional Courses will be offered as required from the subjects mentioned in para 4.5 (i).

LEVEL-4 TERM-1

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 403	Dynamics of Marine Vehicles	3.0	3.0	Program Core
NAME 409	Marine Engineering -II	3.0	3.0	Program Core
GEA 407	Principles of Accounting	2.0	2.0	General Education
GEPM 471	Project Management and Finance	2.0	2.0	General Education
NAME 4XX	Optional Course 2*	3.0	3.0	Technical Electives
Sessional				
NAME 400	Research Project/ Thesis	3.0	6.0	Program Core
NAME 464	Numerical Methods Lab	1.5	3.0	Program Core
NAME 450	Shipyard Practice/Industrial Training (4 Weeks)**	1.5	4 Weeks	Program Core
	Total Course (5T+2S+1RP)	**19.0**	**22.0+4 Weeks**	

* Optional Courses will be offered as required from the subjects mentioned in para 4.2.2 (ii)
** 04 Weeks Industrial/Shipyard Training course will be conducted as NAME-450 on completion of level 3 before commencing level 4.

LEVEL-4 TERM-2

Course No	Course Name	Credit Hours	Contact Hours	Remarks
Theory				
NAME 457	Maritime Economics and Management	3.0	3.0	Program Core
NAME 459	Marine Maintenance and Repair Engineering	3.0	3.0	Program Core
GEEM 441	Engineering Ethics and Moral Philosophy	2.0	2.0	General Education
NAME 4XX	Optional Course 3*	3.0	3.0	Technical Electives
NAME 4XX	Optional Course 4*	3.0	3.0	Technical Electives
Sessional				
NAME 400	Research Project/Thesis	3.0	6.0	Program Core
NAME 410	Marine Engineering Lab-II	1.5	3.0	Program Core
NAME 490	Bangladesh Studies for Naval Architects	1.0	2.0	Program Core
	Total Course (5T+2S+1RP)	**19.5**	**25.0**	

* Optional Courses will be offered as required from the subjects mentioned in para 4.2.2 (ii).

4.2 .1 Program Core Courses

Ser.	Course Code	Course Title	Type of Course	Credit Hour	Level & Term
1.	NAME 107	Introduction to Naval Architecture and Marine Engineering	Theory	3.00	L-1, T-1
2.	NAME 157	Hydrostatics and Stability	Theory	3.00	L-1, T-2
3.	NAME 158	Basic Ship Design	Sessional	1.50	L-1, T-2
4.	NAME 177	Thermal Engineering	Theory	3.00	L-1, T-2
5.	NAME 178	Thermal Engineering Lab	Sessional	1.50	L-1, T-2
6.	NAME 201	Mechanics of Structure	Theory	3.00	L-2, T-1
7.	NAME 202	Mechanics of Structure Lab	Sessional	0.75	L-2, T-1
8.	NAME 205	Shipbuilding Materials and Metallurgy	Theory	3.00	L-2, T-1
9.	NAME 206	Shipbuilding Materials and Metallurgy Lab	Sessional	0.75	L-2, T-2
10.	NAME 207	Ship Design	Theory	3.00	L-2, T-1
11.	NAME 208	Computer Aided Ship Design	Sessional	2.00	L-2, T-1
12.	NAME 213	Fluid Mechanics	Theory	3.00	L-2, T-1
13.	NAME 214	Fluid Mechanics Lab	Sessional	1.50	L-2, T-1
14.	NAME 253	Marine Hydrodynamics	Theory	3.00	L-2, T-2
15.	NAME 254	Marine Hydrodynamics Lab	Sessional	1.50	L-2, T-2
16.	NAME 258	Stability and Machinery Layout Design	Sessional	1.50	L-2, T-2
17.	NAME 300	Ship Design Project	Sessional	3.00	L-3, T-1
18.	NAME 301	Ship Structure	Theory	3.00	L-3, T-1
19.	NAME 307	Design of Special Ships	Theory	3.00	L-3, T-2
20.	NAME 308	Application of ship design software	Sessional	3.00	L-3, T-1
21.	NAME 309	Marine Engineering -I	Theory	3.00	L-3, T-2
22.	NAME 310	Marine Engineering Lab -I	Sessional	1.50	L-3, T-2
23.	NAME 311	Machine Elements Design	Theory	3.00	L-3, T-1
24.	NAME 315	Ship Construction and Welding Technology	Theory	3.00	L-3, T-1
25.	NAME 353	Ship Resistance and Propulsion	Theory	3.00	L-3, T-1
26.	NAME 354	Ship Resistance and Propulsion Lab	Sessional	1.50	L-3, T-2
27.	NAME 363	Numerical Methods	Theory	3.00	L-3, T-2
28.	NAME 400	Research Project/ Thesis	Sessional	6.00	L-4, T-1
29.	NAME 403	Dynamics of Marine Vehicles	Theory	3.00	L-4, T-1
30.	NAME 409	Marine Engineering -II	Theory	3.00	L-4, T-1
31.	NAME 410	Marine Engineering Lab -II	Sessional	1.50	L-4, T-2
32.	NAME 450	Shipyard Practice/Industrial Training	Sessional	1.50	L-4, T-1
33.	NAME 457	Maritime Economics and Management	Theory	3.00	L-4, T-2
34.	NAME 459	Marine Maintenance and Repair Engineering	Theory	3.00	L-4, T-2
35.	NAME 464	Numerical Methods Lab	Sessional	1.50	L-4, T-1
36.	NAME 490	Bangladesh Studies for Naval Architects	Sessional	1.00	L-4, T-2

4.2.2 Elective/Optional Courses

i. One theoretical course will be registered for level 3 term 2 as offered from the following list (Optional 1):

Ser.	Course Code	Course Title	Type of Course	Credit Hour	Level & Term
1.	NAME 371	Finite Element Method for Ship Structure	Theory	3.00	L-3, T-1/2

2.	NAME 373	Computational Fluid Dynamics (CFD)	Theory	3.00	L-3, T-1/2
3.	NAME 375	Composite Materials	Theory	3.00	L-3, T-1/2
4.	NAME 387	Port and Harbor Engineering	Theory	3.00	L-3, T-1/2
5.	NAME 389	Marine Production and Planning	Theory	3.00	L-3, T-1/2

ii. One theoretical course will be registered at the first term of level four and two courses at the second term of level four as offered from the following list (Optional 2,3,4):

6.	NAME 431	Ship Hull Vibration	Theory	3.00	L-4, T-1/2
7.	NAME 435	Computer Aided Ship Production	Theory	3.00	L-4, T-1/2
8.	NAME 437	Inland Water Transportation System	Theory	3.00	L-4, T-1/2
9.	NAME 445	Dredger and Dredging Technology	Theory	3.00	L-4, T-1/2
10.	NAME 447	Maritime Transportation System	Theory	3.00	L-4, T-1/2
11.	NAME 453	Power and Propulsion System	Theory	3.00	L-4, T-1/2
12.	NAME 463	Ship Performance	Theory	3.00	L-4, T-1/2
13.	NAME 465	Navigation and Maritime Regulations	Theory	3.00	L-4, T-1/2
14.	NAME 477	Control Engineering	Theory	3.00	L-4, T-1/2
15.	NAME 481	Optimization Method in Ship Design	Theory	3.00	L-4, T-1/2
16.	NAME 483	Theory of Hydrofoils	Theory	3.00	L-4, T-1/2
17.	NAME 489	Introduction to Offshore Structure	Theory	3.00	L-4, T-1/2
18.	NAME 493	Marine Acoustics	Theory	3.00	L-4, T-1/2
19.	NAME 499	Shipyard Management	Theory	3.00	L-4, T-1/2

4.2.3 Interdisciplinary Courses

Ser.	Course Code	Course Title	Type of Course	Credit Hour	Level & Term
1.	CSE 115	Computer Programming Language	Theory	3.00	L-1, T-2
2.	CSE 116	Computer Programming Language Lab	Sessional	1.50	L-1, T-2
3.	EECE 281	Marine Electrical and Electronics	Theory	4.00	L-2, T-2
4.	EECE 382	Marine Electrical and Electronics Lab	Sessional	1.50	L-3, T-1
5.	ME 150	Mechanical Engineering Drawing	Sessional	1.50	L-1, T-1
6.	SHOP 180	Workshop Practice (Foundry, Welding and Machine Shop)	Sessional	1.50	L-1, T-1
7.	ME 277	Heat Transfer	Theory	3.00	L-2, T-2

4.2.4 Science and Math Courses

Ser.	Course Code	Course Title	Type of Course	Credit Hour	Level & Term
1.	CHEM 101	Fundamentals of Chemistry	Theory	3.00	L-1, T-1
2.	CHEM 102	Chemistry Lab	Sessional	1.50	L-1, T-1
3.	PHY 101	Wave Oscillation, Geometrical Optics and Modern Physics	Theory	3.00	L-1, T-1
4.	PHY 102	Physics Lab	Sessional	1.50	L-1, T-1
5.	PHY 113	Structure of Matter, Electricity and Magnetism	Theory	3.00	L-1, T-2
6.	MATH 101	Differential and Integral Calculus	Theory	3.00	L-1, T-1
7.	MATH 103	Differential Equations and Matrix	Theory	3.00	L-1, T-2
8.	MATH 201	Vector Analysis, Laplace and Coordinate Geometry	Theory	3.00	L-2, T-1

9.	MATH 219	Statistics, Complex Variable and Fourier Transform	Theory	3.00	L-2, T-2

4.2.5 Language Courses

Ser.	Course Code	Course Title	Type of Course	Credit Hour	Level & Term
1.	LANG 102	Communicative English-I	Sessional	1.50	L-1, T-2
2.	LANG 202	Communicative English-II	Sessional	1.50	L-2, T-1

4.2.6 General Education Courses

Ser.	Course Code	Course Title	Type of Course	Credit Hour	Level & Term
1.	GEBS 101	Bangladesh Studies	Theory	2.00	L-1, T-1
2.	GELM 275	Leadership & Management	Theory	2.00	L-2, T-2
3.	GEE 303	Fundamentals of Economics	Theory	2.00	L-3, T-1
4.	GES 305	Fundamentals of Sociology	Theory	2.00	L-3, T-1
5.	GESL 311	Environment, Sustainability and Industrial Law	Theory	2.00	L-3, T-2
6.	GERM 352	Fundamentals of Research Methodology	Sessional	2.00	L-3, T-2
7.	GEA 407	Principles of Accounting	Theory	2.00	L-4, T-1
8.	GEEM 441	Engineering Ethics and Moral Philosophy	Theory	2.00	L-4, T-2
9.	GEPM 471	Project Management and Finance	Theory	2.00	L-4, T-1

CHAPTER 5
COURSE DESCRIPTION

PROGRAM CORE COURSES

Military Institute of Science and Technology
Department of Naval Architecture and Marine Engineering

COURSE INFORMATION

Course Code: NAME 107 **Credit Hours:** 3.0
Course Title: Introduction to Naval Architecture and Marine Engineering **Contact Hours:** 3.0
Level and Term: Level 1 Term 1

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
Introduction to Naval Architecture and Marine Engineering is compulsory theoretical course which will give a brief overview on basic naval architectural and marine engineering knowledge e.g. naval architectural terms, ship dimensions and forms, various drawings in ship design. It also enables students to familiarize themselves with ship propulsion system and machinery.

OBJECTIVES
1. To know ship's different terminology and identify them.
2. To make proficient to describe concepts regarding specification of ships dimensions and forms.
3. To enable achieving ability to explain displacement, lightweight, deadweight, capacity and tonnage.
4. To enable to apply approximation methods to calculate area, centroid & volume.
5. To familiarize with General Arrangement (GA), shell expansion & lines plans.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **Define** ship's different terminology & **identify** them.
2. **Comprehend** basic ideas of specification of ships dimensions and forms, tonnage.
3. **Calculate** waterplane area, volume & **prepare** vessel's displacement curve.
4. **Identify** & **describe** General Arrangement (GA), shell expansion & lines plans.

COURSE CONTENTS
1. Introduction to the course and naval architecture
2. The shape of a ship, Ship particulars, definition of various ship terms
3. Area, moments and centre of gravity calculations
4. Weight and centre of gravity, displacement and centre of buoyancy, Archimedes law of floating bodies
5. Light weight, dead weight, capacity and tonnage, Sub-division elements of ship hull
6. Ship's form coefficients, their applicability and significance, calculation of form coefficients

7. Numerical integration in naval architecture: Simpson's rules, trapezoidal rule, five-eight-minus one rule, application of these rules to find area, moment (first and second) of area, centre of gravity calculation etc., errors and limitation of these rules
8. Ship geometry definition and representation, lines plan and offset table, sectional area curve and its uses
9. Ship design procedure, various ship drawings and their content, use of these drawings
10. Introduction to ship propulsion arrangements, ship's propulsion system and her machinery; deck machinery; arrangement of machinery
11. Introduction to ship systems: bilge ballast system, FO bunkering and delivery system, FW system; fire-fighting system, black and grey water system, power generation and distribution system etc.
12. Various ship fittings; spares; consumables and stores

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** ship's different terminology & **identify** them.	√											
CO2	**Comprehend** basic ideas of specification of ships dimensions and forms, tonnage.	√											
CO3	**Calculate** waterplane area, volume & **prepare** vessel's displacement curve.			√									
CO4	**Identify** & **describe** General Arrangement (GA), shell expansion & lines plans.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** ship's different terminology & **identify** them.	C1			1-4	CT, F
CO2	**Comprehend** basic ideas of specification of ships dimensions and forms, tonnage.	C2			1-4	CT, Mid Term, F
CO3	**Calculate** waterplane area, volume & **prepare** vessel's displacement curve.	C3	1		5	CT/ASG, F
CO4	**Identify** & **describe** General Arrangement (GA), shell expansion & lines plans.	C1			1-4	Mid Term, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to understand ship's different terminology & identify them.
CO2-PO1	Students will be to comprehend basic ideas of specification of ships dimensions and forms, tonnage with the help of fundamental engineering knowledge of the course.
CO3-PO3	Students will be to estimate waterplane area, volume & prepare vessel's displacement curve to give design solution for ship design.
CO4-PO2	The engineering knowledge of the course will help the students to identify & describe General Arrangement (GA), shell expansion & lines plans.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Ship's terms**	CT-1, Final Exam
Class 1	Introduction to NAME	
Class 2	Brief discussion on syllabus, Class Test (CT), mid-term and final exam, mark distribution	
Class 3	L_{OA}, L_{BP}, L_{WL}, moulded breadth, moulded depth, moulded draught, freeboard, air draft, camber, sheer	
Week 2	**Ship's terms**	
Class 4	Flare, stem, stern; skeg; transom; deck; poop deck; forcastle deck; 'tween deck; deckhouse and superstructure;	
Class 5	Ship's weight and centre of gravity, longitudinal centre of gravity (LCG); vertical centre of gravity (VCG); importance of LCG and VCG in ship design; trim; heel and list;	
Class 6	Displacement, longitudinal centre of buoyancy, vertical centre of buoyancy, Archimedes principle; Six degrees of motion of a ship: surge,	

	sway, heave, roll, pitch and yaw;	
Week 3	**Ship's terms**	
Class 7	Light weight, dead weight, capacity; tonnage: net tonnage and gross tonnage; International Convention on Tonnage Measurement of Ships, 1969.	
Class 8	Bulkhead: longitudinal and transverse, cofferdam, double bottom; double hull;	
Class 9	Miscellaneous terminology related to ship and ocean structure;	
Week 4	**Hull form coefficients**	
Class 10	Block coefficient, midship section coefficient, prismatic coefficient, water plane area coefficient,	
Class 11	Problem on form coefficients	
Class 12	Assessment 01 (CT-1)	
Week 5	**Numerical integration in Naval Architecture [part 1]**	CT-2, Mid Term, Final Exam
Class 13	Numerical integration in naval architecture; the trapezoidal rule; error of integration in trapezoidal rule;	
Class 14	Mathematical problems on trapezoidal integration;	
Class 15	Simpon's first rule; intermediate ordinate	
Week 6	**Numerical integration in Naval Architecture [part 2]**	
Class 16	Simpson's second rule; intermediate ordinate;	
Class 17	Five-eight-minus one rule, six ordinates rule;	
Class 18	Problems of Simpson's first and second rule;	
Week 7	**Ship geometry**	
Class 19	Ship coordinate system; ship geometry definition: keel; rise of floor; fall in side; bilge radius; tumble home; parallel middle body; entrance, run; angle of entrance; deadrise angle; kunckle; bulbous bow	
Class 20	Station; waterline; buttock; diagonal; sectional area curve and its uses;	
Class 21	Assessment 02 (CT-2)	
Week 8	**Ship design procedure and main drawings**	
Class 22	Ship design process; Basic (main) drawings in ship design;	Mid Term Exam, Final Exam
Class 23	IACS and its members; mission and vision of IACS;	
Class 24	General arrangement (GA) drawing of different types of ships;	
Week 9	**Main (Basic) drawings in ship design**	
Class 25	Midship section; lines plan and offset table;	
Class 26	Profile and deck plan; shell expansion;	
Class 27	Machinery arrangement; accommodation arrangement; fire and safety plan; mooring arrangement; system diagrams and other drawings;	
Week 10	**Ship propulsion system & Machinery**	
Class 28	Introduction to ship propulsion arrangements	
Class 29	Machinery & equipment fitted onboard ship, Machinery & fittings fitted on ship propulsion system	
Class 30	Assessment 02(Mid-term exam)	
Week 11	**Ship propulsion system & Machinery**	
Class 31	Main propulsion engine, heat engine basics.	
Class 32	Classification of engine	
Class 33	Cycle of operation of engine	

Week 12	Ship propulsion system & Machinery	CT-3/ Assignment, Final Exam
Class 34	Parts of engine Difference between diesel & petrol engine	
Class 35	Basic idea about other power generation machinery	
Class 36	Revision of Ship propulsion system & Machinery	
Week13	**Ship systems**	
Class 37	Introduction to ship systems: bilge ballast system, FO bunkering and delivery system,	
Class 38	FW system; fire-fighting system, black and grey water system	
Class 39	power generation and distribution system etc.	
Week 14	**Ship propulsion system & machinery**	
Class 40	Basic idea ship fittings, spares, consumables and stores.	
Class 41	Assessment 04 (CT-3)	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1, C2
			CO2	C1,C2
			CO3	C3, C4
	Class Participation	5%	CO4	C1, A2
	Mid term	15%	CO2, CO4	C1, C2, C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2, C4
			CO3	C1, C3, C4
			CO4	C2, C3, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Ship Knowledge, Klan Van Dokkam, Dokmer Publisher.
2. The Principles of Naval Architecture Series, The Geometry of Ships, John S. Letcher Jr. SNAME
3. Reed's Naval Architecture for Marine Engineers, E.A. Stokoe, 2003, Thomas Reed Publications.
4. Theoretical Naval Architecture, E.L. Attwood & H.S. Pengelly, 1962, Longmans Green & Co. Ltd.
5. Basic Ship Theory, K.J. Rawson & E. C. Tupper, Vol. 1 & 2., Longman Group Limited.
6. A Textbook of Thermal Engineering, R.S. Khurmi & J.K. Gupta

COURSE INFORMATION

Course Code: NAME 157 **Credit Hours:** 3.00
Course Title: Hydrostatics and Stability **Contact Hours:** 3.00
Level and Term: Level 1 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This is a compulsory course enables students to learn the principles of equilibrium of forces act on a floating body, means to asses intact and damage stability of ships and their statutory requirements. This course also deals with launching of ships once it is built as well as the inclining experiment which measures the weight and centre of gravity of lightship.

OBJECTIVES

1. To impart knowledge on hydrostatics calculations and hydrostatic curves.
2. To familiarize the students with the principle of intact and damage stability of ships.
3. To make proficient to produce ships' docking and launching calculations.
4. To enable to conduct inclining experiment and prepare report for approval or regulatory bodies.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Compute** hydrostatic properties of ship and **construct** hydrostatic curves.
2. **Comprehend** basic ideas of intact and damage stability of ship.
3. **Prepare** vessel's docking and launching calculations.
4. **Perform** inclining experiment of floating structures.

COURSE CONTENTS

1. Introduction; concepts of equilibrium; weight and centre of gravity; displacement and centre of buoyancy.
2. Initial stability; metacentric height: longitudinal and transverse metacentre; metacentric diagram.
3. Hydrostatic properties; hydrostatic and Bonjean curves; their uses.
4. Statical stability, righting arm; curves of statical stability and its application; cross curves of stability and its uses, effect of trim, depth and form on statical stability; significance of curve of statical stability; dynamical stability and its measurement;
5. Free surface effect; calculation of free surface moments; effect of free surface on righting lever curves; means to reduce free surface effect.
6. Weight and trim calculations; effect of change of water density; top weight etc.
7. Inclining experiment: purpose; preparation; experiment; calculation and generation of report.

8. Intact stability: measurement of stability; IMO code of intact stability: mandatory criteria for all ships; stability criteria for special purpose ships; weather criterion; wind heeling moment; intact stability load cases.
9. Subdivision and damage stability: effects of damage of ship hull; SOLAS conventions; watertight subdivisions, curves of floodable length; permeability; evaluation of damage stability: added weight and lost buoyancy method; deterministic and probabilistic means to assess damage stability; sub-division length; factor of subdivision; required subdivision index; attained subdivision index;
10. Stability during dry-docking; launching calculations.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Compute** hydrostatic properties of ship and **construct** hydrostatic curves.	√											
CO2	**Comprehend** basic ideas of intact and damage stability.	√											
CO3	**Prepare** vessel's docking and launching calculations.			√									
CO4	**Perform** inclining experiment of floating structure.				√								

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	C**ompute** hydrostatic properties of ship and **construct** hydrostatic curves.	C3	1		1-4	CT, F
CO2	**Comprehend** basic ideas of intact and damage stability.	C2	1		1-4	CT, MT, F
CO3	**Prepare** vessel's docking and launching calculations.	C3	3		5	CT/ASG, F
CO4	**Perform** inclining experiment of floating structures.	A2	1		8	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to calculate hydrostatic parameters and develop the effects of draught change on them.
CO2-PO1	In order to identify the role and extent of hydrostatic parameters on the principles of intact and damage stability of ships.
CO3-PO3	To analyze vessels' hydrostatic and hydrodynamic parameters for docking and launching calculations.

CO4-PO4	In order to ascertain the level of stability of the vessel and maintenance of upright position at lightship/ designated loading conditions.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction, course administration, motivation lecture	
Class 2	Concepts of equilibrium: stable, neutral and unstable equilibrium; weight and centre of gravity; displacement and centre of buoyancy;	
Class 3	Interaction between weight and buoyancy; righting moment; overturning moment; upsetting forces on a ship; submerged equilibrium;	
Week 2	**Vessels weights, centre of gravity and metacentric height**	
Class 4	Determining vessels weights and centre of gravity;	
Class 5	Initial stability and metacentric height; Transverse metacentre and transverse metacentric height; location of transverse metacentric height; metacentric diagram; Stiff Ship and Tender Ship.	
Class 6	Longitudinal metacentre and longitudinal metacentric height; location of longitudinal metacentric height; application of metacentric height	
Week 3	**Hydrostatic curves**	
Class 7	Waterplane area; centre of floatation (LCF); moment of inertia of the water plane area; displacement; centre of buoyancy (LCB, VCB);	
Class 8	TPC; BM_T; BM_L; MCT1cm; KM_L; KM_T; wetted surface area	
Class 9	Hydrostatic curves, Bonjean curves and their uses	
Week 4	**Statical stability at large angles of heel [part-1]**	
Class 10	Assessment 1	
Class 11	Righting arm; curves of statical stability; down-flooding angle;	

Class 12	Effect of freeboard and metacentric height on righting arm curves; angle of loll; dynamical stability;	CT 2, Final Exam
Week 5	**Statical stability at large angles of heel [part-2]**	
Class 13	Cross curves of stability; computation of righting arm curves; effect of beam and depth on statical stability;	
Class 14	Effect of changes of from on statical stability; Significance of the statical stability curve.	
Class 15	Representation of heeling moment	
Week 6	**Effect of free liquids**	
Class 16	Free-surface effect; evaluation of effect of free-surface on metacentric height;	
Class 17	Evaluation of effect of free-surface on righting arm;	
Class 18	Reduction of free surface effect;	
Week 7	**Weight and Trim calculations [part-1]**	Mid Term, Final Exam
Class 19	Assessment 2	
Class 20	Weight groups; weight and centre of gravity calculations;	
Class 21	Draught marks; trim; trimming moment	
Week 8	**Weight and Trim calculations [part-2]**	
Class 22	Finding trim and draughts at perpendiculars;	
Class 23	Determining draught after change in loading;	
Class 24	Mid-term exam	
Week 9	**The inclining experiment**	
Class 25	Determining displacement and center of gravity from drafts;	
Class 26	The inclining experiment; determination of inclining weight;	
Class 27	Inclining experiment setup; determination of lightship and centre of gravity of vessel;	Mid Term, Final Exam
Week 10	**IMO code of intact stability [part-1]**	
Class 28	Watertight and weathertight opening; down-flooding points; deck edge immersion angle;	
Class 29	The IMO code of intact stability; criteria regarding righting lever curve properties;	
Class 30	Wind speed; gust; roll period; severe wind and rolling criterion (weather criterion);	
Week 11	**IMO code of intact stability [part-2]**	
Class 31	Special criteria for certain types of ships: passenger ships; oil tankers (> 5000 tdw); cargo ships carrying grain in bulk;	
Class 32	Pontoons; Tugs; Fishing vessels;	
Class 33	Intact stability load cases	
Week 12	**Subdivision and damage stability [part-1]**	
Class 34	Watertight bulkhead; bulkhead deck; margin line; permeability; floodable length; symmetrical and unsymmetrical flooding; cross-flooding;	
Class 35	Extent of damage; effects of flooding; method of lost buoyancy and added weight;	
Class 36	Final draughts of a ship after damage (sinkage, trim and heel);	
Week13	**Subdivision and damage stability [part-2]**	
Class 37	Curve of floodable length and its significance; direct and approximate	

<table>
<tr><td></td><td>method to calculate floodable length</td><td rowspan="7">CT 3,
Final Exam</td></tr>
<tr><td>Class 38</td><td>IMO SOLAS convention, Chapter II-1, Part B-Subdivision and stability;</td></tr>
<tr><td>Class 39</td><td>Subdivision length; factor of subdivision; required subdivision index; attained subdivision index;</td></tr>
<tr><td>Week 14</td><td>Launching calculations</td></tr>
<tr><td>Class 40</td><td>Assessment 3</td></tr>
<tr><td>Class 41</td><td>Stability during drydocking; launching calculations;</td></tr>
<tr><td>Class 42</td><td>Course review</td></tr>
</table>

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>COs</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td rowspan="2">Class Test/ Assignment 1-3</td><td rowspan="2">20%</td><td>CO1, CO2, CO3</td><td>C1, C2, C4</td></tr>
<tr><td>CO3</td><td>C3, C4</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO1, CO2, CO3, CO4</td><td>C6, A2</td></tr>
<tr><td>Mid term</td><td>15%</td><td>CO2, CO4</td><td>C1, C2, C4</td></tr>
<tr><td colspan="2" rowspan="4">Final Exam</td><td rowspan="4">60%</td><td>CO1</td><td>C1, C2</td></tr>
<tr><td>CO2</td><td>C1, C2,C4</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td>CO4</td><td>C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. The Principles of Naval Architecture, Vol 1, Stability and Strength, Published by SNAME
2. Ship Hydrostatics and Stability, Adrian Biran
3. Reed’s Naval Architecture for Marine Engineers, E.A. Stokoe, 2003, Thomas Reed Publications.
4. Theoretical Naval Architecture, E.L. Attwood & H.S. Pengelly, 1962, Longmans Green & Co. Ltd.
5. Basic Ship Theory, K.J. Rawson & E. C. Tupper, Vol. 1 & 2., Longman Group Limited.
6. Ship Stability for Masters and Mates, D. R Derrett.

COURSE INFORMATION

Course Code: NAME 158
Course Title: Basic Ship Design
Level and Term: Level 1, Term 2
Credit Hours: 1.50
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This is a compulsory sessional course designed to teach students about the basic design drawings of different types of ship. Students will be able to perform necessary calculations related to the basic design, trim and stability calculations. It is expected that students can develop critical thinking behind each design features, able to check effects of those features using calculations and finally select the appropriate feature.

OBJECTIVES

1. To familiarize students with different types of ships, their General Arrangement and enable them to produce the same.
2. To acquaint students with the Lines Plan and teach them to draw Lines Plan in different scales including Bonjean curves.
3. To enable students to compute hydrostatic properties and to draw hydrostatic curves of ships.
4. To evaluate trim and stability calculations of ship with respect to statutory requirement.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Produce** General Arrangement of different types of ships.
2. **Develop** Lines Plan of ships.
3. **Assess** the loading on vessel using Bonjean curves**.**
4. **Compute** hydrostatic properties of ships to **produce** hydrostatic curves and **prepare** trim and stability calculation on ship design

COURSE CONTENTS

1. General arrangement (GA) plan drawing,
2. Lines plan drawing, Bonjean curves,
3. Hydrostatic calculations, and Stability and cross curves,
4. Trim calculations,
5. Inclining Experiment.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Produce** general arrangement of ships												√

	and floating structures.												
CO2	**Develop** lines plan of ship.												√
CO3	**Assess** the loading on vessel using Bonjean curves	√											
CO4	**Compute** hydrostatic properties of ships to **produce** hydrostatic curves and **prepare** trim and stability calculation on ship design	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Produce** general arrangement of ships and floating structures.	C3	-		-	R,Q,T
CO2	**Develop** lines plan of ship.	C3	-		-	R,Q,T
CO3	**Assess** the loading on vessel using Bonjean curves	C3, C3	1		1-4	R,Q,T
CO4	**Compute** hydrostatic properties of ships to **produce** hydrostatic curves and **prepare** trim and stability calculation on ship design	C3	1		1-4	R,Q,T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO12	In order to develop concept design and general arrangement plan.
CO2-PO12	To link up the general arrangement to lines plan and offset table.
CO3-PO1	In order to assess the loading on vessel using Bonjean curves.
CO4-PO1	In order to practice hydrostatic calculations, trim and stability criteria at different loading conditions.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3

Total	120

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method

COURSE SCHEDULE

Week	Topics
Week 1	Course introduction, Introduction to general arrangement plan, objectives, components, different types of GA, etc.
Week 2	Drawing of General Arrangement Plan
Week 3	Review of General Arrangement Plan
Week 4	Introduction to Lines Plan, Drawing of Lines Plan
Week 5	Review of Lines Plan drawing
Week 6	Drawing of Bonjean Curves
Week 7	Mid Viva
Week 8	Hydrostatic Calculation Using Excel
Week 9	Hydrostatic Calculation Using Excel
Week 10	Hydrostatic Calculation Using Excel
Week 11	Intact stability calculations
Week 12	Cross curve of stability
Week 14	Inclining experiment
Week 13	Final Viva

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C1, C3,A1
			CO 2	C4, C5, A1
			CO 3	C3, C4
			CO 4	C3
	Labtest-1,Labtest-2	30%	CO 1	C1, C3,C4
			CO 2	C4, C5, P1
			CO 3	C3, C4
			CO 4	C3
	Project and Presentation	25%	CO 1, CO 2, CO 3	A1, A2, A3, A4
Lab Quiz		25%	CO 1	CO 2
			CO 2	CO 3
			CO 3	C3, P6, P7
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Reed's Naval Architecture for Marine Engineers, E.A. Stoked, 2003, Thomas Reed Publications.
2. Ship Stability for Masters and Mates, D. R Derrett.

COURSE INFORMATION

Course Code: NAME 177
Course Title: Thermal Engineering
Level and Term: Level 1 Term 2
Credit Hours: 3.0
Contact Hours: 3.0

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course will provide the basic knowledge of thermal engineering, which will function as foundation in applications in major fields of Naval Architecture and Marine Engineering notably in heat engines, air conditioning, refrigeration, steam turbine and gas turbine system.

OBJECTIVES

1. To introduce the basic concepts of thermodynamics, laws of thermodynamics and practical applications of thermodynamics
2. To familiarize with various types of air standard cycles and their applications.
3. To familiarize with various types of non-conventional power generation system

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Describe** the basic concepts of Thermal Engineering.
2. **Explain** and **apply** basic thermodynamic principles and laws to **analyse** and **predict** performance of idealized forms of thermodynamic systems.
3. **Relate** idealized thermodynamic cycles to corresponding real systems.
4. **Explain** properties of steam
5. **Identify** components of IC engine, refrigeration system, air conditioning system and steam boiler and **perform** calculations of their efficiency.
6. **Describe** sources of non-conventional energy.

COURSE CONTENTS

1. **Introduction and Basic Concepts of Thermodynamics and Thermal Engineering**
   Basic concepts of thermodynamics: introduction, applications, system, surrounding universe, zeroth law, properties of a system, state, process, path function, cycle, pure substance, control volume, work interaction and closed system work. Ideal gas equation for various process, closed system work for various process, open system work for various process.
2. **First Law and its application (Non Flow Process)**
   Concept of heat and specific heat, first law of thermodynamics. Energy of an isolated system, PMM-I, concept of internal energy and enthalpy. Heat transfer for various process for closed system. Meyer’s Equation, important thermodynamic relations and cycle concepts, polytrophic

and adiabatic process.

3. **Second Law of Thermodynamics and Entropy**
   Kelvin-Planck and Clausius statement, Equivalence of Kelvin-Planck and Clausius statement. Carnot Cycle, Carnot theorem, corollary of Carnot theorem and efficiency and COP of reversible cycle, Clausius inequality, numerical problem based on 2^{nd} law of thermodynamics.
4. **Gas Power Cycles and Application**
   Basic consideration in the analysis of power cycle, air standard assumptions, an overview of reciprocating engine, Otto Cycle, Diesel Cycle, Brayton Cycle, Dual Combustion Cycle.
5. **Properties of pure substance and Mixture of Gas and Vapor**
   Formation and Properties of Steam and Entropy of Steam, Properties of T-H diagram, T-V diagram, P-V diagram, T-S and H-S diagram for water and steam, Mollier Diagram, terminologies for steam, Advantages of Superheated steam, Entropy of water, dry steam, superheated steam.
6. **Internal Combustion Engine Basics**
   Concept on Heat Engine and classifications, IC engine basic components, Working Principle of a two stroke/ four stroke Engine, Advantages & Disadvantages.
7. **Refrigeration, Air Conditioning System and Phychrometry**
   Basic concepts on Refrigeration and Air Conditioning, Type of Refrigeration Process, Schematic and T-S Diagram Refrigeration cycle, Air Conditioning Types, Study of psychrometric chart
8. **Steam Boiler and Steam Turbine**
   Classification of boilers by mentioning the bases, Different types of boiler with their schematic and salient features, four accessories of Boiler: function and uses, Use of air-preheater, super-heater, fusible plug and safety valve for a boiler. Steam turbine cycle, Schematic and T-S diagram, Turbine Staging; Pressure and velocity profile of turbine, Combined Cycle Power Plant (CCPP).
9. **Non-Conventional Power Generation**
   Basic concepts on non-conventional/ renewable energy sources, thermal power plants, Solar Energy, Geothermal Energy, Energies from Sea, Nuclear Energy and Nuclear Power Plant.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the basic concepts of Thermal Engineering.	√											
CO2	**Explain** and **apply** basic thermodynamic principles and laws to **analyse** and **predict** performance of idealized forms of thermodynamic systems.		√										
CO3	**Relate** idealized thermodynamic cycles to corresponding real systems.	√											
CO4	**Explain** properties of steam	√											
CO5	**Identify** components of IC engine, refrigeration system, air conditioning system and steam boiler and **perform** calculations of their efficiency.		√										
CO6	**Describe** sources of non-conventional energy.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the basic concepts of Thermal Engineering.	C1			1	CT
CO2	**Explain** and **apply** basic thermodynamic principles and laws to **analyse** and **predict** performance of idealized forms of thermodynamic systems.	C2,C3	1		1-4	CT/ASG, F
CO3	**Relate** idealized thermodynamic cycles to corresponding real systems.	C3			1-4	MT, F
CO4	**Explain** properties of steam	C2			1	
CO5	**Identify** components of IC engine, refrigeration system, air conditioning system and steam boiler and **perform** calculations of their efficiency.	C1, A2		1	2-4	CT, F
CO6	**Describe** sources of non-conventional energy.	C1			1	Pr, MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	Students will be able to understand and describe the basic concepts of thermal engineering with the help of the basic fundamental knowledge of the course.
CO2-PO2	Students will gain knowledge on basic thermodynamic principles, laws and formulation. With the help of this knowledge, they will be able to analysis the problems related to thermodynamic systems and predict performances applying mathematics.
CO3-PO1	Applying basic knowledge of the thermodynamic cycles, students will be able to relate the idealized form of cycle with corresponding real systems.
CO4-PO1	Gaining fundamental knowledge on properties of steam, students will be able to explain properties of steam.
CO5-PO2	Students will gain the ability to identify the components of IC engine, refrigeration system, air conditioning system and steam boiler and they will be able to perform calculations of efficiency of mentioned systems applying the knowledge of mathematical formulation.
CO6-PO1	Students will be able to describe sources of non-conventional energy with the basic knowledge of natural science.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction and Basic Concepts of Thermodynamics and Thermal Engineering**	CT 1
Class 1	Basic concepts of thermodynamics: introduction, applications, system, surrounding universe	
Class 2	Basic concepts of thermodynamics: zeroth law, properties of a system, state, process, cycle, pure substance, control volume	
Class 3	Work interaction and closed system work (Work is related to a system and surrounding closed system work = $\int P\,dv$)	
Week 2	**Introduction and Basic Concepts of Thermodynamics and Thermal Engineering (Contd.)**	
Class 4	a) Ideal gas equation for various process b) Closed system work for various process	
Class 5	a) Key note (observation of thermodynamic process) b) open system work	
Class 6	Numerical problems based on a) Thermodynamic work done concepts b) Thermodynamic work done and cycle concept c) Tutorial	
Week 3	**Introduction and Basic Concepts of Thermodynamics and Thermal Engineering (Contd.)**	
Class 7	Numerical problems based on a) Thermodynamic work done concepts b) Thermodynamic work done and cycle concept c) Tutorial	
Class 8	Numerical problems based on a) Thermodynamic work done concepts b) Thermodynamic work done and cycle concept	

	c) Tutorial	
	First Law and its application (Non Flow Process)	CT 2, Final Exam
Class 9	a) Concept of heat and specific heat b) First law of thermodynamics, first law for a cycle and sign convention c) Heat is a path function and energy or internal energy is a property.	
Week 4	**First Law and its application (Non Flow Process) (Contd.)**	
Class 10	a) Energy of an isolated system, PMM-I b) Concept of internal energy and enthalpy. c) Heat transfer for various process for closed system.	
Class 11	a) Meyer's Equation, b) Important thermodynamic relations and air standard values c) Specific heat for polytrophic process	
Class 12	a) Adiabatic process b) Numerical based of 1st law of thermodynamics	
Week 5	**Second Law of Thermodynamics and Entropy**	
Class 13	a) Kelvin-Planck and Clausius statement b) Equivalence of Kelvin-Planck and Clausius statement. c) Carnot Cycle	
Class 14	a) Carnot theorem b) Corollary of Carnot theorem and efficiency and COP of reversible cycle, c) Clausius inequality	
Class 15	Numerical based on 2nd law of thermodynamics	
Week 6	**Gas Power Cycles and Application**	Mid Term, Final Exam, Presentation
Class 16	a) Basic consideration in the analysis of power cycle b) Air standard assumptions c) An overview of reciprocating engine	
Class 17	Application – I: Otto Cycles: The ideal cycle for spark ignition engine	
Class 18	Application – II: Diesel Cycles: The ideal cycle for compression ignition engine	
Week 7	**Gas Power Cycles and Application (Contd.)**	
Class 19	Application – III: Brayton Cycles: The ideal cycle for gas turbine engine	
Class 20	Numerical on Gas Cycle	
Class 21	Numerical on Gas Cycle	
Week 8	**Non-Conventional Power Generation**	
Class 22	Non-Conventional Power Generation	
Class 23	Review Class	
Class 24	Review Class	
Week 9	**Properties of pure substance and Mixture of Gas and Vapor**	Final Exam
Class 25	Formation and Properties of Steam and Entropy of Steam, Properties of T-H diagram, T-V diagram, P-V diagram, T-S and H-S diagram for water and steam	
Class 26	Mollier Diagram, terminologies for steam, Advantages of Superheated steam, Entropy of water, dry steam, superheated steam	

Class 27	Numerical Problems on steam properties	
Week 10	**Internal Combustion Engine Basics**	
Class 28	Concept on Heat Engine and classifications, IC engine basic components	
Class 29	IC engine basic components	
Class 30	Working principle of a two stroke/ four stroke Engine	
Week 11	**Refrigeration, Air Conditioning System and Phychrometry**	CT 3, Final Exam
Class 31	Basic concepts on refrigeration and air conditioning, type of refrigeration Process	
Class 32	Schematic and T-S diagram refrigeration cycle, COP	
Class 33	Numerical problems on refrigeration system	
Week 12	**Refrigeration, Air Conditioning System and Phychrometry (Contd.) and Steam Turbine**	
Class 34	Air Conditioning types, study of psychrometric chart	
Class 35	Steam turbine cycle, Schematic and T-S diagram	
Class 36	Turbine Staging; Pressure and velocity profile of turbine, Combined Cycle Power Plant (CCPP)	
Week13	**Steam Turbine and Steam Boiler (Contd.)**	
Class 37	Numerical on steam turbine	
Class 38	Classification of boilers by mentioning the bases, Different types of boiler with their schematic and salient features,	
Class 39	Four accessories of Boiler: function and uses, Use of air-preheater, super-heater, fusible plug and safety valve for a boiler.	
Week 14		
Class 40	Review Class	
Class 41	Review Class	
Class 42	Review Class	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO5	C1,C2,C3
			CO2	C2,C3
	Class Participation	5%	CO1-CO6	C1, C2, C3, A2
	Mid term	15%	CO3, CO6	C1, C3
Final Exam		60%	CO2	C2,C3
			CO3	C3
			CO4	C2
			CO5	C1,A2
			CO6	C1
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Thermodynamics: An Engineering Approach-Yunus A. Cengel,Michael A. Boles
2. Fundamentals of Engineering Thermodynamics- Michael J. Moran &Howard N. Shapiro.
3. Fundamentals of Thermodynamics – R E Sonntag, C. Borgnakke, G J. Van Wylen.

COURSE INFORMATION

Course Code: NAME 178
Course Title: Thermal Engineering Lab
Level and Term: Level 1 Term 2
Contact Hours: 3.00
Credit Hours: 1.50

RE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The course aims to equip students with basic tools and methodologies for carrying out thermodynamic analyses of engineering systems. With the completion of each experiments, student will gradually develop the ability to compare and apply the theories of thermodynamic principles in the real life applications of thermal engineering notably in properties of fuels, heat engine, refrigeration and conditioning system, steam generation etc.

OBJECTIVES

1. To expose the students to the basic knowledge of thermal equipment and help them to develop experimental skills.
2. To familiarize equipment used for measuring viscosity, flash and fire point and Calorific value of fuels/lubricates used in IC Engines.
3. To familiarize with various types IC engines and their components.
4. To introduce with the models of refrigeration, air conditioning, steam turbine and gas turbine to know about their operating principles.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Conduct** experiments for the determination of viscosity, calorific value, flash point etc. of fuel/Lubricates oil.
2. **Identify** various components of IC engine.
3. **Perform** energy analysis of refrigeration and air conditioning system.
4. **Describe** the operation and **compute** performance of a steam turbine and gas turbine.
5. **Use** modern experimental tools to conduct the experiments related to thermodynamic system.

COURSE CONTENTS

1. Viscosity Test of a Lubricant Oil
2. Determination of Flash Point of Liquid Fuel
3. Calorific value of Gaseous Fuel by Gas Calorimeter
4. Proximate Analysis of Coal
5. Determination of Carbon Residue of a Given Fuel
6. Study of Various Components of an I.C Engine
7. Study of a Refrigeration and Air Conditioning Unit
8. Study of Sling Psychrometer

9. Study of a Gas Turbine.
10. Study the working and function of mountings and accessories in boilers.
11. Study of a steam turbine.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	Course Outcomes (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Conduct** experiments for the determination of viscosity, calorific value, flash point etc. of fuel/Lubricates oil.	√											
CO2	**Identify** various components of IC engine.	√											
CO3	**Perform** energy analysis of refrigeration and air conditioning system.		√										
CO4	**Describe** the operation and **compute** performance of a steam turbine and gas turbine.	√											
CO5	**Use** modern experimental tools to conduct the experiments related to thermodynamic system.					√							

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Conduct** experiments for the determination of viscosity, calorific value, flash point etc. of fuel/Lubricates oil.	C3		1	1-4	R,Q,T
CO2	**Identify** various components of IC engine.	C1			1,2	R,Q,T
CO3	**Perform** energy analysis of refrigeration and air conditioning system.	A2		1	1-4	R,Q,T
CO4	**Describe** the operation and **compute** performance of a steam turbine and gas turbine.	C1,C3			1-4	R,Q,T
CO5	**Use** modern experimental tools to conduct the experiments related to thermodynamic system.	C3			6	PR, Pr, T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	Fundamental knowledge of mathematics and physics is required conduct experiments for the determination of viscosity, calorific value, flash point etc. of fuel/Lubricates oil
CO2-PO1	After familiarization with various components of IC engine, the students should be able to identify these components and describe their functions.
CO3-PO2	The students should be able to analyze the energy and performance of refrigeration and air conditioning process.
CO4-PO1	Fundamental knowledge on steam turbine and steam boiler will help the students to understand the basic operating principle of them.
CO5-PO5	The students will acquire knowledge in modern tools that has been used to carry out various experiments of thermodynamic system.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week	Topics
Week 1	Course introduction
Week 2	a) Viscosity Test of Liquid Substance b) Study of Different Speed Measuring Devices
Week 3	Determination of Flash Point of Liquid Fuel
Week 4	Calorific value of Gaseous Fuel by Gas Calorimeter
Week 5	Proximate Analysis of Coal
Week 6	a) Determination of Carbon Residue of a Given Fuel b) Concept of pressure and pressure sensor Behavior

Week 7	**Lab Test-1**
Week 8	a) Study of Various Components of an I.C Engine b) I.C engine valve timing diagram
Week 9	a) Study of a Refrigeration and Air Conditioning Unit. b) Study of Sling Psychrometer
Week 10	Study of a Gas Turbine.
Week 11	a) Study the working and function of mountings and accessories in boilers b) Study of a steam turbine
Week 12	**Lab Test-2**
Week 13	**Viva**
Week 14	**Final Quiz**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	C3
			CO2	C1
			CO3	A2
			CO4	C1,C3
	Labtest-1,Labtest-2	30%	CO1	C3
			CO2	C1
			CO3	A2
			CO4	C1,C3
			CO5	C3
	Project and Presentation	25%	CO5	C3
Lab Quiz		25%	CO1	C3
			CO2	C1
			CO3	A2
			CO4	C1,C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Thermodynamics: An Engineering Approach-Yunus A. Cengel,Michael A. Boles
2. Fundamentals of Engineering Thermodynamics- Michael J. Moran &Howard N. Shapiro.
3. Fundamentals of Thermodynamics – R E Sonntag, C. Borgnakke, G J. Van Wylen.

COURSE INFORMATION

Course Code: NAME 201
Credit Hours: 3.00
Course Title: Mechanics of Structure
Contact Hours: 3.00
Level and Term: Level 2 Term I

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is intended to provide students with a thorough understanding of the theory and application of structural analysis as it applies to columns, beams and frames. Emphasis is placed on developing the student's ability to calculate the deflection of beam, shear force and bending moment.

OBJECTIVES

1. To evaluate stress and deformation of simple deformable structural under shear, flexure and torsional loadings.
2. To analyze statically indeterminate structure.
3. To analyze deflection of beam and shaft.
4. To establish the stress transformation equations and determine the absolute maximum normal and shear stress.
5. To analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the concepts and principles of structural stability and mechanical components.
2. **Perform** calculation and drawing of shear force and bending moment at different loading conditions.
3. **Analyze** various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.
4. **Evaluate** the deflection of a beam and buckling of a column subjected to loads.

COURSE CONTENTS

1. **Introduction to Mechanics of Structure:** Basic Concept of Mechanics, Importance of Mechanics of Structure in Ship Design, History of Structural Failure of Ships. Centroids of Plane Areas, Centroids of Composite Areas, Moments of Inertia of Plane Areas, Parallel-Axis Theorem for Moments of Inertia, Polar Moments of Inertia, Products of Inertia, Rotation of Axes, Principal Axes and Principal Moments of Inertia.
2. **Tension, Compression, and Shear**: Normal Stress and Strain, Mechanical Properties of Materials, Elasticity, Plasticity, and Creep, Linear Elasticity, Hooke's Law, and Poisson's Ratio, Shear Stress and Strain, Allowable Stresses and Allowable Loads, Design for Axial Loads and

Direct Shear, Problems.

3. **Axially Loaded Members:** Changes in Lengths of Axially Loaded Members, Changes in Lengths Under Non uniform Conditions, Statically Indeterminate Structures, Thermal Effects, Misfits, and Prestrains, Stresses on Inclined Sections, Strain Energy, Impact Loading, Repeated Loading and Fatigue, Stress Concentrations, Nonlinear Behavior, Elastoplastic Analysis, Problems.
4. **Torsion:** Torsional Deformations of a Circular Bar, Circular Bars of Linearly Elastic Materials, Non-uniform Torsion, Stresses and Strains in Pure Shear, Relationship Between Moduli of Elasticity E and G, Transmission of Power by Circular Shafts, Statically Indeterminate Torsional Members, Strain Energy in Torsion and Pure Shear, Thin-Walled Tubes, Stress Concentrations in Torsion, Problems.
5. **Shear Forces and Bending Moments:** Types of Beams, Loads, and Reactions, Shear Forces and Bending Moments, Relationships Between Loads, Shear Forces, and Bending Moments, Shear-Force and Bending-Moment Diagrams, Problems.
6. **Stresses in Beams:** Pure Bending and Non-Uniform Bending, Curvature of a Beam, Longitudinal Strains in Beams, Normal Stresses in Beams, Design of Beams for Bending Stresses, Non-prismatic Beams, Shear Stresses in Beams of Rectangular Cross Section, Shear Stresses in Beams of Circular Cross Section, Shear Stresses in the Webs of Beams with Flanges, Built-Up Beams and Shear Flow, Beams with Axial Loads, Stress Concentrations in Bending, Problems.
7. **Analysis of Stress and Strain:** Plane Stress, Principal Stresses and Maximum Shear Stresses, Mohr's Circle for Plane Stress, Hooke's Law for Plane Stress, Triaxial Stress, Plane Strain, Problems.
8. **Applications of Plane Stress:** Spherical Pressure Vessels, Cylindrical Pressure Vessels, Maximum Stresses in Beams, Combined Loadings, Problems.
9. **Deflections of Beams:** Differential Equations of the Deflection Curve, Deflections by Integration of the Bending-Moment Equation, Deflections by Integration of the Shear-Force and Load Equations, Method of Superposition, Moment-Area Method, Non-prismatic Beams, Strain Energy of Bending, Castigliano's Theorem, Deflections Produced by Impact, Discontinuity Functions, Use of Discontinuity Functions in Determining Beam Deflections, Temperature Effects, Problems.
10. **Statically Indeterminate Beams:** Types of Statically Indeterminate Beams, Analysis by the Differential Equations of the Deflection Curve, Method of Superposition, Temperature Effects, Longitudinal Displacements at the Ends of a Beam, Problems.
11. **Columns:** Buckling and Stability, Columns with Pinned Ends, Columns with Other Support Conditions, Columns with Eccentric Axial Load, The Secant Formula for Columns, Elastic and Inelastic Column Behavior, Inelastic Buckling, Design Formulas for Columns, Problems.
12. **Various Theories of Failure:** Maximum Principal Stress theory also known as Rankine's Theory, Maximum Shear Stress theory or Guest And Tresca's Theory, Maximum Principal Strain theory also known as St.Venant's Theory, Total Strain Energy Theory or Haigh's Theory, Maximum Distortion Energy theory or Vonmises and Hencky's Theory.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	**Explain** the concepts and principles of structural stability and mechanical components.	√											
CO2	**Perform** calculation and drawing of shear force and bending moment diagrams at different loading conditions.	√											
CO3	**Analyze** various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.			√									
CO4	**Evaluate** the deflection of a beam and buckling of a column subjected to loads.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the concepts and principles of structural stability and mechanical components.	C2	1		1-4	CT, F
CO2	**Perform** calculation and drawing of shear force and bending moment diagrams at different loading conditions.	A2	1		1-4	CT, MT, F
CO3	**Analyze** various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.	C4	3		5	CT/ASG, F
CO4	**Evaluate** the deflection of a beam and buckling of a column subjected to loads.	C5	1		1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to calculate stress-strain of mechanical components.
CO2-PO1	In order to apply the mathematics knowledge on load, shear force and bending moment equations to draw the shear force and bending moment diagrams.
CO3-PO3	To design structural members subjected to combined stresses to solve by using Mohr's circle of stress.
CO4-PO2	In order to analyze the deflection and buckling equations to solve the beam and column related problems at different loading conditions.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week 1	**Introduction to Mechanics of Structure**	CT-1 Final Exam
Class 1	Basic Concept of Mechanics, Importance of Mechanics of Structure in Ship Design, History of Structural Failure of Ships.	
Class 2	Centroids of Plane Areas, Moments of Inertia of Plane Areas, Parallel-Axis Theorem for Moments of Inertia.	
Class 3	Polar Moments of Inertia, Rotation of Axes, Principal Axes and Principal Moments of Inertia.	
Week 2	**Tension, Compression, and Shear**	
Class 4	Normal Stress and Strain, Mechanical Properties of Materials, Elasticity, Plasticity, and Creep, Linear Elasticity.	
Class 5	Hooke's Law, and Poisson's Ratio, Shear Stress and Strain, Allowable Stresses and Allowable Loads, Design for Axial Loads and Direct Shear.	
Class 6	Changes in Lengths of Axially Loaded Members, Changes in Lengths Under Non uniform Conditions.	
Week 3	**Axially Loaded Members**	
Class 7	Statically Indeterminate Structures, Thermal Effects, Misfits, and Prestrains.	
Class 8	Stresses on Inclined Sections, Strain Energy, Impact Loading, Repeated Loading and Fatigue, Stress Concentrations, Nonlinear Behavior	
Class 9	Types of bars of varying sections, Stresses in the bars of different sections.	
Week 4	**Torsion**	CT-2 Final Exam
Class 10	Torsional Deformations of a Circular Bar, Circular Bars of Linearly Elastic Materials, Non-uniform Torsion.	
Class 11	Assessment 01	
Class 12	Stresses and Strains in Pure Shear, Relationship Between Moduli of	

	Elasticity *E* and *G*, Transmission of Power by Circular Shafts.	
Week 5	**Shear Forces and Bending Moments**	
Class 13	Statically Indeterminate Torsional Members, Strain Energy in Torsion and Pure Shear, Thin-Walled Tubes, Stress Concentrations in Torsion.	
Class 14	Types of Beams, Loads, and Reactions, Shear Forces and Bending Moments.	
Class 15	Relationships Between Loads, Shear Forces, and Bending Moments, Shear-Force and Bending-Moment Diagrams	
Week 6	**Stresses in Beams**	
Class 16	Shear-Force and Bending-Moment Diagrams. (Continue)	
Class 17	Pure Bending and Non-uniform Bending, Curvature of a Beam, Longitudinal Strains in Beams.	
Class 18	Normal Stresses in Beams, Design of Beams for Bending Stresses, Non-prismatic Beams, Shear Stresses in Beams of Rectangular Cross Section.	
Week 7	**Stresses in Beams**	Mid Term, Final Exam
Class 19	Shear Stresses in Beams of Circular Cross Section, Shear Stresses in the Webs of Beams with Flanges.	
Class 20	Built-Up Beams and Shear Flow, Beams with Axial Loads, Stress Concentrations in Bending.	
Class 21	Assessment 02	
Week 8	**Mohr's Circle**	
Class 22	Plane Stress, Principal Stresses and Maximum Shear Stresses	
Class 23	Mohr's Circle for Plane Stress	
Class 24	Application and Problems	
Week 9	**Deflections of Beams**	
Class 25	Differential Equations of the Deflection Curve, Deflections by Integration of the Bending-Moment Equation.	
Class 26	Deflections by Integration of the Shear-Force and Load Equations, Method of Superposition.	
Class 27	Moment-Area Method, Non-prismatic Beams, Strain Energy of Bending, Castigliano's Theorem.	
Week 10	**Statically Indeterminate Beams**	
Class 28	Types of Statically Indeterminate Beams, Analysis by the Differential Equations of the Deflection Curve	
Class 29	Method of Superposition, Temperature Effects, Longitudinal Displacements at the Ends of a Beam.	
Class 30	Application and Problems.	
Week 11	**Columns**	CT 3, Final Exam
Class 31	Mid-Term Exam	
Class 32	Buckling and Stability, Columns with Pinned Ends.	
Class 33	Columns with Other Support Conditions, Columns with Eccentric Axial Load.	
Week 12	**Columns**	
Class 34	The Secant Formula for Columns, Elastic and Inelastic Column Behavior.	

Class 35	Inelastic Buckling, Design Formulas for Columns.	
Class 36	Application and Problems.	
Week13	**Various Theories of Failure**	
Class 37	Maximum Principal Stress theory also known as Rankine's Theory, Maximum Shear Stress theory or Guest And Tresca's Theory	
Class 38	Maximum Principal Strain theory also known as St.Venant's Theory, Total Strain Energy Theory or Haigh's Theory	
Class 39	Assessment 03	
Week 14	**Course review**	
Class 40	Course review	
Class 41	Course review	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2
			CO3	C3, C4
	Class Participation	5%	CO2	
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2, , C4
			CO2	C1, C2,C4
			CO3	C5, C4
			CO4	C5, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics of Structure, James M Gere
2. Mechanical Behavior of Materials, Meyers and Chawla
3. Strength of Material, Gupta and Khurmi
4. Mechanics of Material, Russell C Hibbeler

COURSE INFORMATION

Course Code: NAME 202 **Contact Hours:** 1.5
Course Title: Mechanics of Structure Lab **Credit Hours:** 0.75
Level and Term: Level 2 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Mechanics of Structure Sessional course is designed to teach students about the basic concepts of strength of materials such as analysis of material properties based on tension, compression, hardness, bending, buckling, impact etc. Students will be able to perform necessary calculations related to the tensile stress, compressive stress, and shear stress. It is expected that students will develop critical thinking about to measure characteristics of strength of material precisely, able to check their effects using calculations and finally chose the appropriate feature of structure.

OBJECTIVES

1. To impart knowledge about the fundamental concepts as stresses and strains, deformations and displacements, elasticity and inelasticity, strain energy, and load-carrying capacity
2. To enable students to learn and appreciate how structural analysis and materials response are intricately involved in the engineering product/device design process.
3. To familiarize the students with the effect of different types of stress on materials.
4. To enable students to know about the fundamental concepts of materials failures.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Measure** tensile and compressive strength of a specimen for applying in a practical design-based project work.
2. **Evaluate** hardness, impact strength, fatigue strength to analyze the application of a specific material for a given design requirement for different loading conditions of structures.
3. **Identify** bending in beams and calculate the bending stresses which further builds the foundation of using modern analysis software.
4. **Assist** in evaluating the capacity of a column to withstand compressive stresses for a safe and sustainable design of ship's hull.

COURSE CONTENTS

1. Study and Calibration of a Universal Testing Machine (UTM);
2. Tensile Test of Mild Steel Specimen;
3. Hardness Test of Metal Specimen;
4. Impact Test of Metal Specimen;
5. Column Test of Mild Steel Specimen;
6. Bending of a beam under point load.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Measure** tensile and compressive strength of a specimen for applying in a practical design-based project work.			√									
CO2	**Evaluate** hardness, impact strength to analyze the application of a specific material for a given design requirements for different loading conditions of structures.		√										
CO3	**Identify** bending in beams and calculate the bending stresses which further builds the foundation of using modern analysis software.		√										
CO4	**Assist** in evaluating the capacity of a column to withstand compressive stresses for a safe and sustainable design of ship's hull.									√			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Measure** tensile and compressive strength of a specimen for applying in a practical design-based project work.	P4				R,Q,T
CO2	**Evaluate** hardness, impact strength to analyze the application of a specific material for a given design requirements for different loading conditions of structures.	C5				R,Q,T
CO3	**Identify** bending in beams and calculate the bending stresses which further builds the foundation of using modern analysis software.	A4	1		1-4	R,Q,T
CO4	**Assist** in evaluating the capacity of a column to withstand compressive stresses for a safe and sustainable design of ship's hull.	A2	1		1-4	R,Q,T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications

CO1-PO3	The students will acquire knowledge on modern tools that can be used to find out different structural problems.
CO2-PO2	Students will identify different structural problems and will try to reach the solutions by applying acquired knowledge.
CO3-PO2	Fundamental knowledge structure failure will help the students to understand the concept of safety factor.
CO4-PO9	Students will work as a team as well as individually to reach the solution of structural based problems.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 5 15
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz	 10 4 4
Preparation of Presentation Engagement in Group Projects Formal Assessment	6 14 02
Total	**60**

TEACHING METHODOLOGY

Lecture followed by hands on experiment session and discussion, co-operative and collaborative method, project-based method.

COURSE SCHEDULE

Week	Topic
Week 1	Course introduction, Study and Calibration of a Universal Testing Machine (UTM)
Week 2	Tensile Test of Mild Steel Specimen
Week 3	Hardness Test of Metal Specimen
Week 4	Impact Test of Metal Specimen
Week 5	Column Test of Mild Steel Specimen
Week 6	Bending of a beam under point load
Week 7	Final Viva and Quiz

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
	Lab participation and Report	20%	CO 1	C1, C3
			CO 2	C4, A1
			CO 3	C3, C4

Continuous Assessment			CO 4	A2
	Labtest-1,Labtest-2	30%	CO 1	C1, C3
			CO 2	C4, P1
			CO 3	C3, C4
			CO 4	A2
	Project and Presentation	25%	CO 1, CO 2, CO 3	A1, A2, A3
Lab Quiz		25%	CO 1	CO 2
			CO 2	CO 3
			CO 3	C3, P7
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of Machine Design – Andrzej Golenko_
2. Theory of Machine and Mechanisms – Joseph E. Shigley, John Joseph Uicker
3. Standard Handbook of Machine Design – Joseph E. Shigley, Charles R. Mischke, Thomas H.Brown
4. Design of Machine Elements – Sharma, C.S.
5. Theory and Problems of Machine Design –Hall, Holowenco and Laughlin
6. Theory of Machine – R.S. Khurmi and J. K. Gupta.

COURSE INFORMATION

Course Code: NAME 205 **Credit Hours:** 3.00
Course Title: Shipbuilding Materials and Metallurgy **Contact Hours:** 3.00
Level and Term: Level 2 Term I

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The knowledge of Shipbuilding Materials and Metallurgy course is intended to provide an integrated approach, utilizing the materials science, and structural integrity principles as they apply to offshore structures and ships. Students will be able to select appropriate materials for ships and marine structure and components. It is expected that students will develop critical thinking to select optimum material for marine structure on the basis of engineering and environment point of view.

OBJECTIVES

1. To enable explain methods of production of cast iron, steel and nonferrous metals.
2. To enable explain the concepts on material property improvement and heat treatment technology.
3. To familiarize with different marine engineering materials and essential criteria on different applications.
4. To introduce the appropriate material depending on application and environment of marine structure and ship.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Select** materials for a particular application and different environment.
2. **Interpret** the design criteria of materials.
3. **Apply** appropriate technology on different materials, their processing and heat treatments in suitable application in marine engineering fields.
4. **Compare** the materials and their properties used in the marine industry

COURSE CONTENTS

1. **Metals as materials of construction:** What is material Science and Engineering, Classification of materials; Materials Design and Selection. Industrially significant properties of metallic materials: Technological Significance; Terminology for Mechanical Properties; Tensile test: Use of the stress-strain diagram, True Stress and True Strain; The Bend test for Brittle materials; Hardness of Materials; Strain Rate Effects and Impact Behavior; Fracture Mechanics; Micro-structural features of fracture in metallic materials, ceramics, glasses and composites; Fatigue; Results and applications of fatigue test; Creep, Stress Rupture and Stress Corrosion.
2. **Production, properties and uses of Pig Iron, Cast Iron and Carbon Steels:** Blast

Furnace production of Pig Iron; Bessemer process for the production of steel; The Open Hearth Process. Phase diagrams, The Fe-Fe3C equilibrium diagram: Equilibrium diagrams, Phase diagrams for two metals completely soluble in liquid and solid states, Two metals completely soluble in the liquid state and completely insoluble in the solid state; Two metals completely soluble in the liquid state but only partly soluble in the solid state; The Eutectoid Reaction; The Iron-Iron Carbide Diagram

3. **Heat treatment of Steel:** Full Annealing; Spheroidizing; Stress-relief Annealing; Process Annealing; Normalizing; Hardening, Austentizing Temperature, Mechanism of heat removal during Quenching, Quenching medium; Tempering
4. **Cast Iron, Alloy, tool, stainless, heat-resisting and creep resisting steels etc.:** White Cast Iron, Malleable Cast Iron, Pearlitic Malleable Iron, Gray Cast Iron, Mechanical properties and applications of Gray Cast Iron, Silicon in Cast Iron, Alloy Cast Iron; Stainless steel types.
5. **Case hardening of steels:** Carburizing; Nitriding; Cyaniding; Flame hardening; Induction hardening.
6. **Nonferrous alloys:** Copper alloys, Brass alloys, Bronze alloys, Gun metal, Bearing Materials, Aluminium alloys, Magnesium alloys, Tin alloys.
7. Protective Coatings. Cement, Timber, Rubber, Glass and Plastic
8. General steel grades and description of IACS requirement for shipbuilding materials.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES:

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Select** materials for a particular application and different environment.							√					
CO2	**Interpret** the design criteria of materials.	√											
CO3	**Apply** appropriate technology on different materials, their processing and heat treatments in suitable application in marine engineering fields.					√							
CO4	**Compare** the materials and their properties used in the marine industry.				√								

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Select** materials for a particular application and different environment.	C1	3		7	CT, F, ASG
CO2	**Interpret** the design criteria of materials.	C2	4		1-4	CT, MT, F
CO3	**Apply** appropriate technology on different materials, their processing and heat treatments in suitable application in marine engineering fields.	C3	1		6	CT, F
CO4	**Compare** the materials and their properties used in the marine industry.	C4	2		8	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q						

– Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO7	Evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in environmental contexts to select materials for a particular application and different environment.
CO2-PO1	Apply knowledge of science and engineering fundamentals and an engineering specialization to interpret the design criteria of materials.
CO3-PO5	To select appropriate techniques with an understanding of the limitations to apply in different materials, their processing and heat treatments in suitable application in marine engineering fields.
CO4-PO4	Analysis and interpretation of data and synthesis of information to compare the materials and their properties used in the marine industry.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	What is material Science and Engineering, Classification of materials	
Class 2	Materials Design and Selection.	
Class 3	Industrially significant properties of metallic materials:	
Week 2	**Metals as materials of construction**	
Class 4	Technological Significance;	
Class 5	Terminology for Mechanical Properties; Tensile test: Use of the stress-strain diagram, True Stress and True Strain;	
Class 6	The Bend test for Brittle materials; Hardness of Materials; Strain Rate	

	Effects and Impact Behavior;	
Week 3	**Metals as materials of construction**	
Class 7	Fracture Mechanics; Micro-structural features of fracture in metallic materials	
Class 8	ceramics, glasses and composites	
Class 9	Fatigue; Results and applications of fatigue test;	
Week 4	**Production, properties and uses of Pig Iron, Cast Iron and Carbon Steels**	CT 2, Final Exam
Class 10	Creep, Stress Rupture and Stress Corrosion.	
Class 11	Blast Furnace production of Pig Iron	
Class 12	Bessemer process for the production of steel;	
Week 5	**Production, properties and uses of Pig Iron, Cast Iron and Carbon Steels**	
Class 13	The Open-Hearth Process	
Class 14	Phase diagrams	
Class 15	Equilibrium diagrams, Phase diagrams for two metals completely soluble in liquid and solid states,	
Week 6	**Production, properties and uses of Pig Iron, Cast Iron and Carbon Steels**	
Class 16	Two metals completely soluble in the liquid state and completely insoluble in the solid state;	
Class 17	Two metals completely soluble in the liquid state but only partly soluble in the solid state;	
Class 18	The Eutectoid Reaction;	
Week 7	**Production, properties and uses of Pig Iron, Cast Iron and Carbon Steels**	Mid Term, Final Exam
Class 19	The Iron-Iron Carbide Diagram	
Class 20	Full Annealing; Spheroidizing; Stress-relief Annealing; Process Annealing;	
Class 21	Normalizing;	
Week 8	**Heat treatment of Steel**	
Class 22	Hardening,	
Class 23	Austentizing Temperature,	
Class 24	Mechanism of heat removal during Quenching, Quenching medium; Tempering	
Week 9	**Cast Iron, Alloy, tool, stainless, heat-resisting and creep resisting steels etc**	
Class 25	White Cast Iron, Malleable Cast Iron	
Class 26	Malleable Cast Iron, Pearlitic Malleable Iron, Gray Cast Iron	
Class 27	Silicon in Cast Iron, Alloy Cast Iron; Stainless steel types.	Mid Term,
Week 10	**Case hardening of steels**	
Class 28	Carburizing; Nitriding;	
Class 29	Cyaniding	
Class 30	Flame hardening; Induction hardening.	
Week 11	**Nonferrous alloys**	
Class 31	Copper alloys	

Class 32	Brass alloys, Bronze alloys,	Final Exam
Class 33	Gun metal, Bearing Materials	
Week 12	**Structural Assemble**	
Class 34	Aluminium alloys	
Class 35	Magnesium alloys	
Class 36	Tin alloys.	
Week13	**Structural Assemble**	CT 3, Final Exam
Class 37	Protective Coatings, Cement	
Class 38	Glass, Plastic, Rubber	
Class 39	Timber	
Week 14	**Shipbuilding Materials**	
Class 40	General steel grades and description of IACS requirement for shipbuilding materials.	
Class 41	Course Revision	
Class 42	Course Revision	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2
			CO4	C3, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C1
	Mid term	15%	CO2, CO4	C1, C2, C5
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C5
			CO3	C2
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introduction of Physical Metallurgy, S.H. Avner, 2^{nd} edition, McGraw-Hill International Editions, Materials Science and Metallurgy Series, 2000.
2. Essentials of Materials Science and Engineering, D.R. Askeland and P.P. Fulay, 2^{nd} edition, Cengage Learning Publishers, Nelson Education Ltd., 2010.
3. Chemistry of Engineering Materials, R.B. Leighou, 1942.
4. Engineering Materials 2: An Introduction to Microstructures, Processing and Design, M.F. Ashby and D.R.H. Jones, 2^{nd} edition, Butterworth-Heinemann publishers ltd., 1998.

COURSE INFORMATION

Course Code: NAME 206 **Credit Hours:** 0.75
Course Title: Shipbuilding Materials and Metallurgy Lab **Contact Hours:** 1.50
Level and Term: Level 2 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Performance or application of material depends on synthesis, composition and properties of material. Like the other engineering field, structural performance of a ship is governed by proper selection of material. This is a compulsory sessional course based on experiment, inspection and composition analysis of materials for a better understanding of structure-material properties correlation. Shipbuilding Materials Sessional is designed to introduce the students with metallography and the influence of metallographic structure on material properties.

OBJECTIVES

1. To introduce students with metallography and the influence of metallographic structure on material properties.
2. To teach the students specimen sample preparation.
3. To help students understand phase diagrams in details.
4. To enable the students to study the microstructure of steel and cast iron.
5. To demonstrate the effect of heat treatment on microstructure and material properties.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Recognize** the structure-material properties correlation;
2. **Distinguish** the variation in material composition;
3. **Relate** the theoretical knowledge with the practical experiment results;
4. **Select** suitable materials in ship construction.

COURSE CONTENTS

1. Introduction to Metallographic and Metallographic Sample Specimen Preparation;
2. Study of Phase Diagrams, Microstudy of steels;
3. Heat treatment of steels;
4. Microstudy of cast irons,
5. Composition analysis of different materials by X-ray;
6. Surface crack detection by Magnetic particle test for NDT.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recognize** the structure-material properties correlation;		√										
CO2	**Distinguish** the variation in material composition;					√							
CO3	**Relate** the theoretical knowledge with the practical experiment results;	√											
CO4	**Select** suitable materials in ship construction.			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Recognize** the structure-material properties correlation;	C1	-	1	1,3,4	R,Q,T
CO2	**Distinguish** the variation in material composition;	C2	1	1	6	R,Q,T
CO3	**Relate** the theoretical knowledge with the practical experiment results;	C3	1	1	1,3,4	R,Q,T
CO4	**Select** suitable materials in ship construction.	C4	1-5	2,3	5	R,Q,Pr
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPING

Mapping	Justifications
CO1-PO2	Students will be able to identify the exact material for efficient ship building by recognizing the structure-material properties correlation.
CO2-PO5	Selection and application of appropriate techniques, resources and modern engineering tools will be required for distinguishing the variation in material composition.
CO3-PO1	Systematic understanding of engineering knowledge by conforming with experimental results.
CO4-PO3	Knowledge of suitable material selection will support practical ship design in the shipbuilding area.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 06

Experiment	15
Self-Directed Learning	
Preparation of Lab Reports	20
Preparation of Viva	6
Preparation of Quiz	12
Total	**60**

TEACHING METHODOLOGY

Lecture followed by hands on experiment and observation, discussion and report submission

COURSE SCHEDULE

Week	Name of the Topics
Week-1	Course introduction, Introduction to metallography and sample preparation.
Week-2	Study of Phase Diagrams
Week-3	Micro study of Steel
Week-4	Heat Treatment of Steel
Week-5	Heat Treatment of Steel(continued)
Week-6	Heat treatment of Cast Iron
Week-7	Final Quiz/ Viva

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation	20%	CO 1, CO 2, CO 3	C1, C2,A1
	Lab Report	40%	CO 1	C1, C4
			CO 2	C4, P1
			CO 3	C3, C4
			CO 4	C3
	Presentation/ Viva	15%	CO 1, CO 2, CO 3, CO 4	A1, A2, A4
Lab Quiz		25%	CO 1	CO 2
			CO 2	CO 3
			CO 3	C3, P7
			CO 4	C3
Total Marks		**100%**		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introduction of Physical Metallurgy, S.H. Avner, 2nd edition, McGraw-Hill International Editions, Materials Science and Metallurgy Series, 2000.
2. Essentials of Materials Science and Engineering, D.R. Askeland and P.P. Fulay, 2nd edition, Cengage Learning Publishers, Nelson Education Ltd., 2010
3. Chemistry of Engineering Materials, R.B. Leighou, 1942.
4. Engineering Materials 2: An Introduction to Microstructures, Processing and Design, M.F. Ashby and D.R.H. Jones, 2nd edition, Butterworth-Heinemann publishers ltd., 1998.

COURSE INFORMATION

Course Code: NAME 207 **Credit Hours:** 3.00
Course Title: Ship Design **Contact Hours:** 3.00
Level and Term: Level 2 Term 1

PRE-REQUISITE

Course Code: NAME 107, NAME 157
Course Title: Introduction to Naval Architecture and Marine Engineering, Hydrostatics and Stability

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The course aims to provide the understanding of the many facets of ship design – function and appearance and design philosophy. A ship structure must be stable, seaworthy and have adequate strength in all weathers. This course will help to develop and apply key theories and principles associated with the design of vessels and also develops fundamental naval architecture knowledge, including a thorough exploration of its concepts and how they are practically used in applications in ships.

OBJECTIVES

1. To enable in interpreting and applying the design principles of naval architecture
2. To enable in imparting knowledge on applying appropriate calculations and interpret outcomes in naval architecture tasks.
3. To introduce to the role that the naval architects play in meeting and industry and international regulatory requirements
4. To enable in preparing a complete design spiral of ship.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Estimate** the values of design parameters, capacities and performances
2. **Apply** knowledge in practical ship designs and construction
3. **Analyze** design philosophy and design aspects of different type of ships
4. **Compare** characteristics of different design stages

COURSE CONTENTS

1. **Introduction to Ship Design:** Engineering design-philosophy: Various design stages: concept design, basic designs, preliminary designs, contract designs, detailed designs.
2. **Ship Design Spiral:** cargo routes, estimation of dimensions and hull form and displacement, preliminary G.A plan, calculation of freeboard, depth, volume, tonnage and capacities, calculation of longitudinal strength, resistance and powering, selection of machinery and outfit, checking for trim and stability, estimation of lightweight and cargo deadweight, economic criteria and evaluation.

3. **Extensive Use of Design Computer Environment:** Given owner's requirements, students individually create and report the conceptual/preliminary design for a displacement ship and Case studies of typical marine vehicles.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Estimate** the values of design parameters, capacities and performances			√									
CO2	**Apply** knowledge in practical ship designs and construction	√											
CO3	**Analyze** design philosophy and design aspects of different type of ships				√								
CO4	**Compare** characteristics of different design stages									√			

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Estimate** the values of design parameters, capacities and performances	C2	6		5	CT, F, ASG
CO2	**Apply** knowledge in practical ship designs and construction	C3	8		1-4	CT, MT, F
CO3	**Analyze** design philosophy and design aspects of different type of ships	C4	4		8	CT, F
CO4	**Compare** characteristics of different design stages	C5	7		-	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO3	Design solutions for complex engineering problems that meet specified needs with appropriate estimate the values of design parameters, capacities and performances.
CO2-PO1	Apply knowledge of science and engineering fundamentals to the solution of complex engineering problems based on apply the knowledge in practical ship designs and construction.
CO3-PO4	To conduct investigations of complex problems using research-based knowledge to analyze the design philosophy and design aspects of different type of ships.
CO4-PO9	Function effectively as an individual and as a member or leader in diverse teams to compare the characteristics of different design stages

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction, course administration	
Class 2	Engineering design philosophy	
Class 3	Design spiral	
Week 2	**Design of Ship**	
Class 4	Various design stages	
Class 5	Concept design; preliminary design	
Class 6	Contract design; detailed design	
Week 3	**Design of Ship**	
Class 7	Basic design	
Class 8	Class approval drawings	
Class 9	Review of design spiral	
Week 4	**Design of Ship**	CT 2, Final Exam
Class 10	Routes	
Class 11	Determination of principal dimensions	
Class 12	Preliminary weight calculation and displacement	
Week 5	**Design of Ship**	
Class 13	Capacity check of deadweight items	
Class 14	Preliminary G.A plan	
Class 15	Preliminary G.A plan	
Week 6	**Design of Ship**	
Class 16	Introduction of LLC 1966	
Class 17	Definitions: type A ship, type B ship, tabular freeboard, bow height etc	

Class 18	Freeboard calculation	
Week 7	**Design of Ship**	Mid Term, Final Exam
Class 19	Tonnage convention 1969	
Class 20	Volume, tonnage and capacities	
Class 21	Net tonnage, gross tonnage	
Week 8	**Design of Ship**	
Class 22	Longitudinal strength; estimation of shear force and bending moment	
Class 23	Calculation of longitudinal strength.	
Class 24	Section modulus and inertia requirement of midship section.	
Week 9	**Design of Ship**	
Class 25	Resistance calculation	
Class 26	Power calculation	
Class 27	Selection of machinery and outfit	Mid Term, Final Exam
Week 10	**Design of Ship**	
Class 28	Trim calculation	
Class 29	Heel calculation	
Class 30	Checking for trim and stability	
Week 11	**Design of Ship**	
Class 31	Estimation of lightweight	
Class 32	Estimation of cargo deadweight	
Class 33	Economic criteria and evaluation.	
Week 12	**Design of Ship**	
Class 34	Extensive use of design computer environment	
Class 35	Extensive use of design computer environment.	
Class 36	Extensive use of design computer environment.	
Week13	**Design of Ship**	CT 3, Final Exam
Class 37	Given owner's requirements, students individually create and report the conceptual/preliminary design for a displacement ship.	
Class 38	Given owner's requirements, students individually create and report the conceptual/preliminary design for a displacement ship.	
Class 39	Given owner's requirements, studentsindividually create and report the conceptual/preliminary design for a displacement ship.	
Week 14	**Design of Ship**	
Class 40	Case studies of typical marine vehicles I	
Class 41	Case studies of typical marine vehicles II	
Class 42	Case studies of typical marine vehicles III	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2, C3
			CO3	C3, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C4
	Mid term	15%	CO2, CO4	C2, C5
Final Exam		60%	CO1	C2

		CO2	C3, C2,C5
		CO3	C4
		CO4	C3
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Principles of Naval Architecture, Vol. 1, 2 &3,
2. Ship Design and Performance for Master and Mates, Dr C B Barrass
3. Practical Ship Design, D.G.M. Watson, 1998, Elsevier Science Ltd.
4. Ship Design - Methodologies of Preliminary Design, ApostolosPapanikolaou, Springer
5. Ship design for efficiency and economy, H Schneekluth and V Bertram

COURSE INFORMATION

Course Code: NAME 208 **Credit Hours:** 2.0
Course Title: Computer Aided Ship Design **Contact Hours:** 4.0
Level and Term: Level 2 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Computer Aided Ship Design sessional course is designed to teach the students about the basic design drawings of different types of ships and draw them with the aid of CAD software. Students will also be able to perform necessary calculations related to the basic structural design and capacity calculations.

OBJECTIVES

1. To enable students to be familiarized with different types of ships and their basic drawings.
2. To familiarize the students to CAD software for designing of various types of drawings of ship.
3. To enable students to use Rule Books for structural design calculation.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Produce** general arrangement (GA), Lines Plan, Mid-ship section drawing, longitudinal construction & shell expansion drawings with the aid of CAD Software.
2. **Interpret** & **use** rule books for structural design calculations.
3. **Prepare** capacity plan of a ship.
4. **Use** modern CAD programs for ship design drawings

COURSE CONTENTS

1. **AutoCAD:** Introduction to CAD, drawing unit and scale, 2-D drawing tools, Modification tools, layers, hatching and dimensioning, working in 3-D space, 3-D coordinate systems, drawing sheet layout, viewpoints, 3-D drawing tools, 3-D wire frame modelling, Surface modelling, solid modelling and rendering.

1. General arrangement (GA) plan drawing in CAD software,
2. Lines plan drawing in CAD software,
3. Preliminary structural design calculation of ships using Rule Book,
4. Mid-ship Section Drawing,
5. Longitudinal Construction Drawing,
6. Shell Expansion Drawing,
7. Capacity Plan calculations.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Produce** general arrangement (GA), Lines Plan, Mid-ship section drawing, longitudinal construction & shell expansion drawings with the aid of CAD Software.			√									
CO2	**Interpret** & **use** rule books for structural design calculations.		√										
CO3	**Prepare** capacity plan of a ship.			√									
CO4	**Use** modern CAD programs for ship design drawings					√							

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Produce** general arrangement (GA), lines plan, mid-ship section drawing, longitudinal construction & shell expansion drawings with the aid of CAD Software.	C3	2	5	3,4	R,Q,T, Pr
CO2	**Interpret** & **use** rule books for structural design calculations.	C2, C3	1		2-4	R,Q
CO3	**Prepare** capacity plan of a ship.	C4	1		5	R,Q,Pr
CO4	**Use** modern CAD programs for ship design drawings	C3			6	PR, T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO3	Students will learn various aspects and approaches of ship design drawings such as general arrangement (GA), lines plan, mid-ship section drawing, longitudinal construction & shell expansion to achieve solutions to real life problems related to ship design in a systematic way.
CO2-PO2	Students will gain knowledge on interpreting and using the rule books to carry out the scantling calculation for structural design of ship.
CO3-PO3	Ability to prepare a capacity plan of ship improves student's judgment towards optimal solution from the alternate solutions
CO4-PO5	The students have to use various modern CAD software that is use of modern engineering tool to draw various ship design drawings in the course.

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

COURSE SCHEDULE

Week	**Topics**
Week 1	Introduction to CAD, drawing unit and scale, 2-D drawing tools, modification tools Layers, hatching and dimensioning
Week 2	Working in 3-D space, 3-D coordinate systems, drawing sheet layout, viewpoints, 3-D drawing tools, 3-D wire frame modelling, Surface modelling, Solid modelling and rendering
Week 3	Introduction to GA, Drawing of General Arrangement Plan in CAD software
Week 4	Presentation and Review of General Arrangement Plan
Week 5	Introduction to Lines Plan, Drawing of Lines Plan in CAD software
Week 6	Presentation and Review of Lines Plan drawing
Week 7	Preliminary structural design calculation of ships using Rule Book
Week 8	**Mid Term Assessment**
Week 9	Mid-ship Section Drawing
Week 10	Longitudinal Construction Drawing
Week 11	Shell Expansion Drawing
Week 12	Capacity Plan calculations
Week 13	**Review Class**
Week 14	**Final Quiz and Viva**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Bloom's Taxonomy**
Continuous Assessment	Lab participation and Report	25%	CO 1	C3
			CO 2	C2, C3
			CO 3	C4
	Labtest-1,Labtest-2	10%	CO 1	C3

			CO 4	C3
	Project and Presentation	35%	CO1, CO2, CO3, CO4	C2,C3, C4
Lab Quiz		30%	CO 1	C3
			CO 2	C2, C3
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Ships & Naval Architecture, R. Munro-Smith, 1973, Institute of Marine Engineers.
2. Basic Ship Theory, K.J. Rawson & E. C. Tupper, Vol. 1 & 2., Longman Group Limited.
3. Rule Book: Lloyd's Register, DNV-GL, NKK

COURSE INFORMATION

Course Code: NAME 213 **Credit Hours:** 3.0
Course Title: Fluid Mechanics **Contact Hours:** 3.0
Level and Term: Level 2 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This is a compulsory theoretical course to promote the knowledge of the students about basic laws, principles and phenomena in the area of fluid flow related engineering problems. The course has also been designed to familiarize the students in the working principles of the design of Hydraulic Machineries used onboard ships.

OBJECTIVES

1. To enable achieving ability to apply the basic applied mathematical tools that support fluid dynamics.
2. To impart knowledge to identify & explain the physical properties of a fluid, its influence on fluid flow & fundamental kinematics of a fluid element
3. To make proficient to explain & formulate the conservation principle of mass, linear momentum and energy for fluid flow. & interpret the working principles of different hydraulic machineries used on board ship.
4. To enable to design & create models of the prototype to investigate different parameter during fluid flow over the profiles and shapes

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Demonstrate** the understanding in applying the basic applied mathematical tools that support fluid dynamics.
2. **Explain** the knowledge to identify the physical properties of a fluid, its influence on fluid flow & fundamental kinematics of a fluid element
3. **Construct** the formulations of the conservation principle of mass, linear momentum and energy for fluid flow and interpret the working principles of different hydraulic machineries used on board ship
4. **Design & create** models of the prototype to investigate different parameter during fluid flow over the profiles and shapes

COURSE CONTENTS

1. **Fluid properties:** Classification of Fluid Flows, Density and Specific Gravity, Energy and specific heats, Compressibility and Bulk Modulus, Viscosity, Surface Tension and Capillary Effect.
2. **Fluid statics and kinematics:** Pressure head, Pascal's law, Instruments to measure fluid pressure, Total pressure on horizontally, vertically and inclined immersed surfaces, Pressure on

a curved surface, Centre of pressure on an inclined immersed surface, Lagrangian and Eulerian descriptions of fluid kinematics, Streamlines and Streamtubes, Pathlines, Streaklines, Timelines, Refractive and surface flow visualization techniques, Plots of fluid flow data, Types of motion or deformation of fluid elements, The Reynolds Transport Theorem, Bernoulli's equation, Euler's equation of motion, Limitations of Bernoulli's equations, Practical Applications of Bernoulli's equation, Venturimeter, Discharge through a Venturimeter, Orifice Meter, Pitot Tube, Discharge over a Rectangular Notch, Discharge over a Triangular Notch.

3. **Continuity, energy and momentum principle:** Conservation of Mass, Mass and Volume flow rates, Moving or deforming control volumes, Incompressible flow, General Equation of Energy, Newton's Laws and Conservation of Momentum, The linear Momentum equation.
4. **Friction and flow through pipes, impact of jets:** Loss of head in pipes, Darcy's and Chezy's Formula for loss of head in pipes, Graphical representation of Pressure head and velocity head, Hydraulic Gradient line, Total Energy Line, Transmission of power through pipes, Time of emptying a tank through a long pipe, Force of Jet Impinging Normally on fixed, hinged, inclined and moving plate, Force of jet impinging on a fixed and moving curved vane.
5. **Laminar and turbulent flows:** Introduction to boundary layers, drags, and wakes, Drag and Lift, Friction and Pressure Drag, Drag coefficients of common geometries, Parallel flow over flat plates, Flow over cylinders and Spheres, Lift.
6. **Dimensional analysis, principles of similitude and model testing:** Fundamental Dimensions, Dimensional Homogeneity, Uses of the principle of Dimensional Homogeneity, Methods of Dimensional Analysis, Rayleigh's Method, Buckingham's Pi-theorem, Selection of Repeating Variables, Advantages of Model Analysis, Hydraulic Similarity, Procedures for model analysis, Comparative studies between prototype and undistorted model.
7. **Aerofoil and its application:** Theory of wings, Cavitation.
8. **Hydraulic machines:** Reciprocating and Centrifugal pumps, pump efficiency.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Demonstrate** the understanding in applying the basic applied mathematical tools that support fluid dynamics.	√											
CO2	**Explain** the knowledge to identify the physical properties of a fluid, its influence on fluid flow & fundamental kinematics of a fluid element		√										
CO3	**Construct** the formulations of the conservation principle of mass, linear momentum and energy for fluid flow and interpret the working principles of different hydraulic machineries used on board ship		√										
CO4	**Design & create** models of the prototype to investigate different parameter during fluid flow over the profiles and shapes			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Demonstrate** the understanding in applying the basic applied mathematical tools that support fluid dynamics.	C3	1		1-4	CT, F
CO2	**Explain** the knowledge to identify the physical properties of a fluid, its influence on fluid flow & fundamental kinematics of a fluid element	C2	1		1-4	CT, MT, F
CO3	**Construct** the formulations of the conservation principle of mass, linear momentum and energy for fluid flow and interpret the working principles of different hydraulic machineries used on board ship	C3	3		5	CT/ASG, F
CO4	**Design & create** models of the prototype to investigate different parameter during fluid flow over the profiles and shapes	C6	1		5-6	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to understand physical properties of a fluid flow & calculate different parameters of fluid dynamics.
CO2-PO2	In order to identify & analyze the fluid flow characteristics & its influence on the fundamental kinematics of a fluid element.
CO3-PO2	To analyze conservation principle of mass, momentum and energy for fluid flow & interpret the working principles of different hydraulic machineries used onboard ship
CO4-PO3	The capability to design and create models of prototypes has to be achieved to investigate different parameter during fluid flow over the profiles and shapes.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	

Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Fluid properties**	CT-1, Final Exam
Class 1	Introduction	
Class 2	Classification of Fluid Flows, Density and Specific Gravity, Energy and specific heats, Compressibility and Bulk Modulus,	
Class 3	Viscosity, surface Tension and Capillary Effect.	
Week 2	**Fluid statics and kinematics**	
Class 4	Pressure head, Pascal’s law, Instruments to measure fluid pressure	
Class 5	Total pressure on horizontally, vertically and inclined immersed surfaces	
Class 6	Pressure on a curved surface, Centre of pressure on an inclined immersed surface	
Week 3	**Fluid statics and kinematics**	
Class 7	Lagrangian and Eulerian descriptions of fluid kinematics, Streamlines and Streamtubes, Pathlines, Streaklines, Timelines,	
Class 8	Refractive and surface flow visualization techniques, Plots of fluid flow data	
Class 9	Types of motion or deformation of fluid elements,	
Week 4	**Fluid statics and kinematics**	CT-2, Mid Term, Final Exam
Class 10	The Reynolds Transport Theorem	
Class 11	Bernoulli’s equation	
Class 12	Assessment 01	
Week 5	**Fluid statics and kinematics**	
Class 13	Euler’s equation of motion	
Class 14	Limitations of Bernoulli’s equations, Practical Applications of Bernoulli’s equation	
Class 15	Venturimeter, Discharge through a Venturimeter	
Week 6	**Fluid statics and kinematics**	
Class 16	Orifice Meter, Pitot Tube	
Class 17	Discharge over a Rectangular Notch, Discharge over a Triangular Notch	
Class 18	Conservation of Mass, Mass and Volume flow rates	
Week 7	**Continuity, energy and momentum principle**	
Class 19	Moving or deforming control volumes, Incompressible flow, General Equation of Energy	
Class 20	Newton’s Laws and Conservation of Momentum, The linear Momentum equation.	
Class 21	Loss of head in pipes, Darcy’s and Chezy’s Formula for loss of head in	

	pipes	Mid Term Exam, Final Exam
Week 8	**Friction and flow through pipes, impact of jets**	
Class 22	Graphical representation of Pressure head and velocity head, Hydraulic Gradient line, Total Energy Line	
Class 23	Transmission of power through pipes, Time of emptying a tank through a long pipe	
Class 24	Assessment 02	
Week 9	**Friction and flow through pipes, impact of jets**	
Class 25	Force of Jet Impinging Normally on fixed, hinged, inclined and moving plate,	
Class 26	Force of jet impinging on a fixed and moving curved vane.	
Class 27	Revision Class	
Week 10	**Laminar and turbulent flows**	
Class 28	Introduction to boundary layers, drags, and wakes	
Class 29	Drag and Lift, Friction and Pressure Drag, Drag coefficients of common geometries	
Class 30	Parallel flow over flat plates, Flow over cylinders and Spheres, Lift	
Week 11	**Dimensional analysis, principles of similitude and model testing**	CT-3/ Assignment, Final Exam
Class 31	Fundamental Dimensions, Dimensional Homogeneity	
Class 32	Uses of the principle of Dimensional Homogeneity, Methods of Dimensional Analysis	
Class 33	Rayleigh's Method, Buckingham's Pi-theorem, Selection of Repeating Variables	
Week 12	**Dimensional analysis, principles of similitude and model testing**	
Class 34	Advantages of Model Analysis	
Class 35	Hydraulic Similarity, Procedures for model analysis	
Class 36	Comparative studies between prototype and undistorted model	
Week13	**Hydraulic machines**	
Class 37	Centrifugal pumps.	
Class 38	Reciprocating Pumps	
Class 39	Pump efficiency	
Week 14	**Aerofoil and its application**	
Class 40	Theory of wings, Cavitation	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2

		CO2	C1, C2,C4
		CO3	C4
		CO4	C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines, R.S. Khurmi, 19th Edition, S. Chand & Company Ltd., 2004.
2. Fluid Mechanics: Fundamentals and Applications, Y.A. Cengel and J.M. Cimbala, 1st edition, McGraw Hill Publishers Ltd., 2006.
3. A Textbook of Fluid Mechanics and Hydraulic Machines, R.K. Bansal, 2005.
4. Theory and Applications of Ocean Surface Waves, C.C. Mei; M. Stiassnie; D.K.P. Yue, 2005, World Scientific Publishing Co. Pvt. Ltd

COURSE INFORMATION

Course Code: NAME 214 **Credit Hours:** 1.50
Course Title: Fluid Mechanics Lab **Contact Hours:** 3.00
Level and Term: Level 2 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This sessional course introduces the principles of fluid mechanics of mechanical systems. Students will be exposed to the experimental methods in the fluid flow systems like flow measurement in closed/open conduits including friction loss, pump performance, center of pressure and buoyancy. By the end of this course students should be able to understand the basic principles and analysis of both static and dynamic fluid systems

OBJECTIVES

1. To familiarize the students with different types of pumps.
2. To impart training to use various flow measuring devices for making engineering judgments.
3. To provide practice in estimating friction losses in fluid flow.
4. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the basic operating principle of a reciprocating and centrifugal pump.
2. **Verify** the Bernoulli's Theorem and **apply** it in flow measuring devices.
3. **Analyze** the head loss due to friction occurring in fluid flow.
4. **Apply** the knowledge of hydrostatic loading to calculate centre of pressure and buoyancy.
5. **Develop** collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.

COURSE CONTENT

1. Performance Test of a reciprocating pump
2. Performance test of Centrifugal Pump Connected in Series and Parallel Connections
3. Study of Propeller Turbine Characteristics
4. Verification of Bernoulli's Equation
5. a) Study of Flow through Orifice
   b) Study of Flow through Venturi Meter
6. a) Calibration of Rectangular Notch
7. b) Calibration of Triangular Notch (V)
8. Determination of the location of the center of pressure for a submerged plane surface
9. Determination of Centre of gravity, Metacenter and Buoyancy of a floating vessel.

10. Determination of Head Loss Due to Pipe Friction.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the basic operating principle of a reciprocating and centrifugal pump.		√										
CO2	**Verify** the Bernoulli's Theorem and **apply** it in flow measuring devices.					√							
CO3	**Analyze** the head loss due to friction occurring in fluid flow.		√										
CO4	**Apply** the knowledge of hydrostatic loading to calculate centre of pressure and buoyancy.		√										
CO5	**Develop** collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.									√			

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the basic operating principle of a reciprocating and centrifugal pump.	C2			1,2	R,Q,T
CO2	**Verify** the Bernoulli's Theorem and **apply** it in flow measuring devices.	C3	1	1	6	R,Q,T
CO3	**Analyze** the head loss due to friction occurring in fluid flow.	C4	2	1	1-4	R,Q,T
CO4	**Apply** the knowledge of hydrostatic loading to calculate centre of pressure and buoyancy.	C3			1-4	R,Q,T
CO5	**Develop** collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	A1, A2, A3, A4		1	7	Pr, PR
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications

CO1-PO2	Students will gain the basic experimental knowledge to explain the basic operating principle of a reciprocating and centrifugal pump.
CO2-PO5	Students will carry out experiment on verification the Bernoulli's Theorem and will be able to apply it to do experiment with modern flow measuring devices like venturimeter, orifice meter and different types of notch. And also they should be able to interpret and analyze the given flow problem and select the required instrument used for flow measurement.
CO3-PO2	If a data regarding the details of the flow of a real fluid is given then the students should be able to interpret the data and applying the correct formula they should be able to calculate the energy loss
CO4-PO2	Student will apply the knowledge of hydrostatic loading to calculate centre of pressure and buoyancy to solve engineering problems related to floating bodies.
CO5-PO9	Students will discuss technical problems and assist each other are required while working in a team as a team member or a leader to carry out each experiment ,hence develop their function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week	**Topics**
Week 1	Introduction to Fluid Mechanics Sessional
Week 2	Performance Test of a reciprocating pump
Week 3	Performance test of Centrifugal Pump Connected in Series and Parallel Connections
Week 4	Study of Propeller Turbine Characteristics
Week 5	Verification of Bernoulli's Equation

Week 6	**Mid Term Assessment**
Week 7	a. Study of Flow through Orifice b. Study of Flow through Venturi-Meter
Week 8	a. Calibration of Rectangular Notch b. Calibration of Triangular Notch (V)
Week 9	Determination of the location of the center of pressure for a submerged plane surface
Week 10	Determination of Centre of gravity, Metacenter and Buoyancy of a floating vessel
Week 11	Determination of Head Loss Due to Pipe Friction
Week 12	Review of all experiments
Week 13	**Final Quiz**
Week 14	**Final Viva**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	C2
			CO2	C3
			C03	C4
			CO4	C3
	Labtest-1,Labtest-2	30%	CO1-CO4	C2,C3,C4
	Project and Presentation	25%	CO5	A1, A2, A3, A4
Lab Quiz		25%	CO1	C2
			CO2	C3
			C03	C4
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fluid Mechanics: Fundamentals and Applications, Y.A. Cengel and J.M. Cimbala,
2. Introduction to Fluid Mechanics, Fox, R.W. and Mc Donald, A.T.
3. Mechanics of Fluids - Irving H. Shames
4. Fluid Mechanics - Frank M. White
5. Fluid Mechanics - E. John Finnemore& Joseph B. Franzini

COURSE INFORMATION
Course Code: NAME 253 **Credit Hours:** 3.0
Course Title: Marine Hydrodynamics **Contact Hours:** 3.0
Level and Term: Level 2 Term 2

PRE-REQUISITE
Course Code: NAME 213
Course Title: Fluid Mechanics

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
This course is intended to give students the skills to analyse the flow of fluid around shapes commonly in the design of marine vehicles, such as the vessel's hull, hydrofoils, propeller blades, etc. It is a compulsory theoretical course designed on the basis to understand the characteristics of fluid flow and its implication in the design of Marine Vehicles.

OBJECTIVES
1. To give brief idea about the flow around bluff and streamlined bodies and discuss the benefits of streamline,
2. To enable achieving ability to calculate the pressure distribution and wake field around a submerged body like ship.
3. To impart knowledge assessing the forces applied by the flow to submerged bodies in fluid by applying the knowledge of fluid flow principles, including conservation of mass, momentum and energy, Bernoulli's principle, the stream and potential functions, and sources and sinks.
4. To enable estimating the wave-induced loads on geometric shapes of floating structures and be able to apply the knowledge in Ship design.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **Describe** the hydrodynamic flow pattern around ship & calculate flow velocity at different point on the flow.
2. **Compute** the pressure distribution and wake field around a submerged body like ship.
3. **Assess** the forces applied by the flow to submerged bodies in fluid by applying the knowledge of fluid flow principles,
4. **Estimate** the wave-induced loads on geometric shapes of floating structures and be able to apply the knowledge in Ship design.

COURSE CONTENTS

1. **Flow of an ideal fluid:** Equation of continuity, streamlines, streak lines and path lines, two-dimensional flow patterns, rotational and irrotational flows, vorticity, velocity potential functions, stream functions, Euler's equation of motion, Bernoulli's equation, velocity and pressure distribution.

2. **Standard Patterns of Flow:** Uniform flow, irrotational vortex, circulation, source, sink and doublet, flow past a half body, cylinder and rankine body, virtual mass and Magnus effect.
3. **Conformal transformation:** Analytic functions, singularities, Cauchy-Riemann equations, complex potential, application of conformal transformation to some flow cases, joukowski's hypothesis, lift of an infinite aerofoil. Theorems of Green, Stokes, Cauchy and Blasius and their application to some hydrodynamic problems.
4. **Flow of a real fluid:** Navier-Stokes equations, displacement, momentum and energy, thickness of the boundary layer, Plane progressive waves, Wave energy, Two and three dimensional ship waves, the method of stationary phase, Energy radiation and wave resistance, Body response in regular waves, Wave exciting force and moment and characteristics of flow around a ship hull.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the hydrodynamic flow pattern around ship & calculate flow velocity at different point on the flow.	√											
CO2	**Compute** the pressure distribution and wake field around a submerged body like ship.		√										
CO3	**Assess** the forces applied by the flow to submerged bodies in fluid by applying the knowledge of fluid flow principles,			√									
CO4	**Estimate** the wave-induced loads on geometric shapes of floating structures and be able to apply the knowledge in Ship design.				√								

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the hydrodynamic flow pattern around ship & calculate low velocity at different point on the flow.	C1	1		1-4	CT, F
CO2	**Compute** the pressure distribution and wake field around a submerged body like ship.	C3	1		5	CT, MT, F
CO3	**Assess** the forces applied by the flow to submerged bodies in fluid by applying the knowledge of fluid flow principles,	C3	3		5	CT/ASG, F
CO4	**Estimate** the wave-induced loads on geometric shapes of floating structures and be able to apply the knowledge in Ship design.	C2	1		1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to find out flow pattern, hydrodynamic characteristics & calculate different properties of fluid flow.
CO2-PO2	In order to identify the role and extent of hydrodynamic parameters to calculate the pressure distribution and wake field around a ship.
CO3-PO3	To analyze & formulate hydrodynamic forces applied by the fluid flow around submerge/floating bodies.
CO4-PO4	To estimate the wave-induced loads on geometric shapes of floating structures and be confident to analyze & interpret data for Ship structure design.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Flow of an ideal fluid**	CT-1, Final Exam
Class 1	Introduction	
Class 2	Ideal fluid, fluid properties, types of fluid flow	
Class 3	Pressure at a point,	
Week 2	**Flow of an ideal fluid**	
Class 4	Equation of continuity,	
Class 5	Streamlines, streak lines and path lines,	
Class 6	Two-dimensional flow patterns,	
Week 3	**Flow of an ideal fluid**	
Class 7	Rotational and irrotational flows, vorticity	
Class 8	Stream functions	

Class 9	Properties of stream functions	
Week 4	**Flow of an ideal fluid**	CT-2, Mid Term, Final Exam
Class 10	Velocity potential functions, flow nets	
Class 11	Euler’s equation of motion	
Class 12	Bernoulli’s equation, Velocity and pressure distribution.	
Week 5	**Standard Patterns of Flow**	
Class 13	Uniform flow, irrotational vortex, circulation,	
Class 14	Source, sink and doublet,	
Class 15	Flow past a half body	
Week 6	**Standard Patterns of Flow**	
Class 16	Flow past a cylinder and rankine body	
Class 17	Virtual mass	
Class 18	Magnus effect	
Week 7	**Conformal transformation**	Mid Term Exam, Final Exam
Class 19	Assessment 01	
Class 20	Analytic functions, singularities	
Class 21	Cauchy-Riemann equations	
Week 8	**Conformal transformation**	
Class 22	Complex potential, ,	
Class 23	Application of conformal transformation to some flow cases	
Class 24	Joukowski’s hypothesis	
Week 9	**Conformal transformation**	
Class 25	Lift of an infinite aerofoil	
Class 26	Theorem of Green,	
Class 27	Theorem of Stokes	
Week 10	**Conformal transformation**	
Class 28	Theorems of Cauchy and Blasius	
Class 29	Application of the theorems to some hydrodynamic problems	
Class 30	Mid term exam	
Week 11	**Flow of a real fluid**	CT-3/ Assignment, Final Exam
Class 31	Navier-Stokes equations	
Class 32	Displacement, momentum and energy thickness of the boundary layer	
Class 33	Assessment 02	
Week 12	**Flow of a real fluid**	
Class 34	Plane progressive waves,	
Class 35	Wave energy,	
Class 36	Two and three dimensional ship waves	
Week13	**Flow of a real fluid**	
Class 37	Method of stationary phase, Energy radiation and wave resistance	
Class 38	Body response in regular waves,	
Class 39	Wave exciting force and moment	
Week 14	**Flow of a real fluid**	
Class 40	Characteristics of flow around a ship hull.	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Applied Hydrodynamics, H.R. Valentine, Newnes-Butterworth; Student international edition, 1969.
2. Newman, John N. (1977), Marine Hydrodynamics, The MIT Press, 432 pp., ISBN: 978-0262140263
3. Theoretical Hydrodynamics, Milne-Thomson, 4th edition, 1962.
4. Fluid Mechanics: Fundamentals and Applications, Y.A. Cengel and J.M. Cimbala, 1st edition, McGraw Hill Publishers Ltd., 2006.

COURSE INFORMATION

Course Code: NAME 254
Course Title: Marine Hydrodynamics Lab
Level and Term: Level 2 Term 2

Credit Hours: 1.50
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Marine Hydrodynamics Sessional course is designed to teach students about the hydrodynamic application is ship and machinery design retrospect, namely types of floating structures, marine machinery parts etc. Students will be able to perform necessary calculations related to the basic design, assess performance calculations once the course is completed.

OBJECTIVES

1. To enable students to be familiarized with different flow patterns in application.
2. To familiarize the students with applied and calculative concept of hydrodynamics
3. To enable students to compute different parameters of ships, floating bodies using hydrodynamics concept.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** about different hydrodynamic features of various types of fluid flows.
2. **Identify** different kinds of fluid flow patterns.
3. **Demonstrate** and **Manipulate** the flow past different shapes and structure for observing laminar and turbulent flows.
4. **Develop** collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.

COURSE CONTENTS

1. Determination of the exact section of the Pitot tube
2. Determination of the flow speed profiles in a pitot tube
3. Determination of measure error using the pitot tube
4. Determination of ship stability
5. Demonstration of Cavitation Phenomenon
6. Determination of Impact against a flat, curve and semispherical surface
7. Study of forced vortex without discharge orifice
8. Observation of laminar, transition and turbulent flow and Classification of the different types of flow depending on Reynolds number
9. Ideal flow around a submersed profile
10. Demonstration the phenomenon associated to the flow in an open channel

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Explain** about different hydrodynamic features of various types of fluid flows	√											
CO2	**Identify** different kinds of fluid flow patterns		√										
CO3	**Demonstrate** and **Manipulate** the flow past different shapes and structure for observing laminar and turbulent flows.					√							
CO4	**Develop** collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.									√			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** about the different hydrodynamic features	C2	1	1	1-4	R,Q,T
CO2	**Identify** different kinds of flow patterns	C1	1	2	1-4	R,Q,T
CO3	**Demonstrate** and **Manipulate** the flow past different shapes and structure for better results;	C3	1	2	6	R,Q,T
CO4	**Develop** collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	A1, A2, A3, A4		1	7	Pr, PR
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	In order to develop problem solving skill.
CO2-PO2	To learn modern tools to solve hydrodynamics problems.
CO3-PO3	In order to assess the analyzing and deconstructing capability of a student to solve a problem related to fluid flow. .
CO4-PO9	Students will discuss technical problems and assist each other are required while working in a team as a team member or a leader to carry out each experiment ,hence develop their function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by Experiment demonstration, experiment conduct by students in group, co-operative and collaborative method, project based method.

COURSE SCHEDULE

Week 1	Course introduction, Introduction to Machineries and equipment.
Week 2	Determination of the exact section of the Pitot tube
Week 3	Determination of the flow speed profiles in a pitot tube
Week 4	Measure error determination using the pitot tube
Week 5	Determination of ship stability
Week 6	Cavitation Phenomenon Demonstration
Week 7	Mid Viva/Mid Quiz
Week 8	Determination of Impact against a flat, curve and semispherical surface
Week 9	Study of forced vortex without discharge orifice
Week 10	Observation of laminar, transition and turbulent flow Classification of the different types of flow depending on Reynolds number
Week 11	Ideal flow around a submerged flow
Week 12	To demonstrate the phenomenon associated to the flow in an open channel
Week 13	Final Viva
Week 14	Quiz

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	15%	CO 1	C2
			CO 2	C1
			CO 3	C3

<table>
<tr><td rowspan="3"></td><td rowspan="3">Mid-quiz
or
Mid Viva</td><td rowspan="3">25%</td><td>CO 1</td><td>C2</td></tr>
<tr><td>CO 2</td><td>C1</td></tr>
<tr><td>CO 3</td><td>C3</td></tr>
<tr><td colspan="2" rowspan="2">Final Viva</td><td rowspan="2">25%</td><td>CO 1</td><td>C2</td></tr>
<tr><td rowspan="2">CO 2</td><td rowspan="2">C1</td></tr>
<tr><td colspan="2" rowspan="2">Final Quiz</td><td rowspan="2">35%</td></tr>
<tr><td>CO 3</td><td>C2</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Applied Hydrodynamics, H.R. Valentine, Newnes-Butterworth; Student international edition, 1969.
2. Marine Hydrodynamics, Newman, John N. (1977), , The MIT Press, 432 pp., ISBN: 978-0262140263
3. Theoretical Hydrodynamics, Milne-Thomson, 4th edition, 1962.
4. Fluid Mechanics: Fundamentals and Applications, Y.A. Cengel and J.M. Cimbala, 1st edition, McGraw Hill Publishers Ltd., 2006.

COURSE INFORMATION

Course Code: NAME 258 **Credit Hours:** 1.50

Course Title: Stability and Machinery Layout Design **Contact Hours:** 3.00

Level and Term: Level 2 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is the third stage of Ship Design and Drawing which is a compulsory sessional course for future naval architects. Students will learn design and drawings of the principle propulsion and steering machineries of a ship which includes rudder, steering, shafting, propeller and main engine foundation. By understanding the complex propulsion system of a ship from this course, it is expected that students will be able to design a complete propulsion system along with proper drawings.

OBJECTIVES

1. To impart the knowledge to carry out the calculation of stability of a ship.
2. To familiarize the students with the arrangement and functions of propulsion and steering system of ships.
3. To design of rudder along with its stock and selection of an appropriate steering gear.
4. To enable selection of proper scantlings by exact calculations to design the engine room foundation.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Prepare** and **explain** the stability booklet of a ship.
2. **Demonstrat**e methodological knowledge and understanding in ship’s rudder, steering and shafting system design.
3. **Design** ship steering and shafting system.
4. **Develop** critically, independently and creatively design of propulsion system of a ship.

COURSE CONTENTS

1. Detail ship stability calculation and stability booklet preparation.
2. Design of a marine rudder
3. Design of ship steering gear system
4. Design of shafting arrangement system and propeller shaft
5. Calculation and drawing of ship engine foundation

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (CO)	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Prepare** and **explain** the stability booklet of a ship		√										
CO2	**Demonstrat**e methodological knowledge and understanding in ship's rudder, steering and shafting system design		√										
CO3	**Design** ship steering and shafting system			√									
CO4	**Develop** critically, independently and creatively design of propulsion system of a ship			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (CO)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Prepare** and **explain** the stability booklet of a ship	C2-C4	1	-	1	R,Q
CO2	**Demonstrat**e methodological knowledge and understanding in ship's rudder, steering and shafting system design	C3	2	-	4	R,Q
CO3	**Design** ship steering and shafting system	C3, C4	3	-	1-5	R,Q
CO4	**Develop** critically, independently and creatively design of propulsion system of a ship	C4,C5	3	-	1-6	R,Q
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	Students will be able to carry out the detailed ship stability calculation using various tools and criteria. Using the result, they will be able to prepare the stability booklet of a ship.
CO2-PO2	By understanding the complex propulsion system of a ship from this course, students will be able to apply knowledge of complete propulsion system in designing a ship
CO3-PO3	Students will be able to explain the steering system and machinery arrangement. With the calculation, they will be able to design steering and shafting system for a ship.
CO4-PO3	In order to develop critically, independently and creatively design of propulsion system of a ship.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Demonstration	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Quiz	 35 10
Preparation of Presentation Engagement in Group Projects Formal Assessment	33
Total	**120**

TEACHING METHODOLOGY

Lecture followed by demonstration of engineering drawings and design, discussion and assignment submission.

COURSE SCHEDULE

Week	Name of the Experiment
Week-1	Course introduction, Overall discussion of ship stability , ship steering system, shafting system, propeller and main engine foundation.
Week-2	Ship Stability Calculation
Week-3	Ship Stability Calculation
Week-4	Ship Stability Calculation
Week-5	Introduction to rudder system, Calculation for rudder system(part 1)
Week-6	Calculation for rudder system(part 2)
Week-7	Mid Viva
Week-8	Introduction to steering system, Calculation for steering system(part 1)
Week-9	Calculation for steering system(part 2)
Week-10	Introduction to shafting system, Calculation for shafting system
Week-11	Calculation for engine foundation(part 1)
Week-12	Calculation for steering system(part 2)
Week 13	Final Viva

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation	20%	CO 1	C1, C3,A1
			CO 2	C4, C5, A1
			CO 3	C3, C4
			CO 4	C3
	Lab Report	40%	CO 1	C1, C3,C4
			CO 2	C4, C5, P1
			CO 3	C3, C4
			CO 4	C3
	Viva	15%	CO 1, CO 2, CO 3	A1, A2, A3, A4

<table>
<tr><td rowspan="4">Lab Quiz</td><td rowspan="4">25%</td><td>CO 1</td><td>CO 2</td></tr>
<tr><td>CO 2</td><td>CO 3</td></tr>
<tr><td>CO 3</td><td>C3, P6, P7</td></tr>
<tr><td>CO 4</td><td>C3</td></tr>
<tr><td>Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. The Principles of Naval Architecture, Vol 1, Stability and Strength, Published by SNAME
2. Ship Hydrostatics and Stability, Adrian Biran
3. Reed’s Naval Architecture for Marine Engineers, E.A. Stokoe, 2003, Thomas Reed Publications.
4. Ship Stability for Masters and Mates, D. R Derrett.
5. Ship Design: Methodologies of Preliminary Design by Apostolos Papanikolaou
6. Practical Design of Hull Structures by Masaki Mano
7. Design Principles of Ships and Marine Structures by Suresh Chandra Misra

COURSE INFORMATION

Course Code: NAME 300 **Credit Hours:** 3.0 (1.5 Cr. Hr. in Each Term)
Course Title: Ship design Project **Contact Hours:** 6.0
Level and Term: Level 3 Term 1/2

PRE-REQUISITE

Course Code: NAME 158, NAME 208, NAME 258
Course Title: Basic Ship Design, Computer Aided Ship Design, Stability and Machinery Layout Design

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Compulsory Sessional course which is intended to assist the reality of accepting a design brief from a client/owner, researching the requirements, coming up with the design of a vessel which will meet those requirements, and preparing the documentation (drawings, calculations and specification of outfit items) to describe the vessel so that it may be built. These courses also provide a solid grounding in the overall ship design process.

OBJECTIVES

1. To enable students to design a general arrangement plan and lines plan as required of the design brief.
2. To enable students to compute hydrostatic properties of ship and able to draw hydrostatic curves.
3. To enable students to calculate scantlings and make midship section and longitudinal drawings.
4. To enable students to make decision of selecting engine andpropeller.
5. To enable students to make decision of designing a complete vessel.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Produce** a suitable hull form by using maxsurf and translate to a lines plan and a general arrangement drawing in Autocad.
2. **Evaluate** the stability of the vessel and selecting engine and propeller.
3. **Perform** scantlings calculation and mid ship section drawing of a vessel.
4. **Describe** new thinking and innovation processes of ship design.

COURSE CONTENTS

1. Design of a particular ship: principal particulars,
2. General Arrangement (GA),
3. Lines plan with offset table, Lightship,
4. Preliminary deadweight and displacement calculation,
5. Freeboard Calculation,
6. Scantling, Mid-ship section drawing,
7. Longitudinal Drawing: Profile Deck & Bottom,

8. Shell Expansion Drawings,
9. Detailed LWT & DWT calculation,
10. Resistance & Power Calculation, machinery, endurance, outfit,
11. Approximate trim and cross curves, Stability for different loading conditions, Wind heel criteria for different loading conditions,
12. Engine selection, Engine Foundation,
13. Rudder design & Steering Arrangement,
14. Shafting & Propeller Design.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (CO)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Produce** a suitable hull form by using maxsurf and translate to a lines plan and a general arrangement drawing in autocad.									√			
CO2	**Evaluate** the stability of the vesseland selecting engine and propeller.										√		
CO3	**Perform** scantlings calculation and mid ship section drawing of a vessel.	√											
CO4	**Describe** a new thinking and innovation processes of ship design.												√

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (CO)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Produce** a suitable hull form by using maxsurf and translate to a lines plan and a general arrangement drawing in AutoCAD.	C3				R,Pr,Q
CO2	**Evaluate** the stability of the vessel and selecting engine and propeller.	C3				R,Pr,Q
CO3	**Perform** scantlings calculation and mid ship section drawing of a vessel.	A2	1		1-4	R,Pr,Q
CO4	**Describe a** new thinking and innovation processes of ship design.	C3	1			R,Pr,Q
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO9	It is required teamwork as well as individual work in order to develop a suitable hull, lines pan and general arrangement.
CO2-PO10	It is required to make a effective presentation and clear instructions to evaluate the stability of the vessel and to select engine and propeller of ship.
CO3-PO1	The knowledge of science has to be applied to perform scantlings calculation and mid ship section drawing of a vessel.

CO4-PO1	In order to develop a concept of innovation processes of ship design.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	28
Preparation of Lab-test	7
Preparation of Quiz	7
Preparation of Presentation	7
Engagement in Group Projects	28
Formal Assessment	1
Total (Each Term)	**120**

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method.

COUSRE SCHEDULE

Term-I

Lecture-1	Course administration, instructors, contents, mark distribution, ethics, tools etc.
	Project inputs and allotment of projects to the students
	Preliminary lightship, deadweight and displacement calculation and determination of preliminary principal particulars (L, B, D, T, etc.) (Using empirical formulae).
Lecture-2	Issues with principal particulars
	Preliminary GA plan; space allocation for cargo and consumables.
	Floodable length calculation, watertight subdivision, Preliminary freeboard calculations.
	Arrangement of propulsion machinery, deck machinery etc., Equipment number calculation, accommodation arrangement.
Lecture-3	Preliminary GA arrangement (sketch in paper) for review
	Issues with General Arrangement
Lecture-4	Submission of Preliminary GA arrangement.
	3D surface model generation (in Rhino/ Maxsurf), preliminary displacement and draft check,
	Compartmentation, cargo and consumables capacity check.
Lecture-5	Issues with 3D model in Rhino and Maxsurf.
Lecture-6	Preliminary hydrostatic report, lines and offset table generation from 3D model.
FIRST PRESENTATION	

Lecture-8	Determination of ship scantling using class rule book Midship section drawing
Lecture-9	Review and problem solving on ship scantling using class rule book Midship section drawing
Lecture-11	Guidance on shell expansion, profile and deck plan and other ship drawings
Lecture-12	Review of shell expansion, profile and deck plan and other ship drawings.
Lecture-13	Detail lightship calculation (using scantling drawings + GA in Excel) + Guidance in stability load cases
Lecture-14	Review and advise on the preliminary trim and stability calculation
SECOND PRESENTATION	

Term-II

Lecture-1	Resistance & power calculation, main engine selection
Lecture-2	Propeller design, gear box selection and shafting design.
Lecture-3	Rudder design & steering arrangement
Lecture-4	Propulsion arrangement (ME, GB, shafting, propeller and rudder) + ME foundation.
Lecture-5	Final weight estimation (hull + mach) including weight margin.
Lecture-6	GA, lines and offset table, hydrostatic, trim & stability updates.
THIRD PRESENTATION	
Lecture-8	Propulsion arrangement (ME, GB, shafting, propeller and rudder)
Lecture-9	Final weight estimation (hull + mach) including weight margin.
Lecture-10	GA, lines and offset table updates
Lecture-11	Hydrostatic, trim & stability updates.
Lecture-12	Review and discussion on report writing
Lecture-13	Quiz & Viva
FINAL PRESENTATION AND REPORT SUBMISSION	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C1, C3,A1
			CO 2	C4, C5, A1
			CO 3	C3, C4
			CO 4	C3
	Labtest-1,Labtest-2	30%	CO 1	C1, C3,C4
			CO 2	C4, C5, P1
			CO 3	C3, C4
			CO 4	C3
	Project and Presentation	25%	CO 1, CO 2, CO 3	A1, A2, A3, A4
Lab Quiz		25%	CO 1	CO 2
			CO 2	CO 3
			CO 3	C3, P6, P7
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Practical Ship Design by D.G.M. Watson
2. Ship Design for Efficiency and Economy by H. Schneekluth & Bertram
3. Principles of Naval Architecture Series, Vol. I, Stability and Strength, published by SNAME
4. Principles of Naval Architecture Series, Vol. II, Resistance, Propulsion and Vibration, published by SNAME
5. Resistance and propulsion of ships, Sv Aa Harvald
6. Ship Knowledge, A Modern Encyclopaedia
7. Ship Stability for Master and Mates, Captain D.R Derrett, Butterworth Heineman.
8. Reed's Naval Architecture for Marine Engineers, E.A. Stokoe, 2003, Thomas Reed Publications.
9. Theoretical Naval Architecture, E.L. Attwood & H.S. Pengelly, 1962, Longmans Green & Co.Ltd.
10. Basic Ship Theory, K.J. Rawson & E. C. Tupper, Vol. 1 & 2., Longman Group Limited.
11. Naval Architecture: Examples and Theory, B. Baxter, Second Impression 1977, Charles Griffin & CompanyLtd.
12. Introduction to marine engineering, D.A.Taylor.
13. Marine Auxiliary Machinery by H. D. McGeorge

COURSE INFORMATION

Course Code: NAME 301 | **Credit Hours:** 3.00
Course Title: Ship Structure | **Contact Hours:** 3.00
Level and Term: Level 3 Term 1

PRE-REQUISITE

Course Code: NAME 201
Course Title: Mechanics of Structure

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This compulsory theoretical course is intended to provide students with a thorough understanding of the theory and application of structural analysis as it applies to the ship's columns, beams and frames. Emphasis is placed on developing the student's ability to calculate the deflection, buckling, shear force and bending moment of ship structural elements.

OBJECTIVES

1. To enable to impart knowledge on static and dynamic effect on ship structure.
2. Achieving ability to understand the theory and application of ship structural analysis**.**
3. To enable to calculate the longitudinal and transverse strength of ship structure.
4. To enable to calculate the buckling and wide plate bending of ship structure.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** structural elements of ships and crafts.
2. **Perform** calculation of stress, strain, displacement, shear force, bending moment and light weight of ship.
3. **Analyze** the longitudinal and transverse strength of ship structure at different loading conditions.
4. **Evaluate** the deflection, bending and buckling of ship structure subjected to dynamic loads.

COURSE CONTENTS

1. **Introduction to Ship Structure:** Structural analysis in Ship Design, steps in ship structural design process, Flowchart method for ship structural analysis, Classification of ship structures, Description of forces acting upon a ship at sea, Smith Effect, Slamming, Hogging, Sagging. Different types of Ship Motion, largest Hogging/Sagging bending moment, Calculation of buoyancy, shear force and bending moment, Total shear force and total bending moment for a ship amongst waves, Buoyancy curve in still water and weight curve, shearing force and bending moment curves, Buoyancy curves amongst waves compared with buoyancy in still water. Functions of the ship structures, Strength/distortion of ship structures.
2. **Longitudinal Strength of Ship Structure:** Assumed form of wave system for structural design, Difference between sinusoidal wave and trochoidal wave, Formation and necessity of trochoid. Distance between half height of a trochoidal wave and the

equivalent still water level, Buoyancy curves for different positions of wave, 'Sagging Condition' and 'Hogging Condition', Plotting the buoyancy curve, Light weight and dead weight, types of weights, plotting the weight curve.

Sir John. H. Biles approximation method, plotting the load, shearing force and bending moment curves from buoyancy and weight curves in calculation of longitudinal strength of a ship. Characteristics of shearing force and bending moment curves of a ship, Sketch the typical curves of load, shearing force and bending moment for a ship, Influence of position of wave on bending moment, Murray's approximate method for calculating the bending moment of a ship. Alternative method for calculating the approximate buoyancy moment, Alternative method for calculating the approximate weight moment, Equation for maximum bending moment of a ship, Calculation of maximum bending moment considering the position of maximum is at amidship.

3. **Stresses in the Structure and the Calculation of Deflection:** Definition of NA, Flexural rigidity of beam, Section Modulus Strain – Curvature and Moment – Curvature relation for a curved beam, Flexure Formula, Equation for the location of NA in the inclined condition of a Ship, Inclination for greatest and least stresses of an inclined Ship, Stress variation with angle of inclination of a ship, Formulation of the necessary steps for calculation of the deflection of ship structure, Shear Formula for a Structure. Influence of shear stress on bending theory stress, Strain energy method for calculating shear deflection, Derivation of equation of shear deflection and calculation of shear deflection, Maximum normal stresses at a cross section, Stress variation in a rectangular cross section for positive and negative bending moment, Different strain energies of a structure.
4. **Local strength problems:** Expression for Bending Moment and Deflection of a simply supported beam and its calculation, Expression for Bending Moment and Deflection of a fixed ended beam and its calculation. Equation for calculating Bending Moment of fixed ended beams, Procedure to determine the total BM of a fixed ended beam, Expressions of shearing force, bending moment and deflection for a flooded watertight bulkhead of a ship, Redundant Structures, Portal frame, Evaluation of the end/corner moment of a portal frame, Influence of rigidity of surrounding structure, Explanation of the importance of the rigidity of the post and stay of a derrick.
5. **Buckling of Structures:** Assumptions need to be considered in the theory of buckling structures. Different states of equilibrium from the viewpoint of buckling of structures. Expression for critical load and critical stress for a hinged ended column, Expression for total maximum stress for a column with initial curvature, Expression for critical stress considering buckling of a simply supported rectangular plate.
6. **Dynamic Effects:** Response of ship due to its Heaving Motion in still water considering un-damped vibration and damped vibration Influences on damping due to heaving motion, Equation for natural pitching period, Equation for pitching angle amongst waves.
7. **Theory of Plates:** Bending of wide plates, Bending of panels of plating, Simply supported rectangular plates, Simply supported plate with uniformly distributed load, Solution of Plate Problem by strain energy method, Rectangular plate bending, Plates with clamped edges, Applicatiuon of plane stress theory to ship structural problems, Simple grillage, Multi-stiffener grillages, Simply supported grillages. Two materials with the same elastic modulus, Two materials of different elastic moduli, Bending of a composite beam, Superstructure Efficiency, Crawford's Theory.
8. **Introduction of FEM**

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** structural elements of ships and crafts.	√											
CO2	**Perform** calculation of static and dynamic forces, displacement, shear force, bending moment and light weight of ship.	√											
CO3	**Analyze** the longitudinal and transverse strength of ship structure at different loading conditions.			√									
CO4	**Evaluate** the deflection , bending and buckling of ship structure subjected to dynamic loads.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** structural elements of ships and crafts.	C2			1-4	CT, F
CO2	**Perform** calculation of static and dynamic forces, displacement, shear force, bending moment and light weight of ship.	A2	1		1-4	CT, MT, F
CO3	**Analyze** the longitudinal and transverse strength of ship structure at different loading conditions.	C4	3		5	CT/ASG, F
CO4	**Evaluate** the deflection , bending and buckling of ship structure subjected to dynamic loads.	C5	1		1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to calculate stress-strain and forces of ship's structural elements.
CO2-PO1	In order to apply the mathematics knowledge to calculate the static and dynamic forces, displacement, shear force, bending moment and light weight of ship.
CO3-PO3	To design the longitudinal and transverse strength related problems of ship structure and solve them.
CO4-PO2	To analyze the deflection, bending and buckling related problems of ship structures

	and solve them.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Static forces acting upon a ship at sea, Buoyancy curve in still water and weight curve.	
Class 2	Shearing force and bending moment curves of a ship, Buoyancy curves amongst waves compared with buoyancy in still water, Dynamic forces acting upon a ship at sea.	
Class 3	Degrees of freedom a ship has in a wave system, Possible distortion of the ships structure with sketch, All the functions of the ship's structure.	
Week 2	**Longitudinal Bending**	
Class 4	Difference between sinusoidal wave and trochoidal wave; The formation and necessity of trochoid.	
Class 5	Buoyancy curves for different positions of wave.'Sagging Condition' and 'Hogging Condition' with sketch.	
Class 6	The procedure for getting the ordinates of the buoyancy curve. Light weight and dead weight. The items of two types of weight.	
Week 3	**Longitudinal Bending**	
Class 7	The distribution of weight of continuous material, Sir John H. Biles approximation, Distribution of dead weight items.	
Class 8	Procedure for calculating the shearing force and bending moment of ship's structure, The characteristics of shearing force and bending moment curves.	
Class 9	The typical curves of shearing force and bending moment, The influence	

	of position of wave on bending moment, Influence of weight distribution on the bending moment.	
Week 4	**Longitudinal Bending**	CT 2, Final Exam
Class 10	Bending moment due to addition of weight, Approximations to bending moment and shearing force, Murray's approximate method for calculating the bending moment on a ship.	
Class 11	Mandelli's approximate method for calculating the bending moment on a ship, Maximum shear force.	
Class 12	Assessment 01 (CT-1)	
Week 5	**Stresses in the Structure and the Calculation of Deflection**	
Class 13	Review of Bending Theory, Calculation of the Section Modulus, Calculate stresses in the inclined condition.	
Class 14	Sketch stresses in corners of section against angle of inclination from vertical, Calculation of the deflection of the structure	
Class 15	Calculation of Shear Stress in the structure, Influence of shear stress on bending stress.	
Week 6	**Dynamic Effects**	
Class 16	Strain energy method for calculating shear deflection, Load line standard of longitudinal strength.	
Class 17	The main two dynamic effects, Influence of the motion of the water particles on the buoyancy of a ship amongst waves.	
Class 18	Influence of ship motions on longitudinal strength, Heaving in still water.	
Week 7	**Dynamic Effects (Continue)**	Mid Term, Final Exam
Class 19	Damped heaving in still water, Heaving amongst regular waves.	
Class 20	Influence of heaving amongst waves on longitudinal strength, Natural pitching period.	
Class 21	Assessment 02 (CT-2)	
Week 8	**Theories of Plates**	
Class 22	Pitching amongst waves, Influence of pitching on longitudinal strength.	
Class 23	Bending of wide plates, Bending of panels of plating.	
Class 24	Simply supported rectangular plates, Simply supported plate with uniformly distributed load.	
Week 9	**Theories of Plates (Continue)**	
Class 25	Solution of Plate Problem by strain energy method, Rectangular plate bending.	
Class 26	Plates with clamped edges, Applicatiuon of plane stress theory to ship structural problems.	
Class 27	Simple grillage, Multi-stiffener grillages, Simply supported grillages.	
Week 10	**Buckling of Structures**	
Class 28	Critical Load for a hinged ended column, Columns with initial curvature.	
Class 29	Buckling of a wide plate, Buckling of a simply supported rectangular plate.	
Class 30	Application and Problems.	
Week 11	**Buckling of Structures (Continue)**	
Class 31	Assessment 03 (Mid Term Exam)	
Class 32	Strain energy method applied to the solution of elastic stability problems, Influence of longitudinal stiffeners on the buckling strength of plating.	

Class 33	Influence of transverse stiffeners on the buckling of plating, Buckling of curved panels of plating.	CT 3, Final Exam
Week 12	**Local Strength Problems**	
Class 34	Bending moment and deflection of beams, Fixed ended beams with arbitrary distribution of loading.	
Class 35	Expression for the shearing force, bending moment and deflection of Bulkhead, Portal frame problem.	
Class 36	Watertight bulkheads, Stayed derrick post problem.	
Week13	**Composite Constructions**	
Class 37	Two materials with the same elastic modulus, Two materials of different elastic moduli.	
Class 38	Bending of a composite beam, Application and Problems.	
Class 39	Assessment 04 (CT-3)	
Week 14	**Structural Discontinuities and Superstructures**	
Class 40	Superstructure Efficiency, Crawford's Theory	
Class 41	Introduction to FEM	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C5,C4
			CO4	C5, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Strength of ships' structure by W Muckle
2. Ship Structural Analysis and Design by Owen F Huges
3. Buckling of Ship Structure by Shama
4. Design of Ship Hull Structure by Yasuhisa Okumoto
5. Design Principles of Ships and Marine Structures by S C Misra

COURSE INFORMATION

Course Code: NAME 307
Course Title: Design of Special Ships
Level and Term: Level 3 Term 1

Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

Course Code: NAME 207
Course Title: Ship Design

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The knowledge of Ship Design – II course is intended to provide the fundamental characteristics of a ship's design and how they affect its behaviour at sea are of crucial importance to many people involved in the design of all marine vessels. This course will help to develop and apply key theories and principles associated with the design of various types of vessels also develops fundamental naval architecture knowledge, including a thorough exploration of its concepts and how they are practically used in applications in ships.

OBJECTIVES

1. To enable to interpret and apply the design and iterative procedure principles of ship.
2. To enable to impart knowledge on appropriate calculations and interpret outcomes in naval architecture tasks.
3. To make skillful to explain a project that not only will satisfy regulations and requirements, but also will fit in the marine environment, economic trends and the accelerating advance of technology.
4. To enable to design different ship efficiently and effectively.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Estimate** the values of design optimization parameters, capacities and performances
2. **Apply** knowledge in practical ship designs.
3. **Analyze** design philosophy and design aspects of different type of ships
4. **Compare** characteristics of the design features of different ships

COURSE CONTENTS

1. Introduction to ship type.
2. **Cargo ship:** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
3. **Passenger ship:** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.

4. **Container Ship: -** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
5. **Ro-Ro Ship: -** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
6. **Tankers: -** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
7. **Trawler:** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
8. **Tug:** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
9. **Dredger: -** Design, general arrangement, construction, midship section, structures, equipment, propulsion and other important systems, operations, environmental concerns, special features.
10. **High Speed Ship: -** Design and construction including special characteristics. Hydrodynamics of small high-speed craft including planning hulls, air cushion vehicles, surface effect ships and catamarans.
11. **Submarine and Warship: -** Design and construction including special characteristics.
12. **Sailing yacht:** Forces and moments acting on a sailing yacht, Speed polar diagrams, Two- and three-dimensional airfoil theory, Application to keel and rudder design, Yacht model testing.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Estimate** the values of design optimization parameters, capacities and performances			√									
CO2	**Apply** knowledge in practical ship designs.	√											
CO3	**Analyze** design philosophy and design aspects of different type of ships.				√								
CO4	**Compare** characteristics of the design features of different ships.							√					

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Estimate** the values of design parameters, capacities and performances	C2	6		5	CT, F, ASG
CO2	**Apply** knowledge in practical ship designs and construction	C3	8		1-4	CT, MT, F
CO3	**Analyze** design philosophy and design aspects of different type of ships	C4	4		8	CT, F
CO4	**Compare** characteristics of different design stages	C5	7		7	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create;						

CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO3	Design solutions for complex engineering problems that meet specified needs with appropriate estimate the values of design parameters, capacities and performances
CO2-PO1	Apply knowledge of science and engineering fundamentals to the solution of complex engineering problems based on apply the knowledge in practical ship designs and construction.
CO3-PO4	To conduct investigations of complex problems using research-based knowledge to analyze the design philosophy and design aspects of different type of ships.
CO4-PO7	Understand and evaluate the sustainability and impact of professional engineering work to compare the characteristics of different design feature.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Design of General Cargo ship**	
Class 1	Introduction to various ship types	
Class 2	Design, general arrangement, construction and midship section of cargo ship	
Class 3	Structural equipment, propulsion and other important systems of cargo ship	
Week 2	**Design of General Cargo ship and Passenger ship**	
Class 4	Environmental concerns and special features of cargo ship, general	CT 1, Final Exam

	arrangement, construction and midship section of passenger ship.	
Class 5	Structures, equipment, propulsion and other important systems of passenger ship	
Class 6	Operations, environmental concerns and special features of passenger ship	
Week 3	**Design of Container Ship**	
Class 7	Design, general arrangement, construction and midship section of container ships	
Class 8	Structures, equipment, propulsion and other important systems of container ships	
Class 9	Operations, environmental concerns and special features of container ships	
Week 4	**Design of Ro-Ro Ship**	
Class 10	Design, general arrangement, construction and midship section of Ro-Ro ships	
Class 11	Structures, equipment, propulsion and other important systems of Ro-Ro ships	
Class 12	Operations, environmental concerns and special features of Ro-Ro ships	
Week 5	**Design of Oil Tanker**	CT 2, Final Exam
Class 13	Design, general arrangement, construction and midship section of tankers	
Class 14	Structures, equipment, propulsion and other important systems of tankers	
Class 15	Operations, environmental concerns and special features of tankers	
Week 6	**Design of Dredger**	
Class 16	Design, general arrangement, construction and midship section of dredgers	
Class 17	Structures, equipment, propulsion and other important systems of dredgers	
Class 18	Operations, environmental concerns and special features of dredgers	
Week 7	**Design of Submarine and Warship**	
Class 19	Design and construction of Submarines	
Class 20	Design and construction of Submarines	
Class 21	Design and construction of Frigate	
Week 8	**Design of Submarine and Warship**	
Class 22	Design and construction of Frigate	
Class 23	Design and construction of Corvette	Mid Term, Final Exam
Class 24	Design and construction of Corvette	
Week 9	**Design of Special Type of Ship**	
Class 25	Design and construction of OPV	
Class 26	Design and construction of OPV	
Class 27	Design and construction of LPC	
Week 10	**Design of Special Type of Ship**	
Class 28	Design and construction of LPC	
Class 29	Design and construction of LCT	
Class 30	Design and construction of LCVP	
Week 11	**Design of High Speed Ship**	
Class 31	Design and construction of High speed crafts including special characteristics	Mid Term, Final Exam
Class 32	Design and construction of High speed crafts including special characteristics	
Class 33	Design and construction of multi-hull vessels including special characteristics	

Week 12	Design of High Speed Ship	
Class 34	Hydrodynamics of small high-speed craft including planning hulls	
Class 35	Hydrodynamics of small high-speed craft including air cushion vehicles	
Class 36	Hydrodynamics of small high-speed craft including surface effect ships	
Week13	**Design of Sailing Yacht**	CT 3, Final Exam
Class 37	Hydrodynamics of small high-speed craft including catamarans	
Class 38	Forces and moments acting on a sailing yacht	
Class 39	Speed polar diagrams	
Week 14	**Design of Sailing Yacht**	
Class 40	Two- and three-dimensional airfoil theory	
Class 41	Application to keel and rudder design	
Class 42	Yacht model testing	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2, C3
			CO3	C3, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C4
	Mid term	15%	CO2, CO4	C2, C5
Final Exam		60%	CO1	C2
			CO2	C3, C2,C5
			CO3	C4
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Hydrodynamics of High Speed Marine Vehicles, O.M. Faltinsen, 2005, Cambridge University Press.
2. Practical Ship Design, D.G.M. Watson, 1998, Elsevier Science Ltd. Fiber Glass Boats, Hugo Du Plessis, 3rdE dition, 1996, McGraw-Hill Book Company.
3. Reeds Naval Architecture For Marine Engineers, E A Stoke
4. Modern Warship: Design and Development, Norman Friedman

COURSE INFORMATION

Course Code: NAME 308

Course Title: Application of ship design software

Level and Term: Level 3 Term 1

Contact Hours: 3.00

Credit Hours: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Application of ship design software course is designed to teach students about the basic design drawings of different types of ship and floating structures by using AutoCAD, Maxsurf and Rhinoceros software. Students will be able to perform necessary calculations related to the basic design of ship, hydrostatic, trim and stability, resistance and required power calculations. It is expected that students will develop critical thinking about measuring characteristics of different parameters precisely, able to check their effects using calculations and finally chose the appropriate feature.

OBJECTIVES

1. To enable students to be familiarized and produce lines plan of ship in 2-D and transform 2-D lines plan into 3-D lines plan.
2. To enable students to generate ship's hull from 3-D lines plan.
3. To enable students to draw different types of ship from preliminary particulars and perform different types of analysis on the designed ship.
4. To apply trim, stability and resistance calculation on designed ship.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Produce** 2-D and 3-D lines plan from offset table.
2. **Develop** hull from 3-D lines plan using modern ship design software.
3. **Evaluate** and **assess** principal particulars and design ship from those data.
4. **Compute and analysis** hydrostatic properties of ships to **produce** hydrostatic curves and **prepare** trim, stability and resistance calculation of the designed ship.

COURSE CONTENTS

1. **Rhinoceros:** Introduction about the Rhinoceros software. Use of surface and solids. Use of 3-D lines generated in AutoCAD into Rhinoceros and develop hull surface.
2. **MAXSURF:** Introduction about the Maxsurf software. Use of generated hull in Rhinoceros into the Maxsurf and analysis of hydrostatics, stability parameters.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Produce** 2-D and 3-D lines plan from offset table.	√											
CO2	**Develop** hull from 3-D lines plan using modern ship design software.					√							
CO3	**Evaluate** and **assess** principal particulars and design ship from those data.	√											
CO4	**Compute and analysis** hydrostatic properties of ships to **produce** hydrostatic curves and **prepare** trim, stability and resistance calculation of the designed ship.												√

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Produce** 2-D and 3-D lines plan from offset table.	C3				R,T,PR
CO2	**Develop** hull from 3-D lines plan using modern ship design software.	C3				R,T,PR
CO3	**Evaluate** and **assess** principal particulars and design ship from those data.	C3, C3	1		1-4	R,T,PR
CO4	**Compute and analysis** hydrostatic properties of ships to **produce** hydrostatic curves and **prepare** trim, stability and resistance calculation of the designed ship.	C3	1		1-4	R,T,PR
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	Students will apply their knowledge to develop concept of 3-D lines plan.
CO2-PO5	Students will acquire knowledge on modern software to draw 3-D lines plan, offset table and 3-D hull.
CO3-PO1	Students will apply their knowledge to assess the requirement and estimation of principal particulars to design a ship.
CO4-PO12	Students will acquire knowledge to evaluate the hydrostatic parameters, trim, stability and resistance of the designed ship at different loading conditions which will help them in life long term.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practice at CAD Lab	 12 30
Self-Directed Learning Preparation of Assignment Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 9 9 5 20
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by CAD session and discussion, co-operative and collaborative method, project-based method

COURSE SCHEDULE

Week	Topics
Week 1	Course introduction, generation of 2-D lines plan from offset table.
Week 2	Generation of 3-D lines plan from 2-D lines plan.
Week 3	Generation of 3-D lines plan from 2-D lines plan.
Week 4	Introduction to Rhinoceros software, basic command and drawings in Rhinoceros
Week 5	Hull generation on 3-D lines plan.
Week 6	Hull generation on 3-D lines plan.
Week 7	Introduction to Maxsurf software
Week 8	Hull generation in Maxsurf from principal particulars
Week 9	Hull generation and hull fairing
Week 10	Generation of hydrostatic curves in Maxsurf and perform stability calculation
Week 11	Stability criteria and different loading conditions
Week 12	Calculation of resistance in Maxsurf
Week 13	Review of the course contents
Week 14	Final Quiz and Viva

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment	Lab participation and Report	20%	CO 1	C1, C3
			CO 2	C4, A1
			CO 3	C3, C4
			CO 4	C3
	Labtest-1,Labtest-2	30%	CO 1	C1, C3

			CO 2	C4, C5
			CO 3	C3, C4
			CO 4	C3
	Project and Presentation	25%	CO 1, CO 2, CO 4	A1, A2, A4
Lab Quiz		25%	CO 1	CO 2
			CO 2	CO 3
			CO 3	C3, P7
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Manuals of Maxsurf
2. Manuals of Rhinoceros
3. Ship Design and Performance for Masters and Mates
4. Ship Stability for Masters and Mates
5. Theoretical Naval Architecture

COURSE INFORMATION
Course Code: NAME 309 **Credit Hours:** 3.0
Course Title: Marine Engineering-I **Contact Hours:** 3.0
Level and Term: Level 3 Term 2

PRE-REQUISITE
Course Code: NAME 177
Course Title: Thermal Engineering

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Compulsory Theoretical Course
Marine Engineering-I course is designed to teach students about the basic concepts of Engines, details of components, operation, combustion of Internal Combustion Engine, components & operation of Gas Turbine used in ships, Marine fuels & properties and components and details of Ships Shafting system. Students will be able to select the suitable marine engine, fuels and lubricants and shafting system for the ships including necessary calculations related with them. It is expected that students will be able to analyze critically for the selection of correct machinery and propulsion system for the designed ship. Students will also be able to analyze the defects of machinery and ships shafting system while working as Marine engineer on board.

OBJECTIVE
1. To provide basic concepts of Various Engine
2. To learn the details of Marine Engines and Gas Turbine.
3. To analyze the various defects and problems related to IC Engine.
4. To analyze and learn about different marine fuels.
5. To provide the concepts of Various shafting equipment and System

COURSE OUTCOMES (COS)
On successful completion of this course, students should be able to:
1. **Describe** the components and working aspects of different types of Internal Combustion engine and gas turbine
2. **Evaluate** the different types of special features of various types of marine engine and gas turbine
3. **Explain** the characteristics of different types of marine fuels
4. **Describe** the shafting system of a ship and the various components of shafting system

COURSE CONTENT

1. **Marine Engines**

   a. **Diesel Engine/ CI Engine:** Related terminology and definitions, Valve timing diagram, CI engine: Basic parts of CI engines, Types, Combustion including phases, Fuel pump mechanism and operation, governor mechanism and operation.

b. **SI engine:** Combustion of SI engine, Carburettor, Supercharging, scavenging, low load running, lube oil testing etc, Engine operation, testing and Fuel metering.

c. **Gas Turbine:** Description of major components of GT, Working principle, Practical session on GT propulsion, Construction of compressor and combustion chamber of GT, Various system of GT, Advantage and disadvantage.

d. **Engine diagnosis and fault finding:** Crankcase explosion, Crankshaft deflection, Load trials. Selection criteria of marine engine.

2. Marine Fuels

Types (Petrol, Diesel, Octane, Biofuels etc.), Octane No, Centane No, Gravity and testing, Description and characteristics of HSDO, LHSDO, IFO

3. Power Transmission

a. Principle and mechanism of Gear box: Coupling and clutch, solid drive coupling, Fluid drive coupling, and other couplings.
b. Description of ship's shafting system, Description of components, Construction and operation: Thrust block, Plummer block, Bulkhead gland, Stern tube, loose coupling.
c. Shafting alignment requirements and various methods

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the components and working aspects of different types of Internal Combustion engine and gas turbine	√											
CO2	**Evaluate** the different types of special features of various types of marine engine and gas turbine		√										
CO3	**Explain** the characteristics of different types of marine fuels				√								
CO4	**Describe** the shafting system of a ship and the various components of shafting system			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the components and working aspects of different types of Internal Combustion engine and gas turbine	C1	1	1	1-4	CT, F
CO2	**Evaluate** the different types of	C3	1	1	1-4	CT/ASG, MT,

	special features of various types of marine engine and gas turbine					F
CO3	**Explain** the characteristics of different types of marine fuels	A3	3	3	5	CT/ASG, MT, F
CO4	**Describe** the shafting system of a ship and the various components of shafting system	A2	4	2	1-4	F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of components and working principle of different types of Internal Combustion engine and gas turbine
CO2-PO2	To Evaluate the different types of special features of various types of marine engine and gas turbine
CO3-PO4	To be able to explain the characteristics of different types of marine fuels
CO4-PO3	This is required in order to describe the propulsion and shafting system of a ship

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	
Class 1	Introductory class	

Class 2	Marine Engines : Study of ICE, Related terminology	CT 1, Final Exam
Class 3	Marine Engines : Types of ICE, Operation of ICE	
Week 2	**Basics of IC Engine**	
Class 4	Study of CI engine: Basic parts of CI & SI engine	
Class 5	Study of CI engine: Descriptions of components of CI engine	
Class 6	Study of CI engine: Descriptions of components of CI engine	
Week 3	**Two stroke and four stroke IC engine**	
Class 7	Study of CI engine: Two Stroke and Four Stroke ICE	
Class 8	Study of operation of Four stroke IC engine	
Class 9	Study of operation of Two stroke IC engine	
Week 4	**Combustion of CI &SI Engine**	CT 2, Final Exam
Class 10	Study of CI engine: Combustion of CI engine	
Class 11	Study of CI engine: Combustion of CI engine	
Class 12	Study of CI engine: Combustion of SI engine	
Week 5	**Important Clearance and Fuel Injection System**	
Class 13	Study of IC engine: Important Clearances of IC engine	
Class 14	Fuel Injection System, requirement and Types	
Class 15	Fuel Injection System, Types	
Week 6	**Governor**	
Class 16	Governor, Types of Governor	
Class 17	Basic operation of Governor	
Class 18	Components and working principle of a governor	
Week 7	**Low Load Running and Supercharging**	Mid Term, Final Exam
Class 19	Low Load Running, Effects of Low load running, Methods to overcome Low Load Running Effects	
Class 20	Supercharging, Turbo Charging	
Class 21	Assessment 02	
Week 8	**STC, Scavenging, Crank case Explosion**	
Class 22	Description and operation of Sequential Turbocharging	
Class 23	Scavenging	
Class 24	Crank case explosion, causes and remedies	
Week 9	**Fuel Timing and Tuning**	
Class 25	Crank shaft deflection, reasons & remedies	
Class 26	Phasing, Calibration and Timing	
Class 27	Tuning of ICE	Mid Term, Final Exam
Week 10	**Problems related to ICE**	
Class 28	Problems Related to ICE	
Class 29	Problems Related to ICE	
Class 30	Mid-term exam	
Week 11	**Gas Turbine**	
Class 31	Problems Related to ICE	
Class 32	Gas Turbine: Classifications, Advantage & disadvantage	
Class 33	Gas Turbine: Description of major components	
Week 12	**Gas Turbine**	
Class 34	Gas Turbine: Working principle of GT	
Class 35	Gas Turbine: Practical session on GT propulsion & working principle	

Class 36	Gas Turbine: Description of Compressor and combustion chamber of GT	
Week13	**Ship's Shafting System**	CT 3, Final Exam
Class 37	Gas Turbine: Practical session on GT	
Class 38	Power transmission: Description of ship's shafting system & description of components	
Class 39	Power transmission: Construction & Operation of Thrust block, Plummer block, Bulkhead gland ,Stern tube, Loose coupling	
Week 14	**Shaft Alignment Methods**	
Class 40	Power transmission : Rough methods Shaft alignment	
Class 41	Power transmission : Precision methods of Shaft alignment	
Class 42	Assessment	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Engineering Fundamentals of the internal combustion Engine - Willard W. Pulkrabek
2. Maine Internal Combustion Engine – A. B. Kane.
3. Marine Diesel Engine- Divehi Arana.
4. Pounder's Maine Diesel Engine and as Turbine- Doug woodland

COURSE INFORMATION

Course Code: NAME 310 **Credit Hours:** 1.50
Course Title: Marine Engineering Lab-I **Contact Hours:** 3.00
Level and Term: Level 3 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Marine Engineering Sessional – I course is designed to familiarized the students with various types of marine machineries and give an overview about their construction and working principles. The students will be able to relate their theoretical knowledge with the experiments performed in this course and comprehend those with industrial training.

OBJECTIVES

1. To give an overview and idea about the machineries used in marine vessels and shipbuilding industries
2. To enable students to be familiarized with the construction (assembling and disassembling), functions and performance test of different engine and its associated components.
3. The course will also be comprehended with an industrial visit to a reputed shipyard and shipbuilding industry.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Outline** different kinds of marine machineries and knows their working principle and construction.
2. **Predict** the workability of the engines by interpretation of performance tests.
3. **Comprehend** the theoretical knowledge of transmission system with its practical functioning
4. **Infer** methods to develop efficient operation of machineries.

COURSE CONTENTS

1. Study of SI and CI engine
2. Dismantling and assembling of Diesel Engine
3. Study of valve timing and diagram
4. Study of tappet adjustment and bumping adjustment
5. Performance test of a high speed diesel engine
6. Study of automotive transmission system
7. Study of diesel power plant of MIST
8. Study of steam boiler and steam turbine unit
9. Study of Gas turbine
10. Study of air compressor and refrigeration system

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Outline** different kinds of marine machineries and knows their working principle and construction.	√											
CO2	**Predict** the workability of the engines by interpretation of performance tests.				√								
CO3	**Conform** the theoretical knowledge of transmission system with its practical functioning	√											
CO4	**Infer** methods to develop efficient operation of the machineries.									√			

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Outline** different kinds of marine machineries and knows their working principle and construction.	C1			1-4	R,Pr
CO2	**Predict** the workability of the engines by interpretation of performance tests of the engines.	C2			1-4	R, Q, Pr
CO3	**Conform** the theoretical knowledge of transmission system with its practical functioning.	A2			1-4	R,Q,Pr
CO4	**Infer** methods to develop efficient operation of the machineries.	C4			1-4	R, Q, Pr
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The students will be able to identify the distinguishing features of marine machineries by utilizing the fundamental operating principle of them.
CO2-PO4	By interpreting the experimental data, students will predict the operating life and efficiency of engines.
CO3-PO1	Experiments performed on transmission system can help the students to recall and reproduces the theoretical knowledge.
CO4-PO9	Students will be able to perform and guide to ensure the effective measures to operate the machineries efficiently.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by experiments and discussion, co-operative and collaborative method, project based method.

COURSE SCHEDULE

Week	Name of the Experiment
Week-1	Course introduction, Introduction to different types of engines existed and auxiliary machineries in marine application.
Week-2	Study of SI and CI engine
Week-3	Dismantling and assembling of a Diesel Engine
Week-4	Study of valve timing and diagram
Week-5	Study of tappet adjustment and bumping adjustment
Week-6	Performance test of a high speed diesel engine
Week-7	Study of automotive transmission system
Week-8	**Mid Term Assessment (Viva / Quiz)**
Week-9	Study of diesel power plant of MIST
Week-10	Study of steam turbine unit and steam boiler
Week-11	Study of Gas turbine
Week-12	Study of air compressor and refrigeration system
Week-13	Review Class
Week-14	**Final Assessment (Viva & Quiz)**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom’s Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C2, C4
			CO 2	A2
			CO 3	C3, C4

			CO 4	C3, A3
	Labtest-1,Labtest-2	30%	CO 1	C1, C4
			CO 2	C4
			CO 3	C3, A2
			CO 4	C3
	Project and Presentation	25%	CO 1, CO 2, CO 3	A2, A3, A4
Lab Quiz		25%	CO 1	C1
			CO 2	C3, A2
			CO 3	C3,C4
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Marine Auxiliary Machinery- H.D Mc George
2. Marine Auxiliary Machinery and System – M. Khetagurov
3. General Engineering Knowledge for Marine Engineers – L. Jackson and T. D. Morton
4. Marine Auxiliary Machinery – H.D. McGeorge

COURSE INFORMATION

Course Code: NAME 311 **Credit Hours:** 3.00
Course Title: Machine Elements Design **Contact Hours:** 3.00
Level and Term: Level 3 Term 1

PRE- REQUISITE

Course Code: NAME 201
Course Title: Mechanics of Structure

RATIONALE

Compulsory Theoretical course based on machine functions and mechanism to design machine elements for efficient operations.

OBJECTIVES

1. To enable to design considering stresses, stress concentration, failure theories and types of fits.
2. To achieve ability to familiarize the students with fracture mechanics, fatigue strength and strength of materials.
3. To teach students the design of screws, belt and chain drives, spring, welded and riveted connections.
4. To enable the students to design various types of gears.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Analyze** stress, stress concentration and suitable types of fits.
2. **Understand and analyze** fatigue strength and strength of material.
3. **Design** screws, springs, welded and riveted joints and belt & chain drives.
4. **Design** various types of gears.

COURSE CONTENTS

1. **Fundamental Principles of Machine Design:** Working Stresses and Failure Theories; Stresses in curved members; Deflection and stiffness considerations; Column design; Statistical considerations; Types of fits.
2. **Design parameters:** analysis with isotropic and anisotropic materials. Design for static strength; Fracture mechanics in design; Design for fatigue strength. Design of screws, fasteners and connections; Keys and couplings, welded and brazed joints; Shafts, keys and couplings, Power screws and bolted connections, Belt and chain drives, Brakes and clutches, Welded and Riveted Connections, rope, belt and chain drives. Springs,
3. **Shaft Piston**
4. **Gears and Gearing systems:** spur, helical, worm and bevel gears, Toothed gearing, Gear trains. Design of marine shafts, stern tube and associated bearings
5. **Shock and vibration:** Properties and design for damping and arresting of vibration. Bearings: Friction, Design of Journal, Ball, Needle and Roller bearings.
6. **Lubrication of machine elements:** Boundary, Hydrostatic and Hydrodynamic lubrication systems.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Analyze** stress, stress concentration and suitable types of fits.	√											
CO2	**Understand and analyze** fatigue strength and strength of material.		√										
CO3	**Design** screws, springs, welded and riveted joints and belt & chain drives.			√									
CO4	**Design** various types of gears.			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Analyze** stress, stress concentration and suitable types of fits.	C3	1		1-4	CT, F
CO2	**Understand and analyze** fatigue strength and strength of material.	C2	1		1-4	CT, Mid Term, F
CO3	**Design** screws, springs, welded and riveted joints and belt & chain drives.	C3	2		5	CT/ASG, F
CO4	**Design** various types of gears.	C3	2		5	Mid Term, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to calculate stress, stress concentration.
CO2-PO2	Using engineering science complex issues related to strength of material has to be analyzed.
CO3-PO3	To design solutions and system components using engineering science.
CO4-PO3	To design solutions and system components using engineering science.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-

Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction	
Class 2	Fundamental Principles of Machine Design	
Class 3	Working Stresses and Failure Theories	
Week 2	**Stress and Deflection Analysis**	
Class 4	Stresses in curved members	
Class 5	Deflection and stiffness considerations	
Class 6	Column design; Statistical considerations	
Week 3	**Design parameters**	
Class 7	Analysis with isotropic and anisotropic materials	
Class 8	Design for static strength; Fracture mechanics in design	
Class 9	Design for fatigue strength	
Week 4	**Design parameters**	CT 2, Final Exam
Class 10	Design of screws	
Class 11	Design of Fasteners and Connections	
Class 12	Design of keys and couplings	
Week 5	**Design parameters**	
Class 13	Design of welded and brazed joints	
Class 14	Design of Power screws and bolted connections	
Class 15	Design of welded and Riveted Connections	
Week 6	**Design parameters**	
Class 16	Design of belt and chain drives	
Class 17	Design analysis of Brakes and clutches	
Class 18	Design and strength of rope, belt and chain drives.	
Week 7	**Design parameters**	Mid Term, Final Exam
Class 19	Design parameters of spring	
Class 20	Analysis of shock and vibration	
Class 21	Properties and design for damping and arresting of vibration	
Week 8	**Bearings**	
Class 22	Analysis of friction	
Class 23	Design of Journal and ball bearing	
Class 24	Needle and Roller bearings	
Week 9	**Gears and Gearing systems**	
Class 25	Design of Spur and Helical gear	

Class 26	Design of worm and bevel gear	
Class 27	Toothed gearing, Gear trains.	Mid Term, Final Exam
Week 10	**Shaft and Tubes**	
Class 28	Design of Marine Shafts	
Class 29	Design of stern tubes	
Class 30	Design of bearings associated with shafts and tubes	
Week 11	**Lubrication**	
Class 31	Lubrication of machine elements	
Class 32	Hydrostatic Lubrication	
Class 33	Hydrodynamic lubrication	
Week 12	**Fittings**	
Class 34	Analysis of various types of fits	
Class 35	Close fit and loose fit	
Class 36	Design of various types of fits and strengths	
Week13	**Design parameters**	CT 3, Final Exam
Class 37	Design od belt and chain	
Class 38	Analysis of pulley , tension and strength	
Class 39	Design criteria of a cam, profile of a cam	
Week 14	**Revision**	
Class 40	Design of gears	
Class 41	Design of spring	
Class 42	Design of shafts	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of Machine Design – Andrzej Golenko_
2. Theory of Machine – R.S. Khurmi and J. K. Gupta.
3. Theory of Machine and Mechanisms – Joseph E. Shigley, John Joseph Uicker
4. Standard Handbook of Machine Design – Joseph E. Shigley, Charles R. Mischke, Thomas H.Brown
5. Design of Machine Elements – Sharma, C.S.
6. Theory and Problems of Machine Design –Hall, Holowenco and Laughlin

COURSE INFORMATION

Course Code: NAME 315 **Credit Hours:** 3.00
Course Title: Ship Construction and Welding Technology **Contact Hours:** 3.00
Level and Term: Level 3 Term I

RE-REQUISITE

Course Code:NAME 107, NAME 207
Course Title: Introduction to Naval Architecture and Marine Engineering, Ship Design

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Ship construction and welding course based on construction procedure of a ship from start to finish to get quality product. All the latest classification society based international regulations and technological developments of standard welding procedure and fabrication of different structural arrangement are applied to the building procedure of a structure.

OBJECTIVES

1. To enable to identify, diagnose and rectify of common welding defects.
2. To enable toimpart knowledge on how consistent weld quality is achieved in practice, through classification society rules, welding procedure specification and weld monitoring and control.
3. To make skillful toexplain the main activities involve in ship construction.
4. Toenable to prepare a complete flow chart of ship construction process.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **States** common welding codes and standards in the welding industry, the quality of welds and welded fabrications and detailed inspection documentation and reports on findings including corrective actions.
2. **Interpret** standard construction procedure thorough knowledge of ship design.
3. **Evaluate** of welding for welding of different units and blocks of the ship.
4. **Apply** rules and regulations related to shipbuilding during construction of vessel.

COURSE CONTENTS

1. **Introduction to Welding:** Welding details: Different types of welding and their equipment.
2. **Welding Principle and Methods:** MMAW, GMAW, SAW, Electro slag welding, TIG and SS welding, MIG and aluminum welding.
3. **Welding Sequences and Defects:** Welding symbols, welding sequence in shipbuilding, Types of welding joints, Types of welding and defect, Common defects in ship welding: welding distortion monitoring and control, inspection and testing of welded specimen.
4. **Nondestructive Testing (NDT) Methods and Techniques:** Difference Between Destructive and Non-Destructive Testing, Advantages of using NDT, Application of NDT, Major Six

Methods: eddy-current, magnetic-particle, liquid penetrant, radiographic, ultrasonic, and visual testing.

5. **Details of Ship Structural Member:** Bottom structure, Keel, Single Bottom structure, Single Bottom structure, Double bottom Structure, Shell Plating, Framing, Tank side Bracket, Bilge keel, Bulkhead, Water tight doors, Deep Tank, Topside Tank, Pillars, Deck, Hatches, Bulwark, Superstructure and Deck house, Stem, Bulbous Bows, Chain Locker, Hawse pipe, Rudder, Shafting, Plate and section preparation, Frame Bending.
6. **Defects in Ship Structure:** structural discontinuity, stress concentration, remedial measures, Cathodic protection, surface preparation and painting.
7. **Shipyard Facilities:** various shops and production facilities and their layout, Process of ship construction, Numerical control.
8. Boat building by materials other than steel, conventional ship construction and block construction method.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**States** common welding codes and standards in the welding industry, the quality of welds and welded fabrications and detailed inspection documentation and reports on findings including corrective actions.	√											
CO2	**Interpret** standard construction procedure thorough knowledge of ship design.				√								
CO3	**Apply** rules and regulations related to shipbuilding during construction of vessel.							√					
CO4	**Evaluate** of welding for welding of different units and blocks of the ship.												√

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**States** common welding codes and standards in the welding industry, the quality of welds and welded fabrications and detailed inspection documentation and reports on findings including corrective actions.	C1	1		1-4	CT, F, ASG
CO2	**Interpret** standard construction procedure thorough knowledge of ship design.	C2	1		8	CT, MT, F
CO3	**Apply** rules and regulations related to shipbuilding during construction of vessel.	C3	4		7	CT, F
CO4	**Evaluate** of welding for welding of	C5	2			MT, F

	different units and blocks of the ship.					
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of science has to be applied to states welding codes and standards, welded fabrications and detailed inspection documentation and reports on findings including corrective actions.
CO2-PO4	Conduct investigations of complex problems using research-based knowledge to understand standard construction procedure thorough knowledge of ship design.
CO3-PO7	To understand and evaluate the sustainability and impact of professional engineering work, rules and regulations related to shipbuilding during construction of vessel are to be applied.
CO4-PO12	Ability to engage in independent and life-long learning in the broadest context of technological change for welding of different units and blocks of the ship.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	
Class 1	Types of Welding	
Class 2	Different types of welding and their equipment. Welding principle	
Class 3	Methods of Welding	
Week 2	**Different welding process**	

Class 4	MMAW (Manual Metal Arc Welding), GMAW(Gas Metal Arc Welding), SAW (Submerged Arc Welding)	CT 1, Final Exam
Class 5	Electro slag welding, TIG and SS welding, MIG (Metal Inert Gas)	
Class 6	Aluminum welding.	
Week 3	**Types and symbol of weeding**	
Class 7	Overview of welding	
Class 8	Types of welding joints.	
Class 9	Welding Symbols	
Week 4	**Defect of Welding**	CT 2, Final Exam
Class 10	Welding sequence in shipbuilding	
Class 11	Common defects in ship welding	
Class 12	Welding distortion monitoring and control	
Week 5	**NDT**	
Class 13	Inspection and testing of welded specimen.	
Class 14	Non-destructive type	
Class 15	Non-destructive testing Procedure, type, equipment and fault	
Week 6	**NDT**	
Class 16	Non-destructive equipment and fault	
Class 17	Overview of Welding joint and NDT	
Class 18	Structural discontinuity, stress concentration, remedial measures	
Week 7	**Structural Assemble**	Mid Term, Final Exam
Class 19	Bottom structure, Keel	
Class 20	Single Bottom structure and Double bottom Structure	
Class 21	Shell Plating, Framing	
Week 8	**Structural Assemble**	
Class 22	Tank side Bracket, Bilge keel	
Class 23	Bulkhead, Water tight doors, Deep Tank, Topside Tank	
Class 24		
Week 9	**Structural Assemble**	
Class 25	Pillars, Deck, Hatches,	
Class 26	Bulwark, Superstructure and Deck house, Stem	
Class 27		Mid Term, Final Exam
Week 10	**Structural Assemble**	
Class 28	Bulbous Bows	
Class 29	Chain Locker, Hawse pipe	
Class 30	Rudder	
Week 11	**Structural Assemble**	
Class 31	Shafting	
Class 32	Overview of welding structure	
Class 33	Shipyard Layout	
Week 12	**Defects in Ship Structure**	
Class 34	Structural discontinuity, stress concentration	
Class 35	Remedial measures, Cathodic protection	
Class 36	Surface preparation and painting	
Week13	**Ship Construction**	
Class 37	Process of ship construction, Conventional ship construction	

Class 38	Block construction method	CT 3, Final Exam
Class 39	Boat building by materials other than steel	
Week 14	**Shipyard Facilities**	
Class 40	Frame Bending, Numerical control.	
Class 41	Various shops and production facilities and their layout Plate and section preparation	
Class 42	Launching	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2
			CO3	C3, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C1
	Mid term	15%	CO2, CO4	C1, C2, C5
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C5
			CO3	C2
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Practical ship design, D. G. M. Watson. Elsevier Ocean Engineering Book Series, Volume – 1
2. Ship Construction, Fifth edition, D. J. Eyres
3. Merchant Ship Construction, D. A. Taylor

COURSE INFORMATION

Course Code: NAME 353 **Credit Hours:** 3.00
Course Title: Ship Resistance and Propulsion **Contact Hours:** 3.00
Level and Term: Level 3 Term 1

PRE-REQUISITE

Course Code: NAME 107, NAME 157
Course Title: Introduction to Naval Architecture and Marine Engineering, Hydrostatics and Stability

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course discusses the selection and evaluation of commercial and naval ship power and propulsion systems. It provides the fundamental aspects as well as practical considerations for ship resistance and associated powering requirements, propeller design and engine selection.

OBJECTIVES

1. To demonstrate knowledge and understanding on components and estimation methods of the resistance of a ship or marine vehicle.
2. To familiarize the students with the principles of propeller design and figure out the delivered power of a ship or marine vehicle.
3. To induce the ability among students to analyse the powering requirements and to select engine for fulfilling service requirements of a ship or marine vehicle.
4. To be able to calculate cavitation related problems for propulsion systems.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Demonstrate** knowledge and understanding on components and estimation methods of the resistance of a ship or marine vehicle.
2. **Apply** the principles of propeller design in developing suitable propulsion system for a marine vehicle.
3. **Analyze** the powering requirements to select engine for fulfilling service requirements of a marine vehicle**.**
4. **Evaluate** cavitation related problems and minimization of it for propulsion systems**.**

COURSE CONTENTS

1. **Theory of Resistance**
   a. Resistance of a ship and its component, Towrope or effective power, Effective Horse Power.
   b. Dimensional Analysis of Ship Resistance, Total Resistance Coefficient. Wake, Eddy.
   c. Different Resistance at different part of Vessel. Definition of Powers and Efficiencies, Forces, velocities, powers and resistances at different locations of vessel
   d. Overall Concept for Powering a Vessel. Definitions of various power, Parts of estimates of power, Ship power estimate flowchart.
   e. Ship resistance determination with model test, Description of Towing Tank with different

facilities required for a standard ship model testing facility, Ship model test Purposes.

f. Laws of Comparison: Geometrical Similarity, Kinematic Similarity, Dynamic Similarity. Dynamic Similarity in case of Incompressible. Frictionless Fluid and No Free Fluid Surface.
g. Froude experiment on friction, Work of towing tank conference on frictional resistance, three dimensional viscous resistance formulation, the work of ITTC on Three Dimensional Viscous Resistance Formulation.
h. Calculation of resistance and effective power by three- dimension extrapolation procedure, Corresponding Speeds, Relation of Residuary Resistance with Displacement, Calculation of resistance and effective power by two-dimension extrapolation procedure
i. Air & Wind Resistance Calculation, Shallow water effect, Shallow Water Effect with narrow channel effect.

2. **Theory of Propulsion**
   a. Types of modern propulsion systems and characteristics.
   b. Propeller Geometry, Manufacturing, Generator & Rake, Skew, Propeller Sections, face and back of the blade, face or geometrical pitch, Typical Blade Sections, the pitch angle, representative mean pitch, relation between pitch and pitch angle, velocity diagram of a section. Wake fraction, Thrust deduction factor.
   c. The Axial Momentum Theory of Propeller Action, The Momentum Theory including Angular Motion, Derivation of Blade Element Theory of Screw Propeller, Math on Blade Element Theory, Math on Momentum Theory
   d. Slip, Slip Angle, Real Slip Ratio, Slip ratio, PPR face, back, leading edge, trailing edge, angle of attack, Skew, Rake, Disk area, projected area, developed area, expanded area.
   e. Cavitation, Cavitation Number, Local Cavitation Number, Use of standard series data, Math on Cavitation.
   f. Open Water Characteristics, Propeller Hull Interaction (Wake gain, thrust deduction, relative rotative efficiency) Propulsive Efficiency and Propulsion Factor, Standard series and Wageningen B PPR series, , Math on Power & Efficiency
   g. Overview of main engine selection considerations, Introduction to ship power train components. Stern tubes, shafts, bearings, Propeller engine matching.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Demonstrate** knowledge and understanding on components and estimation methods of the resistance of a ship or marine vehicle.	√											
CO2	**Apply** the principles of propeller design in developing suitable propulsion system for a marine vehicle.			√									
CO3	**Analyze** the powering requirements to select engine for fulfilling service requirements of a marine vehicle.		√										
CO4	**Evaluate** cavitation related problems and minimization of it for propulsion systems		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Demonstrate** knowledge and understanding on components and estimation methods of the resistance of a ship or marine vehicle.	C3	1		1-4	CT, F
CO2	**Apply** the principles of propeller design in developing suitable propulsion system for a marine vehicle.	C3	1		1-4	CT, MT, F
CO3	**Analyze** the powering requirements to select engine for fulfilling service requirements of a marine vehicle**.**	C4	3		5	CT/ASG, F
CO4	**Evaluate** cavitation related problems and minimization of it for propulsion systems	C5	2		1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to identify and calculate the frictional and residuary resistances of a marine vehicle.
CO2-PO3	In order to figure out the efficiency and effective design of the propulsion system for a marine vehicle.
CO3-PO2	To analyze the power requirements for the selection of suitable engine in fulfilling service requirements of a ship.
CO4-PO2	In order to evaluate cavitation related problems and minimization of it propulsion systems.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30

Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Components of Resistance & Total Resistance**	CT 1, Final Exam
Class 1	Resistance of a ship and its component	
Class 2	Different Resistance at different part of Vessel, Dimensional	
	Analysis of Ship Resistance,	
Class 3	Total Resistance Coefficient.	
Week 2	**Concept of Powering of Vessel**	
Class 4	Wake, Eddy, Definition of Powers and Efficiencies,	
Class 5	Forces, velocities, powers and resistances at different locations of vessel	
Class 6	Overall Concept for Powering a Vessel	
Week 3	**Determination of Resistance using Model test**	CT 2, Final Exam
Class 7	Ship power estimate flowchart	
Class 8	Ship resistance determination with model test	
Class 9	Description of Towing Tank with different facilities required for a standard ship model testing facility, Ship model test Purposes.	
Week 4	**Laws of Comparison**	
Class 10	Laws of Comparison: Geometrical Similarity, Kinematic Similarity, Dynamic Similarity, Dynamic Similarity in case of Incompressible Frictionless Fluid and No Free Fluid Surface	
Class 11	Assessment 01	
Class 12	Froude experiment on friction, Work of towing tank conference on frictional resistance	
Week 5	**Viscous Resistance Formulation**	
Class 13	Three dimensional viscous resistance formulation	
Class 14	The work of ITTC on Three Dimensional Viscous Resistance Formulation	
Class 15	Calculation of resistance and effective power by three-dimension extrapolation procedure, Corresponding Speeds, Relation of Residuary Resistance with Displacement	
Week 6	**Calculation of Resistance and Effective Power**	Mid Term, Final Exam
Class 16	Calculation of resistance and effective power by two-dimension	
	extrapolation procedure	
Class 17	Air & Wind Resistance Calculation	
Class 18	Shallow water effect, Shallow Water Effect with narrow channel	
	effect	
Week 7	**Propeller Geometry**	
Class 19	Manufacturing, Generator & Rake, Skew, Propeller Sections, face	
	and back of the blade, face or geometrical pitch	
Class 20	Typical Blade Sections, the pitch angle, representative mean pitch,	
	relation between pitch and pitch angle, velocity diagram of a section,	
Class 21	Assessment 02	
Week 8	**Propeller related coefficients and characteristics**	
Class 22	The slip, slip ratio. Wake fraction, Thrust deduction factor	
Class 23	Propeller face, back, leading edge, trailing edge, different pitch and	
	pitch angle, angle of attack, skew	

Class 24	Rake, Disk area, projected area, developed area, expanded area	
Week 9	**Theory of Screw Propeller**	
Class 25	The Axial Momentum Theory of Propeller Action	
Class 26	The Momentum Theory including Angular Motion	
Class 27	Derivation of Blade Element Theory of Screw Propeller	
Week 10	**Propeller Hull Interaction**	
Class 28	The analysis of wake, wake gain, thrust deduction, relative rotative	
	efficiency, Propulsive Efficiency and Propulsion Factor	
Class 29	Self-Propulsion Test	
Class 30	Mid-term exam	
Week 11	**Propeller Design**	CT 3, Final Exam
Class 31	Propeller Open Water Characteristics	
Class 32	Standard series and Wageningen B PPR series	
Class 33	Use of standard series data	
Week 12	**Math related to Propeller Design Theories**	
Class 34	Math on Blade Element Theory	
Class 35	Math on Momentum Theory	
Class 36	Math on Power & Efficiency.	
Week13	**Cavitation**	
Class 37	Cavitation : Outline of origin and effects	
Class 38	Preliminary Cavitation Criterion and choice of blade area ratio	
Class 39	Minimization of Cavitation	
Week 14	**Main Engine Selection Considerations**	
Class 40	Overview of main engine selection considerations, Introduction to ship power train components. Stern tubes, shafts, bearings, Propeller engine matching	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Ship Resistance and Propulsion by Anthony F Molland
2. Basic Ship Propulsion by J P Ghose
3. Marine Propellers and Propulsion by John Carlton

COURSE INFORMATION

Course Code: NAME 354 **Credit Hours:** 1.5
Course Title: Ship Resistance and Propulsion Lab **Contact Hours:** 3.0
Level and Term: Level 3 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Resistance and Propulsion Sessional course is designed to teach students how to calculate the different components of ship resistances. Students will be able to perform necessary calculations related to propulsion power and cavitation. It is expected that students can develop critical thinking behind propeller design features, able to check their effects using calculations and finally chose the appropriate feature.

OBJECTIVES

1. To enable students to be familiarized with resistance and power calculations of ships.
2. To familiarize the students with the design of screw propeller.
3. To enable students to compute wake of a ship.
4. To apply cavitation calculation on ship design.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Identify** the components of ship resistance.
2. **Calculate** the frictional and residual resistance.
3. **Perform** 2D and 3D extrapolation using ITTC methods.
4. **Identify** geometric parameters of a propeller.
5. **Calculate** cavitation and relevant characteristics.

COURSE CONTENTS

1. Calculation of residual resistance and frictional resistance
2. Calculation of wind resistance**,** Calculation of total resistance & effective power.
3. Propulsion & powering calculation.
4. Determination of the geometry of blade sections for B-series propeller and its design.
5. Calculation wake of a ship.
6. Resistance & power calculation of high speed planning hull using Savisky's method
7. Resistance & power calculation of high speed planning hull using Holtrop and Mennen's method.
8. Design of a screw propeller using circulation theory.
9. Calculation of 2D and 3D extrapolation using ITTC methods.
10. Calculation of cavitation.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** the components of ship resistance	√											
CO2	**Calculate** the frictional and residual resistance.		√										
CO3	**Perform** 2D and 3D extrapolation using ITTC methods	√											
CO4	**Identify** geometric parameters of a propeller		√										
CO5	**Calculate** cavitation and relevant characteristics	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** the components of ship resistance	C1			1	R,Q
CO2	**Calculate** the frictional and residual resistance.	C3			1-4	R,Q
CO3	**Perform** 2D and 3D extrapolation using ITTC methods	C3			1-4	R,Q
CO4	**Identify** geometric parameters of a propeller	C1			1-4	R,Q
CO5	**Calculate** cavitation and relevant characteristics	C3			1-4	R,Q
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	Fundamental knowledge of resistance will help students to identify the components of ship resistance.
CO2-PO2	Students will formulate how to calculate the frictional and residual resistance.
CO3-PO1	Students will acquire knowledge to perform 2D and 3D extrapolation using ITTC methods.
CO4-PO2	Knowledge gained from this course will be used to identify geometric parameters of a propeller.
CO5-PO1	Students will acquire knowledge to calculate cavitation and relevant characteristics.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning Lecture Practice at CAD Lab	 12 30
Self-Directed Learning Preparation of Assignment Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 9 9 5 20
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by co-operative and collaborative method, project based method

COURSE SCHEDULE

Week	Topic/Experiments
Week 1	Course introduction and basic concepts on ship resistance prediction methods
Week 2	Calculation of residual resistance and frictional resistance.
Week 3	Calculation of wind resistance, Calculation of total resistance & effective power
Week 4	Propulsion & powering calculation
Week	Resistance & power calculation of ship using Holtrop and Mennen's method
Week 6	Resistance & power calculation of high speed planning hull using Savisky's method
Week 7	Calculation of 2D and 3D extrapolation using ITTC methods,
Week 8	**Mid Term Assessment (Quiz/ Viva)**
Week 9	Calculation wake of a ship
Week 10	Calculation of cavitation
Week 11	Determination of the geometry of blade sections for B-series propeller
Week 12	Design of the geometry of blade sections for B-series propeller.
Week 13	To design screw propeller using circulation theory
Week 14	**Final Assessment (Quiz/ Viva)**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components	Grading	COs	Bloom's Taxonomy
Class Attendance and Lab Participation	10%	CO 1-CO 5	C1-C4
Report Writing	50%	CO 1-CO 5	C1
Viva Voce	10%	CO 1- CO 5	C1
Lab Quiz	30%	CO 1	C1, C2

		CO 2	C3
		CO 3	C3, C4
		CO 4	C2, C3
		CO 5	C3
Total Marks	100%		

REFERENCE BOOKS

1. Principle of Naval Architecture: Volume-II- Resistance, Propulsion and Vibration
2. Ship Resistance and Propulsion by Anthony F Molland.
3. Basic Ship Propulsion by J P Ghose.
4. Marine Propellers and Propulsion by John Carlton

COURSE INFORMATION

Course Code:NAME 363 **Credit Hours:** 3.00
Course Title: Numerical Methods **Contact Hours:** 3.00
Level and Term: Level 3 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Compulsory Theoretical Course based on different numerical methods applied to solve various problems in the fields of engineering.

OBJECTIVES

1. To explain the consequences of finite precision and the inherent limits of the numerical methods considered,
2. To select appropriate numerical methods to apply to various types of problems in engineering and science considering the mathematical operations involved accuracy requirements and available computational resources.
3. To enable to demonstrate understanding and implementation of the mathematical concepts and algorithms underlying the numerical methods considered.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the consequences of finite precision and the inherent limits of the numerical methods considered.
2. **Select** appropriate numerical methods to apply to various types of problems in engineering and science considering the mathematical operations involved, accuracy requirements and available computational resources.
3. **Demonstrate** understanding and **implementation** of the mathematical concepts and algorithms underlying the numerical methods considered.

COURSE CONTENTS

1. **Introduction:** Errors in Numerical Calculations, Vector and Matrix Objects,
2. **Solution of System of Linear and Nonlinear Equations:** Gaussian Elimination with Back-substitution, LU Decomposition, Tridiagonal and Band-Diagonal Systems of equations, Singular Value Decomposition, Sparse Linear Systems, Newton-Raphson Method for Nonlinear Systems of Equations, Globally Convergent Methods for Nonlinear Systems of Equations.
3. **Interpolation and Extrapolation:** Polynomial Interpolation and Extrapolation, Cubic Spline Interpolation, Rational Function Interpolation and Extrapolation, Interpolation on Scattered Data in Multi-dimensions, Laplace Interpolation.
4. **Integration of Functions:** Improper Integrals, Romberg Integration, Quadrature by Variable Transformation, Gaussian Quadratures and Orthogonal Polynomials, Multi-dimensional

Integrals.

5. **Evaluation of Functions:** Polynomials and Rational Functions, Evaluation of Continued Fractions, Series and their Convergence, Recurrence Relations, Chebyshev Approximation, Polynomial Approximation from Chebyshev Coefficients, Pade Approximations, Evaluation of Functions by Path Integration.
6. **Sorting and Selection:** Straight Insertion, Shell’s Method, Quicksort, Heapsort, Indexing and Ranking, Determination of Equivalence Classes.
7. **Root Finding:** Secant Method, Bisection, False Position Method, Ridder’s Method, Newton-Raphson Method using Derivative, Roots of Polynomials.
8. **Minimization and Maximization of Functions:** Golden Section Search in One dimension, Downhill Simplex Method in Multi-Dimensions, Powell’s Method, Conjugate Gradient Method, Quasi-Newton Method, Linear Programming: Simplex and Interior-Point Method, Simulated Annealing Methods, Dynamic Programming.
9. **Eigen Systems:** Jacobi Transformations of a Symmetric Matrix, Eigenvlaues and Eigenvectors of a Tridiagonal Matrix, Hermitian Matrices, QR algorithm for Real HessenbergMatrices,
10. **Least Squares, B-splines and Fast Fourier Transform:** Least-squares curve fitting, weighted Least-squares approximation, Method of Least-squares for Continuous Functions, Cubic B- splines, Fast Fourier Transform.
11. **Numerical solution of Ordinary differential equations:** Solution by Taylor’s Series, Euler’s Method, Runge - Kutta Methods, Predictor-Corrector Methods, The Cubic Spline Method,
12. **Numerical solution of Partial differential equations:** Finite Difference Approximations to Derivatives, Laplace’s Equation, Parabolic Equations, Iterative Methods for the Solution of Equations, Hyperbolic Equations.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the consequences of finite precision and the inherent limits of the numerical methods considered.	√											
CO2	**Select** appropriate numerical methods to apply to various types of problems in engineering and science considering the mathematical operations involved, accuracy requirements and available computational resources.	√											
CO3	**Demonstrate** understanding and implementation of the mathematical concepts and algorithms underlying the numerical methods considered.			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom’s Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the consequences of finite precision and the inherent limits of the numerical methods considered.	C3	1		1-4	CT, F
CO2	**Select** appropriate numerical methods to apply to various types of problems in engineering and science considering the	C2	1		1-4	CT, Mid Term, F

	mathematical operations involved, accuracy requirements and available computational resources.					
CO3	**Demonstrate** understanding and implementation of the mathematical concepts and algorithms underlying the numerical methods considered.	C3	3		5	CT/ASG, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to calculate hydrostatic parameters and develop the effects of draught change on them.
CO2-PO1	In order to identify the role and extent of hydrostatic parameters on the principles of intact and damage stability of ships.
CO3-PO3	To analyze vessels' hydrostatic and hydrodynamic parameters for docking and launching calculations.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Errors in Computations**	
Class 1	Introduction	
Class 2	Errors in Numerical Calculations	

Class 3	Vector and Matrix Objects	
Week 2	**Roots of equation-bracketing method**	
Class 4	Gaussian Elimination with Back- substitution	
Class 5	LU Decomposition, Tridiagonal and Band-Diagonal Systems of equations	CT 1, Final Exam
Class 6	Singular Value Decomposition, Sparse Linear Systems, Newton-Raphson Method for Nonlinear Systems of Equations	
Week 3	**Roots of equation-open method**	
Class 7	Globally Convergent Methods for Nonlinear Systems of Equations.	
Class 8	Polynomial Interpolation and Extrapolation	
Class 9	Cubic Spline Interpolation	
Week 4	**Equilibrium conditions**	
Class 10	Equilibrium conditions for floating body and submerged body	
Class 11	Assessment 01	
Class 12	Metacentric height, Transverse metacenter, Moment of inertia	
Week 5	**Systems of linear algebra equation-open method**	CT 2, Final Exam
Class 13	Rational Function Interpolation and Extrapolation, Interpolation on Scattered Data in Multi-dimensions	
Class 14	Laplace Interpolation	
Class 15	Improper Integrals, Romberg Integration	
Week 6	**Systems of linear algebra equation-iterative method**	
Class 16	Quadrature by Variable Transformation	
Class 17	Gaussian Quadratures and Orthogonal Polynomials	
Class 18	Multi-dimensional Integrals.	
Week 7	**Curve fitting**	
Class 19	Polynomials and Rational Functions	
Class 20	Evaluation of Continued Fractions	
Class 21	Series and their Convergence, Recurrence Relations	Mid Term, Final Exam
Week 8	**Interpolation**	
Class 22	Chebyshev Approximation	
Class 23	Polynomial Approximation from Chebyshev Coefficients, Pade Approximations	
Class 24	Evaluation of Functions by Path Integration.	
Week 9	**Numerical Differentiation**	
Class 25	Straight Insertion, Shell's Method, Quicksort	
Class 26	Heapsort, Indexing and Ranking	
Class 27	Determination of Equivalence Classes	
Week 10	**Numerical Integration of equal segments**	
Class 28	Secant Method, Bisection, False Position Method	
Class 29	Ridder's Method, Newton- Raphson Method using Derivative	
Class 30	Mid-term exam	
Week 11	**Numerical integration of unequal segments**	
Class 31	Roots of Polynomials	Mid Term, Final Exam
Class 32	Golden Section Search in One dimension	
Class 33	Downhill Simplex Method in Multi-Dimensions, Powell's Method	

Week 12	**Ordinary differential equation-Initial value problems**	
Class 34	Conjugate Gradient Method, Quasi-Newton Method	
Class 35	Definition and development of weather criterion	
Class 36	Linear Programming: Simplex and Interior-Point Method, Simulated Annealing Methods	
Week13	**Ordinary differential equation-boundary value problems**	CT 3, Final Exam
Class 37	Dynamic Programming length	
Class 38	Jacobi Transformations of a Symmetric Matrix, Eigenvlaues and Eigenvectors of a Tridiagonal Matrix, Hermitian Matrices	
Class 39	QR algorithm for Real HessenbergMatrices,	
Week 14	**Stiffness and multistep method**	
Class 40	Least-squares curve fitting, weighted Least-squares approximation, Method of Least-squares for Continuous Functions	
Class 41	Cubic B- splines, Fast Fourier Transform.	
Class 42	Solution by Taylor's Series, Euler's Method, Runge - Kutta Methods, Predictor-Corrector Methods, The Cubic Spline Method	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3,	C6, A2
	Mid term	15%	CO2	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introductory Methods of Numerical Analysis, Sastry, S.S., 4th edition, Prentice Hall of India, 2006.
2. Numerical Recipes: The Art of Scientific Computing, Press, W.H., Teukolsky, S.A., Vetterling, W.T., Flannery, B.P., 3rd edition, Cambridge University Press,2007.
3. Numerical Methods for Engineers, Chapra andCanale.

COURSE INFORMATION

Course Code: NAME 400
Course Title: Research Project/ Thesis
Level and Term: Level 4 Term 1 & 2
Contact Hours: 12.0 (6.0 credit each term)
Credit Hours: 6.0 (3.0 credit each term)

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is designed to form a basic understanding of research methodology that is what are the important components to look for while conducting a research, how to conduct a research and what to expect from the done work in the process. This course will expose the students to the promising career in various research fields and make them understand the importance of research methodologies in science and engineering.

OBJECTIVES

1. To identify and create the key components of a research proposal
2. To be able to demonstrate the ability to conduct literature reviews and gather the critical scientific information related to the research proposal
3. To develop the skills to objectively review and write a scientific critique of a colleague's proposal
4. To describe the important concepts related to engineering subjects in scientific research
5. To be aware of the underlying concepts and principles of scientific misconduct and plagiarism.
6. To be able to demonstrate writing skills by writing, a clear, concise Thesis Paper with scientifically defensible aims, methods and conclusions

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Describe** quantitative, qualitative and mixed methods approaches to research;
2. **Identify** the components of a literature review process;
3. **Appraise** the reliability and validity of experiments;
4. **Comprehend** the ethical principles of research, ethical challenges and approval processes;
5. **Use** parametric and non-parametric hypothesis tests and write good thesis paper;
6. **Apply** writing skill of research report/ paper.

COURSE CONTENTS

1. **Foundations of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process.
2. **Problem Identification & Formulation** – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis &

Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

3. **Research Design:** Concept and Importance in Research – Features of a good research Design- Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
4. **Qualitative and Quantitative Research:** Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
5. **Use of tools** / techniques for Research and Interpretation of Data
6. **Report Writing** – Layout of a Research Paper
7. Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** quantitative, qualitative and mixed methods approaches to research	√											
CO2	**Identify** the components of a literature review process		√										
CO3	**Appraise** the reliability and validity of Experiments				√								
CO4	**Comprehend** the ethical principles of research, ethical challenges and approval processes								√				
CO5	**Use** parametric and non-parametric hypothesis tests and write good thesis paper									√			
CO6	**Apply** writing skill of research report/paper.										√		

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** quantitative, qualitative and mixed methods approaches to research	C1	1		1-4	R,Pr
CO2	**Identify** the components of a literature review process	C1	3		1-4	R,Pr
CO3	**Appraise** the reliability and validity of experiments	C5	-	1	6	R,Pr
CO4	**Comprehend** the ethical principles of research, ethical challenges and approval processes	C1	1		7	R,Pr
CO5	**Use** parametric and non- parametric hypothesis tests and write good thesis paper	C3	-	3	-	R,Pr
CO6	**Apply** writing skill of research report /paper.					
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	In order to investigate and identify the key components of a research proposal.
CO2-PO2	In order to describe the important concepts related to relevant engineering subjects in scientific research
CO3-PO4	In order to carry out well planned experiment and investigation using state of the art experimental systems and assess the results.
CO4-PO8	To be aware of the underlying concepts and principles of scientific misconduct and plagiarism.
CO5-PO9	To be able to demonstrate writing skills by writing, a clear, concise Thesis Paper with scientifically defensible aims, methods and conclusions as a team
CO6-PO10	To be able to demonstrate article producing capability through publications in renowned conference/seminar/ journal.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	27
Consultation with Supervisor + Experiment/Quantitative Research Work	75
Self-Directed Learning	
Preparation of Research Proposal	6
Preparation of Progress Presentation	6
Preparation of Final Presentation	6
Formal Assessment	
Total (Each Term)	**120**

TEACHING METHODOLOGY

Lecture followed by consultation with respective supervisors, co-operative and collaborative method, project based method

COURSE SCHEDULE

Term – I	
Week 1	Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process. + **Consultation with Supervisor**
Week 2	Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance+ **Consultation with Supervisor**
Week 3	Written Proposal
Week 4	Proposal Presentation
Week 5	Proposal Presentation

Week 6	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses + **Consultation with Supervisor**
Week 7	Descriptive Research Designs – concept, types and uses + **Consultation with Supervisor**
Week 8	Experimental Design: Concept of Independent & Dependent variables + **Consultation with Supervisor**
Week 9	Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches + **Consultation with Supervisor**
Week 10	Progress Presentation – I
Week 11	Progress Presentation – I
Week 12	Use of tools / techniques for Research and Interpretation of Data + **Consultation with Supervisor**
Week 13	Report Writing – Layout of a Research Paper + **Consultation with Supervisor**
Week 14	Ethical issues related to publishing, Plagiarism and Self-Plagiarism + **Consultation with Supervisor**
Term – II	
Week 1	**Consultation with Supervisor**.
Week 2	**Consultation with Supervisor**
Week 3	**Consultation with Supervisor + Preparation for Progress Presentation**
Week 4	**Consultation with Supervisor + Preparation for Progress Presentation**
Week 5	Progress Presentation – II
Week 6	Progress Presentation – II
Week 7	**Consultation with Supervisor**
Week 8	**Consultation with Supervisor**
Week 9	**Consultation with Supervisor**
Week 10	**Consultation with Supervisor**
Week 11	**Consultation with Supervisor + Preparation for Final Presentation**
Week 12	**Consultation with Supervisor + Preparation for Final Presentation**
Week 13	Final Thesis Presentation
Week 14	Final Thesis Presentation

LINKAGE OF CO WITH ASSESSMENT METHODS AND THEIR WEIGHTS

Components	**Grading**	**COs**	**Bloom's Taxonomy**
Written Proposal and Proposal Presentation	10%	CO 1	C1, C3,A1
		CO 2	C4, C5, A1
		CO 3	C3, C4
		CO 4	C3
		CO 5	
		CO 6	
Progress Presentation	10%	CO 1	C1, C3,C4
		CO 2	C4, C5, P1
		CO 3	C3, C4
		CO 4	C3
		CO 5	

		CO 6	
Final Thesis Presentation and Final Thesis Report Submission	40%	CO 1	CO 2
		CO 2	CO 3
		CO 3	C3, P6, P7
		CO 4	C3
		CO 5	
		CO 6	
Continuous Assessment (Supervisor)	40%	CO 1	
		CO 2	
		CO 3	
		CO 4	
		CO 5	
		CO 6	
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Research Methodology – C.R.Kothari
2. Research design: Qualitative, quantitative and mixed methods approaches – Creswell
3. Practical Research: Planning and Design – Leedy

COURSE INFORMATION

Course Code: NAME 403 **Credit Hours:** 3.00
Course Title: Dynamics of Marine Vehicles **Contact Hours:** 3.00
Level and Term: Level 4 Term 1

PRE-REQUISITE

Course Code: NAME 213, NAME 253
Course Title: Fluid Mechanics, Marine Hydrodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The course presents a unified approach to two seemingly different fields of Ship Theory; that is the manoeuvring and the seakeeping. Motion dynamics of a ship regarded as a rigid body in a general motion with six-degree-of-freedom is considered. The effects of non-linearities of the applied sub-models on the physical phenomena associated with the ship behaviour are discussed

OBJECTIVES

1. To demonstrate knowledge and understanding of the underlying principle of linear wave theory and its induced motions and loads on a ship.
2. To be able to apply techniques to predict the roll, pitch and heave motion of a vessel Travelling in regular waves and irregular waves and assess vessel motions against seakeeping criteria
3. To describe the concepts of dynamic stability, motion reduction devices, added resistance in waves and methods to predict the likelihood of seasickness.
4. To enable to predict and assess the manoeuvring behaviour of a vessel.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Describe** the underlying principle of linear wave theory and it's induced motions and Loads on a ship.
2. **Demonstrate** the application of analytical methods for calculating ship motion in the regular and irregular seaways.
3. **Describe** the concepts of dynamic stability, motion reduction devices, added resistance in waves and methods to predict the likelihood of seasickness.
4. **Apply** techniques to predict and assess the manoeuvring behaviour of a vessel.

COURSE CONTENTS

1. Introduction to sea keeping.
2. Recapitulation of gravity waves, Wave record analysis, Rayleigh distribution, Gaussian distribution, Spectral representation of the seaway, Directional spectra.
3. Ship motion in regular waves-Response amplitude operators, Motions in irregular sea, Short-time and long-time statistics of waves.
4. Rigid body motion of a floating body in waves extended to several degrees of freedom and

coupled motions.

5. Roll motions and coupled motions of floaters.
6. Slamming and deck wetness.
7. Introduction to manoeuvrability, Motion stability criterion, ITTC manoeuvring standards,
8. Design of control surface-Rudder design.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (CO)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the underlying principle of linear wave theory and it's induced motions and loads on a ship**.**	√											
CO2	**Demonstrate** the application of analytical methods for calculating ship motion in the regular and irregular seaways.		√										
CO3	**Describe** the concepts of dynamic stability, motion reduction devices, added resistance in waves and methods to predict the likelihood of seasickness.	√											
CO4	**Apply** techniques to predict and assess the manoeuvring behaviour of a vessel.					√							

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the underlying principle of linear wave theory and it's induced motions and loads on a ship**.**	C1	1		1-4	CT, F
CO2	**Demonstrate** the application of analytical methods for calculating ship motion in the regular and irregular seaways.	C3	3		5	CT, MT, F
CO3	**Describe** the concepts of dynamic stability, motion reduction devices, added resistance in waves and methods to predict the likelihood of seasickness.	C1	3		1-4	CT/ASG, F
CO4	**Apply** techniques to predict and assess the manoeuvring behaviour of a vessel.	C3	1		5	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to understand the underlying principle of linear wave theory and it's induced motions and loads on a ship.
CO2-PO2	In order to figure out motion response of marine vessels, analytical techniques to predict roll, pitch and heave motion of a vessel travelling in regular and irregular waves have been used.
CO3-PO3	To describe the concepts of dynamic stability, motion reduction devices, added resistance in waves and methods to predict the likelihood of seasickness.
CO4-PO5	In order to apply mathematical modeling techniques to assess the manoeuvring behavior of a marine vessel.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction to Seakeeping	
Class 2	Introduction to Seakeeping	
Class 3	Sinusoidal Water Waves	
Week 2	**Water Waves**	
Class 4	Mathematical Foundation of the wave motion; Boundary conditions;	
	Solution for a monochromatic progressive wave	
Class 5	Progressive wave; sinusoidal wave; velocity, length and period of waves	
Class 6	Math related to water wave problems	

Week 3	**Water Waves**	
Class 7	Effect of depth on water waves	
Class 8	Energy in waves	
Class 9	Path of particles in deep water and in canal of finite depth	
Week 4	**Water Waves**	CT 2, Final Exam
Class 10	A ship in waves	
Class 11	Assessment 01	
Class 12	Math related to ship in waves	
Week 5	**Uncoupled Heave, Pitch and Roll Motion**	
Class 13	Heaving Motion	
Class 14	Math related to Heaving Motion	
Class 15	Pitching Motion	
Week 6	**Uncoupled Heave, Pitch and Roll Motion**	Mid Term, Final Exam
Class 16	Math related to Pitching Motion	
Class 17	Rolling Motion	
Class 18	Math related to Rolling Motion	
Week 7	**Irregular Seaway**	
Class 19	Classification of seas	
Class 20	Math related to Classification of seas	
Class 21	Assessment 02	
Week 8	**Irregular Seaway**	
Class 22	Irregularity of the seaway and the Histogram	
Class 23	Math related to Irregularity of seaway and histogram	
Class 24	Wave Spectrum	
Week 9	**Irregular Seaway**	
Class 25	Math related to Wave Spectrum	
Class 26	Prediction of an Irregular Seaway; Standard Wave Spectrum	
Class 27	Math related to Prediction of Irregular Seaway	
Week 10	**Ship Motion in Irregular Seaway**	
Class 28	Response in an Irregular Seaway,	
Class 29	Math, Prediction of Motion in an Irregular Seaway	
Class 30	Mid Term Exam	
Week 11	**Non-linear Motion**	CT 3, Final Exam
Class 31	Dynamics Effects	
Class 32	Vertical Bow motion, Vertical Velocity, Vertical Acceleration	
Class 33	Relative Bow motion, Relative bow velocity, Relative Bow motion in an irregular seaway	
Week 12	**Deck Wetness & Slamming**	
Class 34	Deck Wetness, Effect of static and dynamics swell up of water at the bow, probability of deck wetness	
Class 35	Slamming; Kinematic conditions to be investigated in study of slamming; probability of slamming	
Class 36	Motion of a V-shape wedge section	
Week 13	**Ship Manoeuvring**	
Class 37	Introduction to Maneuverability, Motion Stability Criterion, ITTC, maneuvering standards	

Class 38	Various kinds of motion stability, Mathematical Model for Manoeuvring Motions,	
Class 39	Zigzag Manoeuvre, Analysis of Turning ability	
Week 14	**Rudder Design**	
Class 40	Design of control surface (rudder design)	
Class 41	Assessment 03	
Class 42	Review Class	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

REFERENCE BOOKS

1. Dynamics of Marine Vehicles - by R. Bhattacharyya.
2. Principles of Naval Architecture, Vol.3 – Motions in Waves and Controllability.
3. Sea Loads on ship and offshore structure – O.M. Faltinsen

COURSE INFORMATION

Course Code: NAME 409 **Credit Hours:** 3.0
Course Title: Marine Engineering -II **Contact Hours:** 3.0
Level and Term: Level 4 Term 1

PRE-REQUISITE

Course Code: NAME 177, NAME 277, NAME 309
Course Title: Thermal Engineering, Heat Transfer, Marine Engineering-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Compulsory Theoretical Course

Marine Engineering-II course is designed to teach students about the basic concepts of ships auxiliaries used in ship like Pump, Blower & Compressor, Refrigeration & Air conditioning System, Deck Fittings, Centrifuge, Lifesaving Apparatus and Firefighting equipment etc. Students will be able to select the suitable marine auxiliaries, Refrigeration & AC plant, and Lifesaving apparatus including firefighting appliances. It is expected that students will be able to analyze critically for the selection of correct auxiliary machinery and system for the designed ship. Students will also be able to analyze the defects of different systems while working as Marine engineer on board.

OBJECTIVE

1. To analyze the characteristics of all ship fitted auxiliary machineries;
2. To compare the characteristics of construction of different auxiliary machinery;
3. To evaluate different design parameters and performance to select auxiliary machineries;
4. To apply the knowledge of firefighting and lifesaving equipment;
5. To make decision about suitable auxiliary machineries for different vessel as a naval architect;

COURSE OUTCOMES (COS)

On successful completion of this course, students should be able to:

1. **Describe** the characteristics of all ship fitted auxiliary machineries
2. **Evaluate** different design parameters and performance to select auxiliary machineries
3. **Compare** the characteristics of construction of different auxiliary machinery
4. **Apply** the knowledge of firefighting and lifesaving equipment and to decide about suitable auxiliary machineries for different vessel as a naval architect

COURSE CONTENT

1. **Pumps:** Applications of pumps onboard, Types of pump, Characteristics of different pump, NPSH, Head calculation.
2. **Blowers and compressors:** Applications of compressors onboard, Single stage and multistage compressors, Compressor instability, safety etc.,
3. **Refrigeration and air-conditioning**: Thermodynamics, Principles, Load calculation,

Construction details of different types of refrigeration and air-conditioning systems, Refrigerants and their characteristics, Maintenance and repair of units and plants.

4. **Deck fittings**: Windlasses, Capstan, Winches, Cranes, Cargo access equipment for dry, unitized, liquid and cryogenic cargoes.
5. **Steering gear Systems**: Various types of steering system, Characteristics of different steering system, Construction details.
6. **Stabilizer**: Types of stabilizer, Description of different stabilizer used in marine vessels.
7. **Pipe**: Pipe materials, Piping systems and valves, Steam traps, anchors, anchor hawse, chains, etc.
8. **Life Saving Apparatus**: Types of life saving apparatus, Operation and use of life saving apparatus.
9. **Fire Fighting arrangement**: Types of firefighting equipment, Location of installation, description of fixed firefighting equipment.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the characteristics of all ship fitted auxiliary machineries	√											
CO2	**Evaluate** different design parameters and performance to select auxiliary machineries		√										
CO3	**Compare** the characteristics of construction of different auxiliary machinery	√											
CO4	**Apply** the knowledge of firefighting and lifesaving equipment and to decide about suitable auxiliary machineries for different vessel as a naval architect;						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the components and working aspects of different types of Internal Combustion engine and gas turbine	C1	1	1	1-4	CT, F
CO2	**Evaluate** the different types of special features of various types of marine engine and gas turbine	C3	1	1	1-4	CT/ASG, Mid Term, F
CO3	**Explain** the characteristics of different types of marine fuels	A3	3	3	5	CT/ASG, Mid Term, F
CO4	**Describe** the shafting system of a ship and the various components of shafting system	A2	4	2	1-4	F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q						

– Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge is required to analyze the characteristics of all ship fitted auxiliary machineries;
CO2-PO2	The knowledge is required to compare the characteristics of construction of different auxiliary machinery;
CO3-PO1	To be able to to evaluate different design parameters and performance to select auxiliary machineries
CO4-PO6	Able to Apply the knowledge of firefighting and lifesaving equipment and to decide about suitable auxiliary machineries for different vessel as a naval architect

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction	
Class 2	Pumps: Types of pump	
Class 3	Pumps: Types of different pump	
Week 2	**Pumps**	
Class 4	Pumps: Characteristics of different pump	
Class 5	Pumps: Characteristics of different pump	
Class 6	Pumps: NPSH	
Week 3	**Pumps and Compressors**	

Class 7	Pumps: Head calculation	
Class 8	Pumps: Head calculation	
Class 9	Blowers and compressors	
Week 4	**Blowers and compressors**	CT 2, Final Exam
Class 10	Single stage and multistage compressors	
Class 11	Single stage and multistage compressors	
Class 12	Compressor instability, safety etc	
Week 5	**Refrigeration and air-conditioning**	
Class 13	Refrigeration and air-conditioning: Thermodynamics	
Class 14	Refrigeration and air-conditioning: Thermodynamics	
Class 15	Refrigeration and air-conditioning: Principles	
Week 6	**Refrigeration and air-conditioning**	
Class 16	Refrigeration and air-conditioning: Load calculation	
Class 17	Refrigeration and air-conditioning: Load calculation	
Class 18	Refrigeration and air-conditioning: Load calculation	
Week 7	**Refrigeration and air-conditioning**	Mid Term, Final Exam
Class 19	Refrigeration and air-conditioning: Construction details of different types of refrigeration and air-conditioning systems	
Class 20	Refrigeration and air-conditioning: Construction details of different types of refrigeration and air-conditioning systems	
Class 21	Assessment 02	
Week 8	**Refrigeration and air-conditioning**	
Class 22	Refrigeration and air-conditioning: Refrigerants and their characteristics	
Class 23	Refrigeration and air-conditioning: Maintenance and repair of units and plants.	
Class 24	Refrigeration and air-conditioning: Maintenance and repair of units and plants.	
Week 9	**Deck fittings**	
Class 25	Deck fittings: Windlasses, Capstan, Winches	
Class 26	Deck fittings: Cranes	
Class 27	Deck fittings: Cargo access equipment for dry, unitized, liquid and cryogenic cargoes.	Mid Term, Final Exam
Week 10	**Steering gear**	
Class 28	Steering gear: Systems	
Class 29	Steering gear: Types, Characteristics	
Class 30	Mid-term exam	
Week 11	**Steering gear and Stabilizer**	
Class 31	Steering gear: Construction details	
Class 32	Stabilizer: Types and working Principles	
Class 33	Stabilizer: Description of Operation	
Week 12	**Pipe Materials**	
Class 34	Pipe: Pipe materials, Piping systems and valves, Steam traps,	
Class 35	Pipe: Piping systems	
Class 36	Pipe: valves, Steam traps	
Week13	**Life Saving and Fire Fighting Equipment**	
Class 37	Life Saving Apparatus: Types	

Class 38	Life Saving Apparatus: Operation and use	CT 3, Final Exam
Class 39	Fire Fighting arrangement: Types of firefighting equipment	
Week 14	**Life Saving and Fire Fighting Equipment**	
Class 40	Fire Fighting arrangement: Location, Fixed firefighting equipment	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Marine Auxiliary Machinery- H.D Mc George
2. Marine Auxiliary Machinery and System – M. Khetagurov
3. General Engineering Knowledge for Marine Engineers – L. Jackson and T. D. Morton
4. Marine Auxiliary Machinery – D.W. Smith
5. Introduction to Naval Engineering – E. F. Gritzen
6. Introduction to Marine Engineering – D. A. Taylor
7. Principles of Naval Engineering – M. A. Carr

COURSE INFORMATION

Course Code: NAME 410 **Credit Hours:** 1.50
Course Title: Marine Engineering Lab -II **Contact Hours:** 3.00
Level and Term: Level 4 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Marine Engineering Sessional-II course is designed to teach students different kinds of marine engine & auxiliary components and preparing technical specifications of those components or machineries. Students will be able to perform necessary calculations related to machines and prepare technical specifications once the course is completed. It is expected that students will develop critical thinking about how to calculate various machinery parameters thus prepare technical specifications.

OBJECTIVES

1. To enable students to be familiarized with different types of machineries in application.
2. To familiarize the students with applied and calculative concept of marine machineries and devices.
3. To enable students to compute different parameters of ships and machines related to shipyard.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** about the different features of marine machineries.
2. **Identify** different specifications of a tender.
3. **Demonstrate** and **manipulate** the technical specifications of different machineries.

COURSE CONTENTS

1. Calculation of engine power and preparation of technical specification for designing a propulsion system for a specific vessel.
2. Selection and preparation of technical specification and selection of an air compressor for sand blasting purpose in a ship yard.
3. Study on CNC cutting and bending machine and preparation of technical specification to be used in a ship yard.
4. Calculations of the capacity of a pump required for a dry dock or floating dock and prepare its technical specification.
5. Calculation of the cooling load and preparation of technical specification of an air conditioning plant for a specific vessel.
6. Calculation of the cooling load and preparation of technical specification of a refrigeration plant for a specific vessel.
7. Preparation of technical specification, selection and design of steering system of a specific

vessel.
8. Preparation of technical specification, selection and design of storage unit of a fishing vessel.
9. Calculation of electric load and selection of diesel generator unit to be used for specific vessel and preparation of its technical specification
10. Preparation of technical specification and selection of engine analyzer unit to be used for specific vessel.
11. Preparation of comparative statement.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** about the different features of marine machineries		√										
CO2	**Identify** different specifications of a tender		√										
CO3	**Demonstrate** and **manipulate** the technical specifications of different machineries			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** about the different features of marine machineries	C2	1	1	1-4	R,Q,T
CO2	**Identify** different specifications of a tender	C1	1	2	1-4	R,Q,T
CO3	**Demonstrate** and **manipulate** the technical specifications of different machineries	C3	1	2	1-4	R,Q,T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	Basic knowledge about different features and parameters of marine machineries which will enable students to understand the specifications and characteristics.
CO2-PO2	Through understanding of various tender, terms & condition, code of conduct and specifications for bidding tender.
CO3-PO3	Students will learn about technical specification, also how to calculate, manipulate and demonstrate those.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 9 9 5 20
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method.

COURSE SCHEDULE

Week	TOPIC
Week 1	Course introduction
Week 2	Calculation of engine power and preparation of technical specification for designing a propulsion system for a specific vessel.
Week 3	Selection and preparation of technical specification and selection of an air compressor for sand blasting purpose in a ship yard.
Week 4	Study on CNC cutting and bending machine and preparation of technical specification to be used in a ship yard.
Week 5	Calculation of the capacity of a pump required for a dry dock or floating dock and prepare its technical specification.
Week 6	Calculation of the cooling load and preparation of technical specification pf an air conditioning plant for a specific vessel
Week 7	**Mid Viva**
Week 8	Calculation of the cooling load and preparation of technical specification pf a refrigeration plant for a specific vessel.
Week 9	Preparation of technical specification, selection and design of steering system of a specific vessel.
Week 10	Preparation of technical specification, selection and design of storage unit of a fishing vessel.
Week 11	Calculation of electric load and selection of diesel generator unit to be used for specific vessel and preparation of its technical specification
Week 12	Preparation of technical specification and selection of engine analyzer unit to be used for specific vessel.
Week 13	Preparation of comparative statement.
Week 14	**Final Viva/ Quiz**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Lab participation and Report</td><td rowspan="3">15%</td><td>CO 1</td><td>C2</td></tr>
<tr><td>CO 2</td><td>C1</td></tr>
<tr><td>CO 3</td><td>C3</td></tr>
<tr><td rowspan="3">Mid-quiz
or
Mid Viva</td><td rowspan="3">25%</td><td>CO 1</td><td>C2</td></tr>
<tr><td>CO 2</td><td>C1</td></tr>
<tr><td>CO 3</td><td>C3</td></tr>
<tr><td colspan="2" rowspan="2">Final Viva</td><td rowspan="2">25%</td><td>CO 1</td><td>C2</td></tr>
<tr><td rowspan="2">CO 2</td><td rowspan="2">C1</td></tr>
<tr><td colspan="2" rowspan="2">Final Quiz</td><td rowspan="2">35%</td></tr>
<tr><td>CO 3</td><td>C2</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Marine Auxiliary Machinery- H.D Mc George
2. Marine Auxiliary Machinery and System – M. Khetagurov
3. General Engineering Knowledge for Marine Engineers – L. Jackson and T. D. Morton
4. Marine Auxiliary Machinery – D.W. Smith
5. Introduction to Naval Engineering – E. F. Gritzen
6. Introduction to Marine Engineering – D. A. Taylor
7. Principles of Naval Engineering – M. A. Carr

COURSE INFORMATION
Course Code: NAME 450
Course Title: Shipyard Practice/Industrial Training
Level and Term: Level 4 Term 1
Credit Hours: 1.50
Contact Hours: 4 Weeks

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
Compulsory sessional course based on practical industrial attachment.

OBJECTIVES
1. To enable the students to understand the overall management and operation of a shipyard/ dockyard.
2. To enable the students to see the design and construction works of a ship practically in the ground level
3. To enable the students to understand the different parameters of shipbuilding i.e. materials, welding, painting, trial etc.
4. To enable the students to understand the launching, docking and undocking of a ship.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **Explain** the overall management and operation of a shipyard/ dockyard.
2. **Identify** required skills for shipbuilding industries.
3. **Use** management tools to handle different categories of work forces.
4. **Manage** the crisis and resolve the conflicts amongst subordinates.
5. **Carry out** construction and repair works for a ship.

COURSE CONTENTS
1. Industry organogram, office admin of industry, flow of job responsibilities in industry etc.
2. Activities of various department/office in the shipyard
3. Ship construction procedures/methods, phases of construction
4. Various machineries and automation procedure in a shipyard/ dockyard
5. Attachment with various marine workshop/ institutes to see the practical work pattern and procedures.

- The schedule and detail contents will be fixed by the shipyard/industry according to their convenience.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (CO)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the overall management and operation of a shipyard/ dockyard.												√
CO2	**Identify** required skills for shipbuilding industries	√											
CO3	Use **management** tools to handle different categories of work forces									√			
CO4	**Manage** the crisis and resolve the conflicts amongst subordinates									√			
CO5	**Carry out** construction and repair works for a ship			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME(CO)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the overall management and operation of a shipyard/ dockyard.	6	1		4-6	R,Q,T
CO2	**Identify** required skills for shipbuilding industries	4	1		6	R,Q,T
CO3	Use **management** tools to handle different categories of work forces	4	7		5-6	R,Q,T
CO4	**Manage** the crisis and resolve the conflicts amongst subordinates	4	7		5-6	R,Q,T
CO5	**Carry out** construction and repair works for a ship	6	1		4-6	R,Q,T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	-
Experiment	-
Self-Directed Learning	
Preparation of Lab Reports	-
Preparation of Lab-test	-
Preparation of Quiz	-
Preparation of Presentation	-
Engagement in Group Projects	-
Formal Assessment	
Total	**28 Days**

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method

COURSE SCHEDULE

Week-1	Introduction and Overview of the Shipyard Industry organogram,
	Office admin of industry, flow of job responsibilities in industry etc.
	Design (Preliminary drawing, Production drawing)
	Plate classification, storage, shot blasting and priming, Plate bending,
	Cranes, Oxygen Plant, CNC cutting operation, CNC milling operation
Week-2	Welding types (Arc, Gas, TIG, MIG) and methods
	Keel Laying
	Block preparation, framing and erection
	Sand Blasting and Painting
	Marine machineries and Pump
	Engine Room Construction and Engine Selection
Week-3	Water/ Air tightness test
	Piping system design and pipe bending
	Outfit installation
	Warehouse: setting up and operation
	Quality Control (Testing and Inspection)
	Docking/ undocking
	Hull repairing
Week-4	Launching
	Inclination test
	Sea trial
	Quiz Test and Viva Voce
	Closing

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment (40%)	Class participation and observation	10%	CO 1	C6
			CO 2	C4
			CO 3	A4
			CO4	A4
			CO 5	C6
	Assignment	10%	CO 1	C6
			CO 2	C4
			CO 3	A4
			CO4	A4
			CO 5	C6
	Viva Voce	20%	CO 1	C6
			CO 2	C4
			CO 3	A4

			CO4	A4
			CO 5	C6
Repot and Presentation		60% (30% + 30%)	CO 1	C6
			CO 2	C4
			CO 3	A4
			CO4	A4
			CO 5	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Dockyard Manual
2. Technology of ship repair – Benkovsky, Galver

COURSE INFORMATION

Course Code: NAME 457
Course Title: Maritime Economics and Management
Level and Term: Level 4 Term 2

Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

Course Code: NAME 107, NAME 157, NAME 207
Course Title: Introduction to Naval Architecture and Marine Engineering, Hydrostatics and Stability, Ship Design

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The maritime economics and management is a concept as well as application based theoretical course which is essential for all undergraduate students in the field of Naval Architecture & Marine Engineering. This course enhances the competency of students to work and make decision on ship design and financial estimation in shipyard, dockyard and maritime shipping industries after their graduation.

OBJECTIVES

1. Be able to impart knowledge on worldwide maritime shipping routes and shipping phenomena.
2. Achieving ability to apply decision tree in selection of size and type of vessels in procurement and design process of a fleet.
3. Be proficient to design cost effective ships as per owners' requirements.
4. Be able to develop new tools for ship design throughout the shipbuilding career.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Comprehend** the global shipping and maritime management.
2. **Analyse** consolidate and synthesize knowledge select shipping elements in the global logistics and maritime management domain.
3. **Apply** management tools in maritime shipping and related economic activities.
4. **Design** modern management tools for ship design and construction.

COURSE CONTENTS

1. Overview of global maritime domain and its system.
2. Blue economy and its components.
3. Understanding the maritime transportation management.
4. Elements of shipping; Freight market and operating economics; Chartering of ships.
5. Shipbuilding cost estimation; Maritime related tendering and contracts.
6. International payment systems and money flow mechanism.
7. Commercial, marketing, legal and financial aspects of shipbuilding and shipping.
8. Alternative maritime designs. Overall optimization for speed size combinations of ships.
9. Relative importance of technical and economic features of marine vehicle design, Importance

and application of ICT in maritime designs.

10. Safety management concept in ships and ports and ISO certifications.
11. Management practices in maritime projects.
12. Goal based design, construction and repair/maintenance of marine vehicles.
13. Role of IACS, class surveyors and other maritime agencies.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES:

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Comprehend** the global shipping and maritime management.	√											
CO2	**Analyse** consolidate and synthesize knowledge select shipping elements in the global logistics and maritime management domain.		√										
CO3	**Create and Apply** appropriate management tools in maritime shipping and related economic activities.					√							
CO4	**Design** modern management tools for ship design and construction.						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Comprehend** the global shipping and maritime management.	C2	2	A1	1-4	CT, F
CO2	**Analyse** consolidate and synthesize knowledge select shipping elements in the global logistics and maritime management domain.	C4	3	A1	1-5	CT, MT, F
CO3	**Create and Apply** appropriate management tools in maritime shipping and related economic activities.	C6	3	A2	5-7	CT/ASG, F
CO4	**Design** modern management tools for ship design and construction.	A3	6	A2	5-7	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of science has to be applied to calculate global shipping trends, construction requirement of new vessels, renovation of middle aged vessels and costing in maritime management.
CO2-PO2	In order to identify the best ship of the best type for best route and subsequently carry out cost-benefit analysis based on shipping elements in the global logistics

	and maritime management domain.
CO3-PO5	Creating and applying appropriate management tools in maritime shipping and related economic activities, the optimization will be enhanced in terms of resource and time management in maritime transportation.
CO4-PO6	Designing the modern management tools for ship design and construction will guide shipping and shipbuilding industries to adapt and implement IMO, IACS and other international as well as local legislative issues.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 30 21 21
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction	
Class 2	General understanding of maritime transportation Management	
Class 3	General understanding of maritime transportation Management	
Week 2	**Elements of shipping**	
Class 4	Shipping basics	
Class 5	Blue economy and its components	
Class 6	Shipping as a component of blue economy	
Week 3	**Maritime transportation management**	
Class 7	Understanding the maritime transportation management	
Class 8	Freight market and operating economics	
Class 9	Chartering of ships	
Week 4	**Shipping Management**	
Class 10	Shipping management basics	
Class 11	Principles of shipping management	

Class 12	Bill of lading	CT 2, Final Exam
Week 5	**Shipping Management**	
Class 13	Shipping agency	
Class 14	Ship Chandler	
Class 15	Port duties	
Week 6	**Shipbuilding Economics and Finance**	
Class 16	Shipbuilding cost estimation	
Class 17	Selection of shipbuilding materials for cost effectiveness	
Class 18	Selection of onboard machinery for cost effectiveness	
Week 7	**Shipbuilding Economics and Finance**	Mid Term, Final Exam
Class 19	Shipbuilding capital budgeting	
Class 20	Relation of shipbuilding capitals with ship operating costs	
Class 21	Decision tree of shipbuilding capital financing criteria	
Week 8	**Shipbuilding Economics and Finance**	
Class 22	Tools on capital investment	
Class 23	Use of modern tools and methods on investment assessment	
Class 24	Self-financing vs credit financing optimization	
Week 9	**Shipbuilding Economics and Finance**	
Class 25	Cost benefit analysis for shipbuilding and shipping sector	
Class 26	Cost of propulsion	
Class 27	Cost vs size and speed of vessel	Mid Term, Final Exam
Week 10	**Shipbuilding Economics and Finance**	
Class 28	Internal payment systems and transactions	
Class 29	LC procedure	
Class 30	SWIFT method	
Week 11	**Shipbuilding Economics and Finance**	
Class 31	Bank charges and financing challenges	
Class 32	Spread, float etc in maritime financing	
Class 33	Working capital handing	
Week 12	**Maritime Tender and Contracts**	
Class 34	Tendering basics	
Class 35	Maritime specification and offers	
Class 36	Relation between tender participation and ship design	
Week13	**Maritime Tender and Contracts**	CT 3, Final Exam
Class 37	Elements of maritime contracts	
Class 38	Formats and execution of maritime contracts	
Class 39	Modes of delivery	
Week 14	**Revision**	
Class 40	Revision on shipping management	
Class 41	Revision on shipbuilding management	
Class 42	Open discussion	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components	Grading	COs	Blooms Taxonomy

Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Engineering Economics & Ship Design, I.L. Buxton, 3rd Edition, 1987, British Maritime Technology Ltd.
2. Cost Management in Shipbuilding - Planning, Analyzing and Controlling Product Cost in the Maritime Industry, Jan O. Fischer, GerdHolbach, GKP Publishing.
3. Economics of Shipping Practice and Management – Alan E. Branch
4. Liner Shipping Economics – J.O. Jansson and D. Shneerson
5. Maritime Economics – Martin Stopford
6. The Blackwell Companion to Maritime Economics – Wayne K. Talley
7. Reeds 21st Century Ship Management – J.K. Shim & J.G. Siegel
8. Elements of Shipping – Alan E. Branch

COURSE INFORMATION
Course Code: NAME 459 **Credit Hours:** 3.00
Course Title: Marine Maintenance and Repair Engineering **Contact Hours:** 3.00
Level and Term: Level 4 Term II

PRE-REQUISITE
Course Code: NAME 205, NAME 215, NAME 309 and NAME 409
Course Title: Shipbuilding Materials and Metallurgy, Ship Construction and Welding Technology, Marine Engineering-I, Marine Engineering-II

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
This course aims to provide the knowledge of the shipbuilding and ship repair sector. In order to gain the essential skills and knowledge required, enabling to successfully run and manage the building and repair process the content of this course is essentially important. An array of challenging topics such as the docking process, specifications and docking incidents and accidents, ship repair special rules, contracts and project management is integral part of this course.

OBJECTIVES
1. To identify and rectify of different defects and damage of structure.
2. To impart knowledge on ship repair and maintenance technology with a view to perform shop floor work at ship building or ship repair industries.
3. To make skillful to explain quality product by providing quality and effective tools.
4. To enable to strike a balance between theoretical and practical skills.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **States** the various methods of corrosion and corrosion prevention.
2. **Apply** knowledge in machinery maintenance.
3. **Demonstrate** as a relevant engineer on board and their activities.
4. **Analyze** the aspects of welding, hull survey and paint scheme.

COURSE CONTENTS
1. Maintenance requirements: Corrosion, fatigue, Marine fouling.
2. Failure causes: Fatigue failure of structural members, deformation failures, Failure due to corrosion. Repairs to failures.
3. Measures for failure of structural members due to deformation, corrosion, fatigue, crack detection etc.
4. Prevention of marine growth and removal of marine growth both in dry and wet condition.
5. Design considerations with regard to maintenance. Welding repair decision model.
6. Classification requirements of hull survey, identification of defects, plates and welds. Plate cutting and welding, tolerance requirements, distortion removal.
7. Underwater welding: Dry and wet.
8. Welding inspection.

9. NDT tests to survey ship for repair
10. Impact of preventive maintenance and repair techniques on operation.
11. Maintenance Schedule. Machinery Maintenance (Marine Engine and Generator set): Top overhauling, Major overhauling

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**States** the various methods of corrosion and corrosion prevention.	√											
CO2	**Apply** knowledge in machinery maintenance.		√										
CO3	**Demonstrate** as a relevant engineer on board and their activities.						√						
CO4	**Analyse** the aspects of welding, hull survey and paint scheme							√					

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**States** the various methods of corrosion and corrosion prevention.	C1	1		1-4	CT, F, ASG
CO2	**Apply** knowledge in machinery maintenance.	C2	3		1-4	CT, MT, F
CO3	**Demonstrate** as a relevant engineer on board and their activities.	C3	6		7	CT, F
CO4	**Analyse** the aspects of welding, hull survey and paint scheme	C4	7		7	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of science has to be applied to states the various methods of corrosion and corrosion prevention.
CO2-PO2	Conduct investigations of complex problems using research-based knowledge to apply knowledge in machinery maintenance.
CO3-PO6	Contextual knowledge to assess health, safety and legal issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems to demonstrate as a relevent engineer on board and their activities.
CO4-PO7	Understand and evaluate the sustainability and impact of professional engineering work to analyse the aspects of welding, hull survey and paint scheme.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	**Contents**	**Assessment**
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Maintenance requirements – corrosion	
Class 2	Maintenance requirements – fatigue	
Class 3	Marine fouling	
Week 2	**Fatigue, Crack and Corrosion**	
Class 4	Failure causes	
Class 5	fatigue failure of structural members	
Class 6	fatigue failure of structural members, Ship	
Week 3	**Fatigue, Crack and Corrosion**	
Class 7	failure due to corrosion	
Class 8	Deformation failures	
Class 9	Repairs to failures	
Week 4	**Structural Failure**	CT 2, Final Exam
Class 10	Measures for failure of structural members due to deformation	
Class 11	Measures for failure of structural members due to corrosion	
Class 12	Measures for failure of structural members due to fatigue	
Week 5	**Structural Failure**	
Class 13	Measures for failure of structural members due to crack detection etc.	
Class 14	Measures for failure of structural members due to crack detection etc.	
Class 15	Prevention of marine growth	
Week 6	**Prevention of Corrosion**	
Class 16	Prevention of marine growth	
Class 17	Removal of marine growth	
Class 18	Removal of marine growth in dry condition	
Week 7	**Prevention of Corrosion**	

Class 19	Removal of marine growth in wet condition.	Mid Term, Final Exam
Class 20	Removal of marine growth both in dry and wet condition.	
Class 21	Design considerations with regard to maintenance.	
Week 8	**Prevention of Corrosion**	
Class 22	Design considerations with regard to maintenance.	
Class 23	Maintenance scheduling.	
Class 24	Maintenance scheduling.	
Week 9	**Maintenance scheduling**	
Class 25	Maintenance based on IACS 47	
Class 26	Maintenance based on IACS 47	
Class 27	Maintenance based on IACS 47	Mid Term, Final Exam
Week 10	**Maintenance scheduling**	
Class 28	Welding repair decision model.	
Class 29	Welding repair decision model.	
Class 30	Welding inspection and repair	
Week 11	**Maintenance scheduling**	
Class 31	Welding inspection and repair	
Class 32	Welding inspection and repair	
Class 33	Classification requirements of hull survey	
Week 12	**Structural Assemble**	
Class 34	Classification requirements of hull survey	
Class 35	Identification of defects	
Class 36	Identification of defects	
Week13	**Structural Assemble**	CT 3, Final Exam
Class 37	Plates and welds.	
Class 38	In situ plate cutting and welding	
Class 39	Tolerance requirements	
Week 14	**Launching Procedure**	
Class 40	Distortion removal.	
Class 41	Underwater welding – dry and wet.	
Class 42	Impact of preventive maintenance and repair techniques on operation.	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO2, CO3	C1, C2
			CO4	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C1
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C2
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Inspection, Repair and Maintenance of Ship Structures by Piero Caridis
2. Ship Construction, D.J. Eyres, 5th Edition 2001, Butterworth-Heinemann.
3. Commercial Ship Surveying, Harry Alexander
4. Technology of Ship Repairing, Benkovsky
5. Ship repair and maintenance handbook 2005 by Dieter Mergner

COURSE INFORMATION

Course Code: NAME 464
Course Title: Numerical Methods Lab
Level and Term: Level 4 Term 1
Credit Hours: 1.50
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Numerical Methods Sessional course is designed to teach students the basics of programming in general and programming MATLAB in particular using the knowledge gained in Numerical Methods theory course. Students will be able to solve programming problems & perform computation, apply numerical methods in problem solving and analyse ideas to solve problem. It is expected that students can develop critical thinking behind developing codes and able to check their calculations.

OBJECTIVES

1. To enable students to be familiarized and implement different programming concept in application.
2. To familiarize the students with applied and calculative concept of MATLAB.
3. To enable students to compute different parameters of ships using programming concept of MATLAB using numerical methods.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Solve** programming problems and **Perform** computations with the aid of MATLAB.
2. **Apply** numerical methods in problem solving and assignments.
3. **Analyse** and **Contrast** ideas to solve complicated problems.

COURSE CONTENTS

1. Introduction to MATLAB; Errors in Numerical Techniques: Calculation of Truncation Error in a Series, Approximation.
2. Solution of nonlinear equation by numerical method: method of false position.
3. Finding roots of a equation by Newton Raphson method.
4. Interpolating a table of data by Newton's forward and backward difference interpolation formula, Lagrange's Interpolation formula and Inverse Lagrange's Interpolation formula
5. Numerical differentiation for equidistant x by Newton's and Stirling's Interpolating Formulae
6. Numerical Integration Formulae (Trapezoidal and Simpson's 1/3 rule) for Equidistant x co-ordinates
7. An Application of Numerical Integration in Fourier Series
8. Solution of Simultaneous Equation of a Linear System by Gauss-Jordan (direct) Method
9. Solution of Simultaneous Equation of a Linear System by Gauss-Seidal (Iterative) Method
10. Fitting Linear and Nonlinear curves from experimental data by Least Square Method

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Solve** programming problems and **Perform** computations with the aid of MATLAB		√										
CO2	**Apply** numerical methods in problem solving and assignments					√							
CO3	**Analyse** and **Contrast** ideas to solve complicated problems			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Solve** programming problems and **Perform** computations with the aid of MATLAB	A5	1	1	1-4	R,Q,T
CO2	**Apply** numerical methods in problem solving and assignments	C3	1	2	6	R,Q,T
CO3	**Analyse** and **Contrast** ideas to solve complicated problems	C4	1	2	5	R,Q,T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	Primary but practical idea about MATLAB, knowing programming problems and learn how to compute & solve those problems using MATLAB.
CO2-PO5	Detail and critical discussion about numerical methods of programming and apply those for different problem solving, demonstration, calculation and assignments.
CO3-PO3	Know about few complicated and exceptional problems, analyze those problems critically thus contrast ideas to solve the problems,

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30

Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 9 9 5 20
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method, lab work.

COURSE SCHEDULE

Week	TOPIC
Week 1	Course introduction.
Week 2	Errors in Numerical Techniques: Calculation of Truncation Error in a Series Approximation.
Week 3	Solution of nonlinear equation by numerical method: method of false position.
Week 4	Finding roots of a equation by Newton Raphson method.
Week 5	Interpolating a table of data by Newton’s forward and backward difference interpolation formula, Lagrange’s Interpolation formula and Inverse Lagrange’s Interpolation formula.
Week 6	Numerical differentiation for equidistant x by Newton’s and Stirling’s Interpolating Formulae.
Week 7	Mid Viva/lab test
Week 8	Numerical Integration Formulae (Trapezoidal and Simpson’s 1/3 rule) for Equidistant x co-ordinates.
Week 9	An Application of Numerical Integration in Fourier Series.
Week 10	Solution of Simultaneous Equation of a Linear System by Gauss-Jordan (direct) Method.
Week 11	Solution of Simultaneous Equation of a Linear System by Gauss-Seidal (Iterative) Method.
Week 12	Fitting Linear and Nonlinear curves from experimental data by Least Square Method.
Week 13	Final Viva/lab test

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	15%	CO 1	A5
			CO 2	C3
			CO 3	C4

<table>
<tr><td rowspan="3"></td><td rowspan="3">Mid-quiz
or
Mid Viva</td><td rowspan="3">25%</td><td>CO 1</td><td>A5</td></tr>
<tr><td>CO 2</td><td>C3</td></tr>
<tr><td>CO 3</td><td>C4</td></tr>
<tr><td colspan="2" rowspan="2">Final Viva</td><td rowspan="2">25%</td><td>CO 1</td><td>A5</td></tr>
<tr><td rowspan="2">CO 2</td><td rowspan="2">C3</td></tr>
<tr><td colspan="2" rowspan="2">Final Quiz</td><td rowspan="2">35%</td></tr>
<tr><td>CO 3</td><td>A5</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Numerical Recipes: The Art of Scientific Computing, Press, W.H., Teukolsky, S.A., Vetterling, W.T., Flannery, B.P., 3rd edition, Cambridge University Press, 2007.
2. Numerical Methods for Engineers, Chapra and Canale.
3. Introductory Methods of Numerical Analysis, Sastry, S.S., 4th edition, Prentice Hall of India, 2006.

COURSE INFORMATION

Course Code: NAME 490 **Credit Hours:** 1.0
Course Title: Bangladesh Studies for Naval Architect **Contact Hours:** 2.0
Level and Term: Level 4 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course has been designed to help the students in obtaining comprehensive idea about the history, culture and heritage of Bangladesh. It will introduce students with economy, society, politics, diplomacy and foreign policy of Bangladesh. Students will learn about the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future. It will also assist the students in assessing roles and contribution of Bangladesh in the regional and international bodies which are dedicated to establish world peace.

OBJECTIVES

1. To introduce students with maritime and shipbuilding heritage of Bangladesh.
2. To provide in-depth knowledge on prospects and challenges in shipbuilding in Bangladesh.
3. To provide brief idea about inland waterways and sea route of Bangladesh.
4. To impart knowledge about different organisations related to ship design, building, recycling and different sea borne trade and commerce.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Describe** maritime and shipbuilding heritage of Bangladesh.
2. **Evaluate** the prospects and challenges in shipbuilding in Bangladesh.
3. **Explain** about inland waterways and sea route of Bangladesh.
4. **Organize** different organisations related to ship design, building, recycling and different sea borne trade and commerce.

COURSE CONTENTS

1. Maritime and shipbuilding heritage of Bangladesh
2. Shipbuilding vise a vise nation building and civilization
3. Dimensions, prospects and challenges in shipbuilding in Bangladesh
4. Sea routes of Bangladesh
5. Inland waterways of Bangladesh
6. Organizations of Seafarers, Naval Architects, Marine Engineers, etc in Bangladesh
7. Notable personalities in maritime arena
8. Operation jackpot and preparations for national requirements in future.
9. Implication of maritime zone act

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (CO)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** maritime and shipbuilding heritage of Bangladesh.												√
CO2	**Evaluate** the prospects and challenges in shipbuilding in Bangladesh.						√						
CO3	**Explain** about inland waterways and sea route of Bangladesh.												√
CO4	**Organize** different organisations related to ship design, building, recycling and different sea borne trade and commerce										√		

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (CO)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** maritime and shipbuilding heritage of Bangladesh.	C2, C5, C6				R,Q,Pr
CO2	**Evaluate** the prospects and challenges in shipbuilding in Bangladesh.	A4				R,Q,Pr
CO3	**Explain** about inland waterways and sea route of Bangladesh.	C1, C4, P1, A4			1-4	R,Q,Pr
CO4	**Organize** different organisations related to ship design, building, recycling and different sea borne trade and commerce	C1, C4, P1, A4			1-4	R,Q,Pr
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO12	In order to develop concept of historical and socio-economic aspects of Bangladesh.
CO2-PO6	To link up the customs and traditions of Bangladesh.
CO3-PO12	In order to assess the episodes and events those lead to the independence of our motherland.
CO4-PO10	In order to describe issues of national challenges and ways to overcome and thus contribute to national building program.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 16

Discussion	10
Self-Directed Learning	
Preparation of Presentation	16
Preparation of Viva	6
Preparation of Quiz	12
Total	**60**

TEACHING METHODOLOGY

Lecture followed by open discussion, presentation and report submission.

COURSE SCHEDULE

WEEK	TOPIC
Week 1	Maritime and shipbuilding heritage of Bangladesh
Week 2	Shipbuilding vise a vise nation building and civilization
Week 3	**Presentation**
Week 4	Dimensions, prospects and challenges in shipbuilding in Bangladesh
Week 5	Sea routes of Bangladesh and Inland waterways of Bangladesh
Week 6	**Presentation**
Week 7	Organizations of Seafarers, Naval Architects, Marine Engineers, etc in Bangladesh
Week 8	Notable personalities in maritime arena and their contributions to the nation.
Week 9	**Presentation**
Week 10	Operation jackpot and preparations for national requirements in future
Week 11	Implication of maritime zone act
Week 12	**Presentation**
Week 13	**Final Viva**
Week 14	**Final Quiz**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Bloom's Taxonomy
Continuous Assessment	Participation and Report	20%	CO 1	C2, C5
			CO 2	A4
			CO 3	C1, C4
			CO 4	C1, C4
	Presentation	30%	CO 1	C2, C5
			CO 2	A4
			CO 3	C1, C4
			CO 4	C1, C4
	Case Study/ Viva	25%	CO 1, CO 2, CO 3	C2, C5, A4, C1
Lab Quiz		25%	CO 1	C2, C5
			CO 2	A4
			CO 3	C1, C4
			CO 4	C1, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Shipbuilding Industry of Bangladesh in the Light of Global Trend by Md. Ruhul Amin
2. Bengal Industries and the British Industrial Revolution (1757-1857) by Indrajit Ray
3. World Bank reports

1. Bangladesh Studies – Shamsul Kabir Khan
2. Habits of Highly Effective People – Stephen R Covey
3. India Wins Freedom – Maulana Abul Kalam Azad
4. The History of Bengal – Charles Stewart
5. A History of Bangladesh – Willem van Schendel
6. History of Bangladesh: A Sub-continental Civilisation – Abul Maal A. Muhith
7. Bangla bhasha o oitihasik bhasha andolan – Mohammad Matiur Rahman
8. Breakup of Pakistan: Background & Prospects of Bangladesh – Kabir Uddin Ahmed
9. Bangladesh: Quest for Freedom and Justice – Kamal Hossain

ELECTIVE/OPTIONAL COURSES

Military Institute of Science and Technology
Department of Naval Architecture and Marine Engineering

COURSE INFORMATION

Course Code: NAME 375
Course Title: Composite Materials
Level and Term: Level 3 Term I/II
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

Course Code: NAME 201
Course Title: Mechanics of Structure

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This optional theoretical course will provide students a fundamental concept of modern composite materials which are being used in an ever-increasing range of applications and industries. Basic knowledge of composite materials will allow students to understand the issues associated with using these materials, as well as gain insight into how their usage differs from conventional materials such as metals, and ultimately be able to use composites to their fullest potential. At the end of the course students will develop critical thinking & skills needed for the design, manufacture and analysis of composite materials from a material scientist's viewpoint.

OBJECTIVES

1. To impart knowledge on characteristics, classifications and applications of composite materials.
2. To achieve ability to differentiate of micro-mechanics and macro-mechanics of composite materials.
3. To understand the composite structural analysis.
4. To calculate the laminate stress-strain, buckling, bending, deflection etc.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the types of composite materials and their characteristic features.
2. **Perform** calculation the elastic and strength properties of unidirectional laminates using micromechanics and macro-mechanics theory.
3. **Analyze** the most appropriate manufacturing process for fabricating composite materials.
4. **Evaluate** the fracture, fatigue, impact performance, the non-destructive inspection (NDT) and structural health monitoring of composite materials.

COURSE CONTENTS

1. **Introduction to composite materials**
    a. Basic concepts, characteristics, advantages and drawbacks of composites over monolithic materials
    b. Classifications, common types of fibers and matrices, mechanical properties
    c. Applications of composite material

   d. Manufacturing methods and processes

2. **Macromechanics analysis of lamina**
   a. Review of definitions of stress, strain, elastic moduli
   b. Strain energy stress-strain relationships for different types of materials
   c. Stress-strain relationships for a unidirectional/bidirectional lamina
   d. The engineering constants of a unidirectional/bidirectional lamina in terms of the stiffness and compliance.

3. **Elastic properties of the unidirectional lamina**
   a. Engineering constants, Stress-strain relationship of a thin lamina
   b. Transformation of stress and strain and elastic constants
   c. typical elastic properties of a unidirectional lamina
   d. Relationship of Compliance and Stiffness Matrix
   e. Hooke's Law for a Two-Dimensional Angle Lamina.

4. **Micromechanical analysis of a lamina**
   a. Assumptions and limitations, Longitudinal strength and stiffness
   b. In-plane shear modulus and Poisson's ratio
   c. Concepts of volume and weight fraction of fiber and matrix, density and void fraction in composites
   d. Four elastic moduli, two coefficients of thermal expansion and two coefficients of moisture expansion of a unidirectional.

5. **Analysis of laminated composites**
   a. Basic assumptions, Strain-displacement relationship
   b. Laminate stiffness, Laminate strength, determination of lamina stress and strain
   c. Types of laminate configuration, Layered laminate
   d. In-plane stiffness of symmetric laminates
   e. Flexural stiffness of symmetric sandwich laminates
   f. Behaviour of general laminates**.**

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	**COURSE OUTCOME (CO)**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Explain** the types of composite materials and their characteristic features.	√											
CO2	**Perform** calculation the elastic and strength properties of unidirectional laminates using micromechanics and macro-mechanics theory.	√											
CO3	**Analyze** the most appropriate manufacturing process for fabricating composite materials.		√										
CO4	**Evaluate** the fracture, fatigue, impact performance, the non-destructive inspection (NDT) and structural health monitoring of composite materials.			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the types of composite materials and their characteristic features.	C2	1		1-4	CT, F
CO2	**Perform** calculation the elastic and strength properties of unidirectional laminates using micromechanics and macro-mechanics theory.	A2	1		1-4	CT, Mid Term, F
CO3	**Analyze** the most appropriate manufacturing process for fabricating composite materials.	C4	3		1-4	CT/ASG, F
CO4	**Evaluate** the fracture, fatigue, impact performance, the non-destructive inspection (NDT) and structural health monitoring of composite materials.	C5	1		5	Mid Term, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	To apply the knowledge of science to explain the types of composite materials and their characteristic features.
CO2-PO1	The knowledge of mathematics and science has to be applied to calculate the elastic and strength properties of unidirectional laminates using micromechanics and macro-mechanics theory.
CO3-PO2	To analyze the most appropriate manufacturing process for fabricating composite materials.
CO4-PO3	To design the composite material structures and analyzes them by different numerical techniques.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction to composites**	CT 1, Final Exam
Class 1	Introduction, Background.	
Class 2	Characteristics, classifications and uses.	
Class 3	classifications and uses (Continue)	
Week 2	**Introduction to composites (Continue)**	
Class 4	Polymer Matrix Composites, Metal Matrix Composites	
Class 5	Ceramic Matrix Composites, Carbon–Carbon Composites	
Class 6	Recycling Fiber-Reinforced Composites	
Week 3	**Introduction to composites (Continue)**	
Class 7	Mechanics Terminology	
Class 8	Manufacturing processes	
Class 9	Applications and Problems	
Week 4	**Macro-mechanical Analysis of a Lamina**	CT 2, Final Exam
Class 10	Review of Definitions (Strain, Stress, Elastic Moduli, Strain Energy)	
Class 11	Assessment 01	
Class 12	Hooke’s Law for Different Types of Materials.	
Week 5	**Macro-mechanical Analysis of a Lamina (Continue)**	
Class 13	Relationship of Compliance and Stiffness Matrix	
Class 14	Hooke’s Law for a Two-Dimensional Angle Lamina	
Class 15	Strength Failure Theories of an Angle Lamina	
Week 6	**Macro-mechanical Analysis of a Lamina (Continue)**	
Class 16	Strength Failure Theories of an Angle Lamina(Continue)	
Class 17	Hygrothermal Stresses and Strains in a Lamina	
Class 18	Applications and Problems	
Week 7	**Micro-mechanical Analysis of a Lamina**	Mid Term, Final Exam
Class 19	Volume and Mass Fractions, Density, and Void Content	
Class 20	Strength of Materials Approach	
Class 21	Assessment 02	
Week 8	**Micromechanical Analysis of a Lamina (Continue)**	
Class 22	Semi-Empirical Models	
Class 23	Elasticity Approach	
Class 24	Elastic Moduli of Lamina with Transversely Isotropic Fibers	
Week 9	**Micromechanical Analysis of a Lamina (Continue)**	
Class 25	Ultimate Strengths of a Unidirectional Lamina.	
Class 26	Coefficients of Thermal Expansion.	
Class 27	Coefficients of Moisture Expansion.	
Week 10	**Macromechanical Analysis of Laminates**	
Class 28	Introduction	
Class 29	Stress–Strain Relations for a Laminate.	
Class 30	Mid-term exam	
Week 11	**Macromechanical Analysis of Laminates (Continue)**	
Class 31	Stress–Strain Relations for a Laminate (Continue).	
Class 32	In-Plane and Flexural Modulus of a Laminate.	
Class 33	Hygrothermal Effects in a Laminate	
Week 12	**Failure, Analysis, and Design of Laminates**	CT 3, Final Exam
Class 34	Introduction	
Class 35	Special Cases of Laminates.	
Class 36	Failure Criterion for a Laminate.	
Week 13	**Failure, Analysis, and Design of Laminates (Continue)**	

Class 37	Design of a Laminated Composite	
Class 38	Design of a Laminated Composite (Continue).	
Class 39	Assessment 03	
Week 14	**Failure, Analysis, and Design of Laminates (Continue)**	
Class 40	Mechanical Design Issues	
Class 41	Applications and Problems	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C5, C4
			CO4	C5, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics of Composite Materials – Auter Kaw
2. Mechanics of Composite Materials – R Jones
3. Principles of Composite Material Mechanics – Ronald F Gibson
4. Mechanics of Composite Materials with MATLAB – George Z. Voyiadjis & Peter I. Kattan
5. Composite Materials: Science and Engineering – Krishan K. Chawla

COURSE INFORMATION

Course Code: NAME 387
Course Title: Port and Harbor Engineering
Level and Term: Level 3 Term1
Credit Hours: 3.0
Contact Hours: 3.0

PRE-REQUISITE

Course Code: NAME 307
Course Title: Design of Special Ships

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Port and Harbor Engineering theoretical optional course aims to impart knowledge on port and harbour infrastructure, analyses how ports are organized, managed and planned and related with transport chain. Students specializing in this program must understand the significance and challenges related to ports and harbours.

OBJECTIVES

1. To ensure a thorough knowledge and understanding of port and harbour types, characteristics, planning and cargo handling.
2. To enable to find out design solution for various types of environmental and operational challenges.
3. To give an overview about ports of Bangladesh.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Analyze** and **evaluate** the types, design philosophy, design aspects and construction, of port and harbor.
2. **Explain** and **estimate** different types of environmental and operational loads encountered by port and harbor.
3. **Design** and **plan** to integrate port and harbour infrastructure.
4. **Demonstrate** the basic design of port and terminal layout.
5. **Apply** the knowledge in different port structure design which will help to select a suitable port in Bangladesh.

COURSE CONTENTS

1. **Introduction:** Introduction to Port and Harbor, Port and Harbor characteristics, Ship characteristics and tonnage calculation, Port and Harbor planning, Access channel, Wharf, Quay, Pier and Jetty
2. **Berthing and Mooring:** Structure, Requirement, Berthing Area and Anchorage area, Mooring, Mooring system layout, Anchor, The Rode System, The Mooring Buoy, Pennants, Dolphin Berthing environment and energy calculation, Fender selection and fender system design
3. **Cargo Handling** in ports (Container, Container Cranes, Bulk Cargo)
4. **Natural Phenomenon and Loads:** Wind, Wave, Tide, Current loads, Operational loads and

other Environmental loads.

5. **Breakwater:** Concept on breakwater, Arrangement of breakwater, Design Process of breakwater, Types of breakwater, Wave Structure Interactions, Rubble mound breakwater, Vertical breakwater: types and construction, Floating breakwater: Classification of floating breakwaters and their details, Advantage and Disadvantage, Floating breakwater design
6. **Port Functions, Organisation and Planning Methodology:** Port Functions, Transport chain, Organisation of seaports, Types of planning, planning process, Planning tasks, functional requirements and planning elements, Layout development, evaluation techniques, Economic and financial analysis
7. **Port Terminals and Container Terminals: Planning and Design:** Terminal components, types of terminals, Terminal capacity: maximum or optimum, terminal dimensions, Container transport and terminal operations**,** Lay-out development of container terminals
8. **IMO and Marine Pollution from Ships:** UNCLOS, GESAMP, Sources of pollution, Existing IMO instrument, Management of ballast water: BWM, General Obligations Under the BWM Convention, BWM plan and standard
9. **Sea and River Ports of Bangladesh**: Chittagong Port Authority, Mongla Port Authority, Payra Port Authority: facilities, strength and weakness, River Ports of Bangladesh and their Assessment.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	**COURSE OUTCOMES (COs)**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Analyze** and **Evaluate** the types, design philosophy, design aspects and construction, of port and harbor.		√										
CO2	**Explain** and **Estimate** different types of environmental and operational loads encountered by port and harbor.							√					
CO3	**Design** and **Plan** to integrate port and harbour infrastructure.			√									
CO4	**Demonstrate** the basic design of port and terminal layout.		√										
CO5	**Apply** the knowledge in different port structure design which will help to select a suitable port in Bangladesh.						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	**COURSE OUTCOMES (COs)**	**Bloom's Taxonomy**	**CP**	**CA**	**KP**	**Assessment Methods**
CO1	**Analyze** and **Evaluate** the types, design philosophy, design aspects and construction, of port and harbor.	C4, C5			1-4	CT,F
CO2	**Explain** and **Estimate** different types of environmental and operational loads encountered by port and harbor.	C2	2		7	CT, F MT

CO3	**Design** and **Plan** to integrate port and harbour infrastructure.	C6	1	3	4	MT, F
CO4	**Demonstrate** the basic design of port and terminal layout.	C3			1-4	F, ASG
CO5	**Apply** the knowledge in different port structure design which will help to select a suitable port in Bangladesh.	C6		1	7	CT/ASG, F

(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	The learners will be able to analyze and evaluate the types, design philosophy, design aspects and construction, of port and harbor with substantiated conclusions using fundamental engineering principle of this course.
CO2-PO7	Considering the sustainability of port and harbor infrastructure design in point of view of environmental contexts, achieving ability to explain and estimate different types of environmental and operational loads encountered by port and harbor.
CO3-PO3	Student will achieve the ability to design and plan to integrate port and harbor infrastructure to give solution of specific needs with appropriate criteria.
CO4-PO2	Applying the literature knowledge on design of port and terminal layout., students will be able to demonstrate to actual design layout of port and terminal.
CO5-PO6	Students will be able to apply the knowledge in different port structure design which will help to select a suitable port in Bangladesh which is application of contextual knowledge to assess societal, safety and the consequent responsibilities relevant to professional engineering practice.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3

Total	**120**	

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT-1, Final Exam
Class 1	Introduction to Port and Harbour course, Definition of Harbour and Port, Harbour components, Classifications of Port and Harbour	
Class 2	Port and Harbor characteristics, Differences between ports and Terminals, Review on Ship Characteristics: Displacement Tonnage, standard Displacement Tonnage, Lightweight and Deadweight, Deadweight Tonnage, Gross and Net Registered Tonnage	
Class 3	Port and Harbor planning, Access channel, Wharf, Quay, Pier and Jetty	
Week 2	**Berthing and Mooring**	
Class 4	Structure, Requirement, Berthing area and Anchorage area	
Class 5	Mooring and ship motion inside the port	
Class 6	Anchor, The Rode System, The Mooring Buoy, Pennants,	
Week 3	**Berthing and Mooring (Contd.)**	
Class 7	Mooring System Layout, Mediterranean Mooring of Ships	
Class 8	Dolphin and Case Study	
Class 9	Assessment -1 (CT-1)	
Week 4	**Berthing and Mooring (Contd.)**	CT-2, Mid Term, Final Exam
Class 10	Berthing environment and energy calculation	
Class 11	Fender selection and fender system design,	
Class 12	Fender accessories and other design criteria, Review on Berthing and Mooring	
Week 5	**Natural Phenomenon and Loads**	
Class 13	Wind, Wave, Tide, Current loads	
Class 14	Wind, Wave, Tide, Current loads	
Class 15	Morison Equation to calculate wave and current load	
Week 6	**Natural Phenomenon and Loads (Contd.)**	
Class 16	Operational Load: Cargo load, pallet, container, Light Commercial or Fishing vessel	
Class 17	Operational Load: Vehicular Load, Rail-mounted and Material Handling equipment, Heavy load transporter in use at shipbuilding yard¸ Port buildings and superstructure	
Class 18	Operational load: Port buildings and superstructure and Review	
Week 7	**Breakwater**	Mid Term Exam, Final
Class 19	Concept on breakwater, Arrangement of breakwater, Design Process of breakwater	
Class 20	Types of breakwater	
Class 21	Wave Structure Interactions	
Week 8	**Breakwater (Contd.)**	
Class 22	Structural design of rubble mound breakwater	
Class 23	Vertical breakwater: types and construction	
Class 24	Floating breakwater, Classification of floating breakwaters and their	

	details, Floating breakwaters: Advantage and Disadvantage, Floating breakwater design	Exam
Week 9	**Port Functions, Organisation and Methodology**	
Class 25	Port Functions, Transport chain, Organisation of seaports	
Class 26	Types of planning, planning process	
Class 27	Planning tasks, functional requirements and planning elements	
Week 10	**Port Functions, Organisation and Methodology (Contd.)**	
Class 28	Layout development, evaluation techniques	
Class 29	Economic and financial analysis and general observations	
Class 30	Assessment 3 (Mid Term Exam)	
Week 11	**Port Terminals and Container Terminals: Planning and Design**	CT-3/ Assignment, Final Exam
Class 31	Terminal components, types of terminals	
Class 32	Terminal capacity: maximum or optimum, terminal dimensions	
Class 33	Container transport and terminal operations,	
Week 12	**Port Terminals and Container Terminals: Planning and Design**	
Class 34	Lay-out development of container terminals	
	IMO and Marine Pollution from Ships	
Class 35	UNCLOS, GESAMP, Sources of pollution, Existing IMO instrument	
Class 36	Management of ballast water: BWM, General Obligations Under the BWM Convention, BWM plan and standard	
Week13	**Sea and River Ports of Bangladesh**	
Class 37	Chittagong Port Authority: Facilities, strength and weakness	
Class 38	Mongla Port Authority: Facilities, strength and weakness Payra Port Authority: Facilities, strength and weakness	
Class 39	Assessment- 4 (CT-3/Assignment)	
Week 14	**Sea and River Ports of Bangladesh (Contd.)**	
Class 40	River Ports of Bangladesh and their Assessment	
Class 41	Review Class and Open Discussion	
Class 42	Review Class and Open Discussion	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C2,C4,C5
			CO5	C6
	Class Participation	5%	CO1- CO5	
	Mid term	15%	CO2, CO3	C2, C6, A2
Final Exam		60%	CO1	C4, C5, P1
			CO2	C2, C4
			CO3	C6,A4
			CO4	C3, A3
			CO5	C6,
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Port Engineering by Zhou Liu & Hans F. Burcharth
2. Port Engineering: Planning, Construction, Maintenance, and Security by G. P. Tsinker
3. Ports and Terminals, Prof. I. H. Ligteringen, September 2000, Delft University of Technology.
4. Design and Construction of Ports and Marine Structures, A. D. Quinn, McGraw-Hill Book Company Ltd.
5. Port Management, Hercules
6. Dock and Harbour Engineering, Ozha & Ozha, 1 st Edition, Charotar Books, Anand., 1990

COURSE INFORMATION

Course Code: NAME 371 **Credit Hours:** 3.00
Course Title: Finite Element Method for Ship Structure **Contact Hours:** 3.00
Level and Term: Level 3, Term 1/2

PRE-REQUISITE

Course Code: NAME 201, NAME 301
Course Title: Mechanics of Structure, Ship Structure

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This optional theoretical course is intended to provide students with the necessary fundamental knowledge about the implementation of Finite Element Method for Engineering Analysis. The students should be able to Understand the fundamentals of Finite Element Method and stiffness method to solve engineering problems. Furthermore, after successful completion of this course students will develop skills to solve ship structure problems using finite element analysis.

OBJECTIVES

1. To acquire knowledge about the fundamentals of finite element analysis.
2. To be proficient in finite element formulations of ship structural problems.
3. Be aware of limitations of finite elements and source of errors both in modeling and computation.
4. Be able to solve ship structure problems using finite element methods.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Comprehend** the fundamentals of finite element analysis and finite element formulations.
2. **Solve** ship structure problems using finite element analysis.
3. **Interpret** results obtained from a finite element analysis.

COURSE CONTENTS

1. **Introduction:** Introduction to Finite Element Method, Elements and Nodes, Problem modeling using FEM and result checking, discretization and other approximations, responsibility of the user, Elementary matrix algebra.
2. **Bar and Beams. Linear Static Analysis:** Introduction, Stiffness Matrix Formulation: Bar Element, Stiffness Matrix Formulation: Beam element, Properties of **k** and **K**. Avoiding Singularity, Mechanical Loads, Thermal Loads, An Application.
3. **Plane Problems:** Introduction, Constant Strain Triangle (CST), Linear Strain Triangle (LST), Bilinear Quadrilateral (Q4), Quadratic Quadrilateral (Q8), Improved Bilinear Quadrilateral (Q6), Elements with "Drilling" d.o.f., Elements of More General Shape, Loads, Stress Calculation, Application examples
4. **Two-Dimensional Isoparametric Elements and Solution Techniques:** Node Numbering and Matrix Sparsity, Equation Solving, Transformations, Isoperimetric Elements: Formulation,

5. **Numerical Integration:** Gauss Quadrature and Isoparametric Elements, Choice of Quadrature Rule. Instabilities, Stress Calculation and Gauss Points, Nature of Finite Element Solution, Convergence Requirements. Patch Test, Infinite Media and Infinite Elements, Substructures, Symmetry, Constraints, Examples
6. **Modeling, Errors, and Accuracy in Linear Analysis:** Modeling in General, Structure Behavior and Element Behavior, Element Tests and Element Shapes, Test Cases and Pilot Studies, Material Properties, Loads, Connections, Boundary Conditions, Planning the Analysis, Numerical Error: Sources and Detection, Common Mistakes, Checking the Model, Critique of FE Results, Stress Concentrations. Sub-modeling, Convergence with Mesh Refinement, Error Measures and Adaptivity
7. **Plate and Shells:** Assumption and application of thin and thick plate theories, Finite elements for plates: Kirchhoff and R-M plate elements and related DoF, Finite Element for shells and DoF.
8. **Finite Element Idealization of Ship Structures:** Beam element idealization of ships' primary structural members, Hybrid modelling approach of ship structures using bar, beam and shell finite elements.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES:

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Comprehend** the fundamentals of finite element analysis and finite element formulations.	√											
CO2	**Solve** ship structure problems using finite element analysis.					√							
CO3	**Interpret** results obtained from a finite element analysis.				√								

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Comprehend** the fundamentals of finite element analysis and finite element formulations.	C2	1		1-4	CT, F
CO2	**Solve** ship structure problems using finite element analysis.	C3	3		6	CT, MT, F
CO3	**Interpret** results obtained from a finite element analysis.	C5	1		5	CT/ASG, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics, science and engineering fundamentals has to be applied to understand the fundamentals of finite element analysis.

CO2-PO5	Appropriate finite elements shall be used to model the physical behaviour of the structure using software in order to obtain an approximate solution.
CO3-PO4	Results obtained from finite element analysis shall be critically examined and verified.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction, course administration, motivation lecture	
Class 2	Introduction to the Finite Element Method (FEM), stress-strain curve of steel, Hooke’s law; Poisson’s ratio.	
Class 3	Assumptions for a linear-elastic finite element analysis, FEM formulation, Equilibrium, Compatibility and Material Law, Rigid body motion in 1D, 2D and 3D space and its significance.	
Week 2	**Elementary matrix algebra**	
Class 4	Vector & Matrix , Matrix addition, multiplication and its significance, inversion of [2 x 2], [3 x 3] and [4 x 4] matrices,	
Class 5	Gaussian elimination, singular matrix, Eigen value & Eigen vector of a matrix.	
Class 6	Element, node and DOF, DoF of 1D Bar and 2D beam elements.	
Week 3	**1D Bar Element**	
Class 7	Stiffness matrix formulation of a 1D bar, Applications and Limitations	
Class 8	Problem solving using 1D bar element	
Class 9	Class Test-1	
Week 4	**2D Beam Element**	
Class 10	Stiffness matrix formulation of a 2D beam element	

Class 11	Applications and Limitations of a 2D beam element	CT 2, Final Exam
Class 12	Problem solving using 2D beam element	
Week 5	**Plane Stress Element**	
Class 13	Plane problems, plane stress and plain strain element	
Class 14	CST element, strain-displacement matrix	
Class 15	LST element, strain-displacement matrix	
Week 6	**Plane Stress Element**	
Class 16	Q4 element, strain-displacement matrix	
Class 17	Q8 element, strain-displacement matrix	
Class 18	Class Test -2	
Week 7	**Plane Stress Element**	Mid Term, Final Exam
Class 19	Q6 element, shear locking and remedy	
Class 20	Loads and Boundary Conditions (BC) in plane problems	
Class 21	Mid Term Exam	
Week 8	**Software Application**	
Class 22	Guidance on uses of finite element software	
Class 23	Software application for solving 2D beam problem	
Class 24	Software application for solving 2D plane stress problem.	
Week 9	**Isoparametric Elements and Solution Techniques**	
Class 25	Isoparametric Elements: Formulation	
Class 26	Jacobian and stiffness matrix of isoparemetric elements,	
Class 27	Problems on coordinate and displacement interpolations of isoperimetric elements	Mid Term, Final Exam
Week 10	**Numerical Integration**	
Class 28	Gauss Quadrature and Isoparametric Elements	
Class 29	Stress Calculation and Gauss Points	
Class 30	Nature of FE solutions, Convergence requirements	
Week 11	**Modeling, Errors, and Accuracy in Linear Analysis**	
Class 31	Sources of errors in FEA, common mistakes in FEA, A case study on errors in FEA	
Class 32	Element tests (Patch test) and their shapes, Numerical errors: ILL-conditioning.	
Class 33	Means to improve FE solutions.	
Week 12	**Plate and Shells**	
Class 34	Assumption and application of thin and thick plate theories	
Class 35	Finite elements for plates: Kirchhoff and R-M plate elements and related DoF	
Class 36	Finite Element for shells and DoF	
Week13	**Finite Element Idealization of Ship Structures**	CT 3, Final Exam
Class 37	Substructures, symmetry, anti-symmetry and constraints	
Class 38	Beam element idealization of ships' primary structural members	
Class 39	Hybrid modeling approach of ship structures using finite elements	
Week 14	**Course Review**	
Class 40	Class Test-3	
Class 41	Course review	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Finite Element Modelling for Stress Analysis by Robert D. Cook
2. Fundamentals Finite Element Analysis by David Huttons.
3. The Finite Element Method It's Basis & Fundamentals by O.C. Zienkiewicz, R.L. Taylor & J.Z. Zhu
4. Finite Element Procedures by Klaus-Jürgen Bathe

COURSE INFORMATION

Course Code: NAME 373
Course Title: Computational Fluid Dynamics
Level and Term: Level 3 Term 1
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

Course Code: NAME 213, NAME 253
Course Title: Fluid Mechanics, Marine Hydrodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course introduces the beginning graduate and advanced undergraduate students to finite difference methods as a means of solving different type of differential equations that arise in fluid dynamics. Fundamentals of numerical analysis, ordinary differential equations and partial differential equations related to fluid mechanics and heat transfer will be reviewed. Error control and stability considerations are discussed and demonstrated. The Navier-Stokes equations will be solved using a commercial software.

OBJECTIVES

1. To demonstrate knowledge and understanding on flow computations using current best practices for numerical model and method selection and assessment of the quality of results obtained.
2. To familiarize the students with the physically justified assumptions to simplify and carry out feasible analysis of real-life fluid flow and heat transfer problems.
3. To induce the ability among students to use powerful computational tools to analyse fluid dynamics and heat transfer related problems.
4. To be able to simulate the resistance and propulsion related flow phenomena in the field of ship hydrodynamics.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Comprehend** different flow computations using current best practices for numerical model and method selection and assessment of the quality of results obtained.
2. **Make** physically justified assumptions to simplify and carry out feasible analysis of real-life fluid flow and heat transfer problems.
3. **Use** powerful computational tools to analyse fluid dynamics and heat transfer related problems.
4. **Apply** these methods and tools to simulate the resistance and propulsion related flow phenomena in the field of ship hydrodynamics.

COURSE CONTENT

1. **Governing equations of fluid flow:** Finite Control Volume, Substantial Derivative, Physical meaning of gradient of velocity, Conservation and non-conservation form of continuity equation, Conservation and non-conservation form of Navier-Stokes equation, Energy equation.

2. **Boundary integral methods:** Discretisation and Interpolation, Boundary Element Method, Green's theorem, Application of Boundary Integral Method to radiation and diffraction problems,
3. **Discretization schemes:** finite difference methods, finite volume methods, finite element methods, spectral methods etc.
4. **Finite Volume Method:** Diffusion problem, Convection – Diffusion problem, Discretization Schemes, Pressure – Velocity coupling, Solution of Discretized Equations, Unsteady flows, Implementation of Boundary Conditions, Errors and Uncertainty in CFD modeling.
5. **Turbulence modeling:** Characteristics of turbulent flow, Transition from laminar to turbulent flow, Reynolds Averaged Navier Stokes Equation (RANS), Turbulence Models, i.e., k-epsilon model, k-omega model, Spalart Almaras model, LES, DES, DNS etc.
6. **Grid generation:** Body-fitted coordinate grids for complex geometries, Cartesian vs curvilinear grids, Block-structured grids, Unstructured grids, Discretization in unstructured grids, Staggered vs co-located grid arrangements.
7. **Free surface flow:** free surface computation with linear and fully nonlinear boundary conditions, Numerical treatment of fluid-body interface, CFD application to free surface flow past ship shape objects using Reynolds Averaged Navier Stokes Equation (RANS).
8. **Errors and Uncertainty in CFD modelling:** Errors and Uncertainty in CFD, Numerical Errors, Input Uncertainty, Physical Model Uncertainty, Verification and Validation.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Comprehend** different flow computations using current best practices for numerical model and method selection and assessment of the quality of results obtained	√											
CO2	**Make** physically justified assumptions to simplify and carry out feasible analysis of real- life fluid flow and heat transfer problems.		√										
CO3	**Use** powerful computational tools to analyse fluid dynamics and heat transfer related problems.					√							
CO4	**Apply** these methods and tools to simulate the resistance and propulsion related flow phenomena in the field of ship hydrodynamics									√			

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Comprehend** different flow computations using current best practices for numerical model and method selection and assessment of the quality of results obtained	C3	1		1-4	CT, F
CO2	**Make** physically justified assumptions to simplify and carry out	C3	3		5	CT, MT, F

	feasible analysis of real- life fluid flow and heat transfer problems.					
CO3	**Use** powerful computational tools to analyse fluid dynamics and heat transfer related problems.	C4	3		1-4	CT/ASG, F
CO4	**Apply** these methods and tools to simulate the resistance and propulsion related flow phenomena in the field of ship hydrodynamics	C5	1		1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be acquired to figure out current best practices for numerical model and method selection and assessment of the uality of results obtained
CO2-PO2	In order to simplify and solve real life fluid flow and heat related problems, physically justified assumptions need to be made.
CO3-PO5	To analyze the fluid dynamics and heat transfer related problems modern tools like flow and heat transfer simulation software like fluent will be used.
CO4-PO9	In order to implement CFD techniques and tools to simulate real world resistance and propulsion related flow phenomena in the field of ship hydrodynamics

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction and Governing Equations of Fluid Flow**	CT 1, Final Exam
Class 1	Introduction, Finite Control Volume	
Class 2	Substantial Derivative	
Class 3	Physical meaning of gradient of velocity	
Week 2	**Governing Equations of Fluid Flow**	
Class 4	Conservation and non-conservation form of continuity equation	
Class 5	Conservation and non-conservation form of Navier-Stokes equation	
Class 6	Energy equation	
Week 3	**Boundary Integral Method**	
Class 7	Discretisation and Interpolation	
Class 8	Boundary Element Method	
Class 9	Green's theorem, Application of Boundary Integral Method to radiation and diffraction problems	
Week 4	**Discretization schemes**	CT 2, Final Exam
Class 10	finite difference methods, finite volume methods,	
Class 11	Assessment 01	
Class 12	finite element methods, spectral methods	
Week 5	**Finite Volume Method**	
Class 13	Diffusion problem	

Class 14	Convection – Diffusion problem,	
Class 15	Discretization Schemes,	
Week 6	**Finite Volume Method**	
Class 16	Pressure – Velocity coupling,	
Class 17	Solution of Discretized Equations,	
Class 18	Unsteady flows	
Week 7	**Finite Volume Method**	
Class 19	Implementation of Boundary Conditions,	
Class 20	Errors and Uncertainty in CFD modeling	
Class 21	Assessment 02	
Week 8	**Turbulence Modelling**	Mid Term, Final Exam
Class 22	Characteristics of turbulent flow,	
Class 23	Transition from laminar to turbulent flow,	
Class 24	Reynolds Averaged Navier Stokes Equation (RANS),	
Week 9	**Turbulence Modelling**	
Class 25	Turbulence Models, i.e., k-epsilon model	
Class 26	k-omega model, Spalart Almaras model,	
Class 27	LES, DES, DNS models	
Week 10	**Grid generation**	
Class 28	Body-fitted coordinate grids for complex geometries	
Class 29	Cartesian vs curvilinear grids,	
Class 30	Mid-term exam	
Week 11	**Grid Generation**	CT-3, Final Exam
Class 31	Block-structured grids, Unstructured grids,	
Class 32	Discretization in unstructured grids,	
Class 33	Staggered vs co-located grid arrangements	
Week 12	**Free Surface Flow**	
Class 34	free surface computation with linear and fully nonlinear boundary conditions,	
Class 36	CFD application to free surface flow past ship shape objects using Reynolds Averaged Navier Stokes Equation (RANS).	
Week13	**Error and Uncertainty Analysis in CFD**	
Class 37	Errors and Uncertainty in CFD	
Class 38	Numerical Errors	
Class 39	Input Uncertainty, Physical Model Uncertainty	
Week 14	**Error and Uncertainty Analysis in CFD**	
Class 40	Verification and Validation	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2

		CO2	C1, C2,C4
		CO3	C2, C4
		CO4	C2,C3,C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H.K. Versteeg and W Malalasekera, 2nd edition, Pearson Prentice Hall Editions, 2007.
2. Computational Methods for Fluid Dynamics, Ferziger, J.H. and Peric, M., 3rd edition, Springer-Verlag publishing group, 2002.
3. The Boundary Element Method with Programming for Engineers and Scientists, Beer, G., Smith, I., Duenser, C., Springer-Verlag/Wien publisher, 2008.
4. Computational Fluid Dynamics: An Introduction, John F. Wendt, 3rd edition, Springer Verlag Berlin Heidelberg, 2009.

COURSE INFORMATION

Course Code: NAME 389
Course Title: Marine Production and Planning
Level and Term: Level 3 Term 2
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Marine Production and Planning is a theoretical course designed to teach students about detail process and production planning of Marine vessels, shipyard and offshore platforms. In this course students will be acknowledged about the programming concept and network analysis. Thus, they will develop the necessary knowledge and skills for product standardization, scheduling and resource allocation involved in production of marine structures.

OBJECTIVES

1. To familiarize with ship production system.
2. To able to organize the design, material management in hull and outfit processing.
3. To make proficient in resource allocation, cost estimation for standardized production.
4. To understand various programming concept, database management and network analysis.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Perform** the Production Planning and control.
2. **Analyse** ship production methods, shipyard layout & productivity;
3. **Apply** linear programming, Network analysis and DBMS in shipbuilding
4. **Evaluate** production, scheduling and resource allocation;
5. **Build** and lead effective production teams and shipbuilding projects;

COURSE CONTENTS

1. Overview of ship production system; Shipbuilding Process, Shipyard Layout and Shipyard productivity.
2. Production Planning and Control; Introduction, Forecasting, Inventory, MRP, CPM, PERT, etc.
3. Design Process, Shipbuilding Process & Methods and Material Management in hull outfit and steel processing.
4. Shipbuilding production, scheduling, resource allocation and cost estimation.
5. Product standardization, work simplification, work breakdown and integrated zone engineering.
6. Linear programming concepts; introduction, requirement, formulations, solutions, etc.
7. Network analysis; Critical Path Analysis- introduction, advantage, fundamentals, logical sequencing, scheduling computations, etc.
8. Data Base Management System (DBMS) in production planning and control; overview, architecture, data models, schemas, independence, rules, generalization, specialization &

normalization, etc.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Perform** the production planning and control.		√										
CO 2	**Analyze** ship production methods, shipyard layout & productivity;		√										
CO 3	**Apply** linear programming, Network analysis and DBMS in shipbuilding			√									
CO 4	**Evaluate** production, scheduling and resource allocation.										√		
CO 5	**Build** and lead effective production teams and shipbuilding projects											√	

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Perform** the production, planning and control.	A2		1	1-4	CT, F
CO2	**Analyze** ship production methods, shipyard layout & productivity;	C4		4	1-4	CT, ASG, F
CO3	**Apply** linear programming, Network analysis and DBMS in shipbuilding	C3	1	3	5	CT, Mid Term, F
CO4	**Evaluate** production, scheduling and resource allocation.	C5	3	5	1-4	Mid Term, F
CO5	**Build** and lead effective production teams and shipbuilding projects	P5	2	2		ASG, Pr

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	Students will be able to take identify and undertake the necessary steps for planning and control during production.
CO2-PO2	By analyzing various methods of productions and layout, students will be capable of decision making for higher productivity.
CO3-PO3	Upon taking into consideration of database management system and network analysis, students will develop the skill of choosing appropriate planning and production design,
CO4-PO10	Students will be able to use programming tools and network so that they can evaluate and schedule the production with allotted resources.
CO5-PO11	Students will be developed with the knowledge of how to lead a production process including the decision making capability in individual projects.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	**Contents**	**Assessment**
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Overview of ship production system, stages and evolution	
Class 2	Shipbuilding layout and influencing factors	
Class 3	Layout of shipyard with respect to different generation of shipbuilding.	
Week 2	**Production Planning and Control**	
Class 4	Production system, classification and function	
Class 5	Forecasting, their types, approaches and function	
Class 6	Inventory and their models	
Week 3	**Production Planning and Control**	
Class 7	MRP, Inputs and outputs of MRP models	
Class 8	Network Technique of project management	
Class 9	Calculation models and steps in calculations in a Network Analysis	
Week 4	**Design Process**	CT 2, Final Exam
Class 10	Shipbuilding Process & Methods	
Class 11	Material Management in hull outfit and steel processing.	
Class 12	Assessment 1	
Week 5	**Product Work Breakdown**	
Class 13	Work simplification	
Class 14	Characteristics of WBS	
Class 15	Work breakdown and integrated zone engineering.	
Week 6	**Layout Strategy of Production System**	
Class 16	Layout Strategy of Production System	
Class 17	Requirements and strategies of good layout	
Class 18	Procedure for line balancing	
Week 7	**Hull Production**	

Class 19	Material handling method and process in shipyard	Mid Term, Final Exam
Class 20	Welding and weld defects	
Class 21	Assessment 02	
Week 8	**Outfitting**	
Class 22	Outfitting pattern and characteristics	
Class 23	Outfitting works in various spaces of ship	
Class 24	Inspection before commissioning of ships	
Week 9	**Cost Assessment in Ship Production**	
Class 25	Different approaches of cost assessment in ship building.	
Class 26	Salient features of various method	
Class 27	Advantage and disadvantage of various methods	Mid Term, Final Exam
Week 10	**Network Analysis**	
Class 28	Projects and its salient features	
Class 29	Working methodology of critical path analysis	
Class 30	Activities and events in CPA	
Week 11	**Network Analysis**	
Class 31	Dependency rule and logical sequencing	
Class 32	Forward Pass Computation and Backward Pass Computation	
Class 33	Mid-term exam	
Week 12	**Database Management System**	
Class 34	DBMS and it's characteristics	
Class 35	The 3-tier architecture of DBMS.	
Class 36	Entity-Relationship Model and Relational Model	
Week13	**Database Management System**	CT 3, Final Exam
Class 37	Generalization, Specialization and Inheritance in DBMS	
Class 38	Codd's 12 rules in a DBMS	
Class 39	Relational algebra	
Week 14	**Database Management System**	
Class 40	The mapping process of Entities and Relationships available to convert E-R diagram into relational scheme	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	A2, A5, C1
			CO2, CO5	C2, C4
	Class Participation	5%	CO1, CO2, CO3, CO4, CO5	C3, A4
	Mid term	15%	CO3, CO4	C1, C6, P1
Final Exam		60%	CO1	C1, C6
			CO2	A3, C4,C5
			CO3	C3, A4
			CO4	C5

		CO5	A4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Engineering for Ship Production, Lambs
2. Ship Production, Hammon and Moore

COURSE INFORMATION

Course Code: NAME 431
Course Title: Ship Hull Vibration
Level and Term: Level 4 Term 1/2
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is designed to provide knowledge on Ship Vibration which covers the basic ship vibration, types of vibration, mathematical basis of ship vibration, transverse vibration of beams, hydrodynamic inertial coefficients, virtual weights, torsional vibration of ships and mounting of engines that are essential for understanding the vibration problems in ship and offshore structures.

OBJECTIVES

1. To introduce the students with the types, causes and reduction of ship vibration
2. To enable the students proper understanding and interpretation of the results of hull vibration.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the types and causes of ship vibration
2. **Interpret** the consequences of vibration, the limits and **predict** possibilities of reduction.
3. **Analyze** the frequencies of vibration for different types of ships/ Floating bodies.
4. **Apply** analytical and numerical solutions of free and forced global hull-girder vibration for various degree of freedoms

COURSE CONTENTS

1. **Introduction and Mathematical basis of Ship vibration:** Definition and types of ship hull vibration, causes of hull vibration, Modes of vibration, Importance of vibration on ships, Mathematical basis of ship vibration calculation of ship hull vibration, Natural vibration and forced vibration, Resonance and Damping, Natural vibration and forced vibration with damping, Transverse vibration of beams.
2. **Hydrodynamic Inertia Coefficients and Added Virtual Weight:** Calculation of added mass Effects of restricted water on added virtual mass, added mass for hull girder vibration (vertical and horizontal), Added mass moment of inertia in torsional vibration.
3. **Natural Frequencies of a Ship's Hull:** Measurement of ship vibration, Two-Node vertical and horizontal frequencies of a ship hull, Higher flexure frequencies, Torsional frequencies of a hull, Empirical formulae for calculating hull frequencies: Schlick formula, Todd formula, Burrill formula, Bunyan formula, Lockwood Taylor formula, Kumai's Formula. Frequencies of higher modes.
4. **Hull Response to Exciting Forces:** Allowable limits of vibration in a ship, Calculation of

amplitude, Transverse vibration of engines, Sprung masses, Vibration induced in ship structure due to wave, propeller and machinery, Tensional, flexural and longitudinal vibrations of propeller shafting system.

5. **Consequences and Prevention of Ship Vibration:** Consequences of vibration in different types of vessels. Reduction of resonant vibration, Reduction of exciting forces, Reduction of existing vibration, Reduction of engine unbalance, Reduction of local vibration, Use of vibration Neutralizers, Elastic mountings, Reduction of vibration by propeller and machinery selection, suppression, isolation and insulation.
6. **Single degree of freedom systems:** Free and forced vibrations, clamping, classification and damped systems. Energy methods. Vibration isolation and transmissibility. Vibration measuring instruments such as displacement, velocity, acceleration and frequency measurements, Dunkerley's equation.
7. **Two degrees of freedom system:** Free, forced, damped and undamped motions matri.x formulation, matrix method, using of Lagrange's equations to determine equations of motion, Dynamic vibration absorbers, principle of Orthogonality. Semi-definite systems. Combined rectilinear and angular modes. Torsional systems.
8. **Multi degrees of freedom systems:** Free and Forced vibrations of longitudinal torsional and lateral modes. Critical speeds of rotors matrix formulation, stiffness and flexibility influence coefficients. Eigen value problem Matrix method, Matrix interactions technique for Eigen values and Eigen vectors. Stodola's method, Hozler's method.
9. **Continuous Systems:** Axial vibrations of bars, torsional vibrations of shafts, transverse vibrations of strings and bending vibrations of beams. Free and forced vibration of strings classical and energy methods.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the types and causes of ship vibration	√											
CO2	**Interpret** the consequences of vibration, the limits and **predict** possibilities of reduction.		√										
CO3	**Analyze** the frequencies of vibration for different types of ships/ Floating bodies.		√										
CO4	**Apply** analytical and numerical solutions of free and forced global hull-girder vibration for various degree of freedom..			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the types and causes of ship vibration	C2			1,2	CT
CO2	**Interpret** the consequences of vibration, the limits and **predict** possibilities of reduction.	C2,C3			1,4	F, Mid Term
CO3	**Analyze** the frequencies of vibration for	C4	1		1-4	CT, Mid

	different types of ships/ Floating bodies.					Term, F
CO4	**Apply** analytical and numerical solutions of free and forced global hull-girder vibration for various degree of freedom..	C3	1,2		5	CT/ASG, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	To explain the ship hull vibration with the basic science and mathematical formulation and
CO2-PO2	In order to identify and interpret the causes and effects of hull vibration and their allowable limits and based on the consequences to predict the possible solution to reduce the problems.
CO3-PO2	In order to estimate and analyze various mode of frequency of ship hull vibration using engineering sciences.
CO4-PO3	To find solutions of various mood vibration applying analytical and numerical method and use the results to consider dynamics features of hull at an earlier design stage of the project.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Individual Assignment, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 30 21 21
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	**120**

COURSE SCHEDULE

Week	Contents/Topics	Assessment
Week 1	**Introduction and Mathematical basis of Ship vibration**	CT 1
Class 1	Overview to ship vibration Course, Definition and types of ship hull vibration	
Class 2	Causes of hull vibration, Modes of vibration, Importance of vibration on ships	
Class 3	Mathematical basis of ship vibration calculation of ship hull vibration	
Week 2	**Introduction and Mathematical basis of Ship vibration (Contd.)**	
Class 4	Natural vibration and forced vibration	
Class 5	Natural vibration and forced vibration, Magnification factor, resonance and damping	
Class 6	Natural vibration and forced vibration with Viscous damping	
Week 3	**Introduction and Mathematical basis of Ship vibration (Contd.)**	
Class 7	Natural vibration and forced vibration with Viscous damping	
Class 8	Transverse vibration of beams and Review of this chapter	
Class 9	**Assesment-1**	
Week 4	**Hydrodynamic Inertia Coefficients and Added Virtual Weight**	CT 2, Final Exam
Class 10	Concepts of virtual added mass/weight, Effects of restricted water on added virtual mass	
Class 11	Added mass for vertical and horizontal hull girder vibration	
Class 12	Added mass moment of inertia in torsional vibration, Mathematical Examples and Review of this chapter	
Week 5	**Natural Frequencies of a Ship's Hull**	
Class 13	Measurement of ship vibration and vibration generators	
Class 14	Two-Node vertical and horizontal frequencies of a ship hull	
Class 15	Higher flexure frequencies, Torsional frequencies of a hull, Frequencies of higher modes	
Week 6	**Natural Frequencies of a Ship's Hull (Contd.)**	
Class 16	Empirical formulae for calculating hull frequencies: Schlick formula, Todd formula	
Class 17	Empirical formulae for calculating hull frequencies: Burrill formula, Bunyan formula, Lockwood Taylor formula, Kumai's Formula	
Class 18	**Assessment -2**	
Week 7	**Hull Response to Exciting Forces**	Mid Term & Final Exam
Class 19	Allowable limits of vibration in a ship, Calculation of amplitude, Sprung masses	
Class 20	Vibration induced in ship structure due to wave, propeller and machinery, Transverse vibration of engines	
Class 21	Tensional, flexural and longitudinal vibrations of propeller shafting system and Review of this chapter	
Week 8	**Consequences and Prevention of Ship Vibration:**, ,	
Class 22	Consequences of vibration in different types of vessels. Reduction of resonant vibration, Reduction of exciting forces, Reduction of existing vibration, Reduction of local vibration, Use of vibration Neutralizers,	
Class 23	Reduction of engine unbalance, Elastic mountings, Reduction of vibration by propeller and machinery selection, suppression, isolation and insulation	
Class 24	Reduction of vibration by propeller and machinery selection, suppression, isolation and insulation and Review of this chapter	
Week 9	**Single degree of freedom systems**	
Class 25	Free and forced vibrations, clamping, classification and damped systems. Energy methods	
Class 26	Vibration isolation and transmissibility. Vibration measuring instruments	

	such as displacement, velocity, acceleration and frequency measurements, Dunkerley's equation.	
Class 27	**Assessment 3**	CT-3/ASG, Mid Term, Final Exam
Week 10	**Twodegrees of freedom system**	
Class 28	Free, forced, damped and undamped motions matrix formulation, matrix method	
Class 29	using of Lagrange's equations to determine equations of motion, Dynamic vibration absorbers, principle of Orthogonality	
Class 30	Semi-definite systems. Combined rectilinear and angular modes. Torsional systems.	
Week 11	**Multi degrees of freedom systems**	
Class 31	Free and Forced vibrations of longitudinal torsional and lateral modes	
Class 32	Critical speeds of rotors matrix formulation, stiffness and flexibility influence coefficients	
Class 33	Critical speeds of rotors matrix formulation, stiffness and flexibility influence coefficients	
Week 12	**Multi degrees of freedom systems**	
Class 34	Eigen value problem, Matrix method, Matrix interactions technique for Eigen values and Eigen vectors	
Class 35	Matrix method, Matrix interactions technique for Eigen values and Eigen vectors	
Class 36	Stodola's method and Hozler's method	
Week13	**Continuous Systems**	Final Exam
Class 37	Axial vibrations of bars and Torsional vibrations of shafts	
Class 38	Transverse vibrations of strings and bending vibrations of beams	
Class 39	Free and forced vibration of strings classical and energy methods	
Week 14		
Class 40	Revision Class-1	
Class 41	Revision Class-2	
Class 42	**Assessment -4**	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment	20%	CO1, CO2	C1, C2, C3
			CO4	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C2, C3
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Ship Hull Vibration - F. H. Todd (1961)
2. Naval Architecture for Marine Engineers - W. Muckle (1975): Vibration Chapter
3. Muckle's Naval Architecture - Revised by D. A. Taylor (1987)
4. Guide to Ship Vibration - NKK (1984)
5. Dynamic Analysis of Offshore Structures - C. A. Bravia & S. Walker (1979)

COURSE INFORMATION

Course Code: NAME 435 **Credit Hours:** 3.00
Course Title: Computer Aided Ship Production **Contact Hours:** 3.00
Level and Term: Level 4 Term 1/2

PRE-REQUISITE

Course Code: NAME 107, NAME 207
Course Title: Introduction to Naval Architecture and Marine Engineering, Ship Design

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Optional Theoretical Course based on in-depth knowledge on Ship Production by using software. The goal of this course is to provide the basic concepts and tools of computer aid ship design and how to apply these concepts and tools in practical computer aided ship design problems.

OBJECTIVES

1. Be able to impart knowledge on 3D modelling.
2. Achieving ability to familiarize the students with the industry standard designs.
3. Be proficient to produce ships' hull and other critical parts.
4. Be able to determine the effectiveness of CAM in ship designing.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Develop** 3D hull modelling and **fit** internal structures
2. **Produce** a limited set of design drawings to industry standards
3. **Develop** a concept design based on an appraisal of operational requirements
4. **Create** an assembly of parts, **create** a detailed drawing, **assemble** a manufacturing environment.
5. **Create** basic NC sequences necessary for material removal.
6. **Perform** ship design, production, management and critically **assesses** their contribution and effectiveness.

COURSE CONTENTS

1. Introduction to computer aided manufacture (CAM)
2. Surface modeling, B-spline, non-uniform rational B-spline.
3. physically based deformable surface, sweeps and generalized cylinders
4. offsets, blending and filtering surfaces
5. Mathematical representation of hull form
6. Numerical control (NC) and robotics application in CAM
7. shell plate development
8. Modern ship production methods in a total ship system and concurring engineering context
9. Basic fabrication and material handling processes, process planning and scheduling.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Develop** 3D hull modelling and **fit** internal structures			√									
CO2	**Produce** a limited set of design drawings to industry standards		√										
CO3	**Develop** a concept design based on an appraisal of operational requirements			√									
CO4	**Create** an assembly of parts, **create** a detailed drawing, **assemble** a manufacturing environment.							√					
CO5	**Create** basic NC sequences necessary for material removal.		√										
CO6	**Perform** ship design, production, management and critically **assesses** their contribution and effectiveness.					√							

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Develop** 3D hull modelling and **fit** internal structures	C6	1	1	1-4	CT/ASG, F
CO2	**Produce** a limited set of design drawings to industry standards	C3	1	3	1-4	CT/ASG,F
CO3	**Develop** a concept design based on an appraisal of operational requirements	C6	1	2	5	CT/ASG,
CO4	**Create** an assembly of parts, **create** a detailed drawing, **assemble** a manufacturing environment.	C6, C6, C6	1	1	1-4	CT/ASG, F MT
CO5	**Create** basic NC sequences necessary for material removal.	C6	1	1	3	CT/ASG, F MT
CO6	**Perform** ship design, production, management and critically **assesses** their contribution and effectiveness.	C3, C5	1	2	1-4	CT/ASG, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPING

Mapping	Justifications
CO1-PO3	To develop 3D hull modelling and fit internal structures, by using software.
CO2-PO2	In order to produce a limited set of design drawings to industry standards.
CO3-PO3	To develop a concept design based on an appraisal of operational requirements.

CO4-PO7	To create an assembly of parts, create a detailed drawing, assemble a manufacturing environment.
CO5-PO2	To create basic NC sequences necessary for material removal.
CO6-PO5	In order to perform ship design, production, management and critically assesses their contribution and effectiveness for complex engineering problems.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction to computer aided manufacture (CAM)**	CT 1, Final Exam
Class 1	Introduction	
Class 2	Basic Strategies	
Class 3	Approaches in Design	
Week 2	**Surface modelling**	
Class 4	Defining Surface Parts	
Class 5	Combining Surfaces	
Class 6	Surface vs Solid Modeling	
Week 3	**B-spline**	
Class 7	Types of B-spline	
Class 8	Curves and Surfaces	
Class 9	Algorithms of B-spline	
Week 4	**Non-uniform rational B-spline**	
Class 10	Usage of Non-uniform rational B-spline	
Class 11	Assessment 01	
Class 12	Construction of the basis functions	
Week 5	**Physically based deformable surface**	

Class 13	Modelling of Physically based deformable surface	Mid Term, Final Exam
Class 14	Approach	
Class 15	Applications of Physically based deformable surface	
Week 6	**Sweeps and generalized cylinders**	
Class 16	Modelling of Sweeps and generalized cylinders	
Class 17	Approach	
Class 18	Applications of Sweeps and generalized cylinders	
Week 7	**Offsets**	Mid Term, Final Exam
Class 19	Modelling and Approach	
Class 20	Application of Offsets	
Class 21	Assessment 02	
Week 8	**Blending and filtering surfaces**	
Class 22	Modelling of Blending and filtering surfaces	
Class 23	Approach	
Class 24	Applications of Blending and filtering surfaces	
Week 9	**Mathematical representation of hull form**	
Class 25	Hull form and geometry.	
Class 26	Methodology for Hull Modeling	
Class 27	Guidelines for Work Sequence	CT 2, Final Exam
Week 10	**Numerical control (NC)**	
Class 28	Fundamentals of NC	
Class 29	Advantages and Limitations, Components of NC	
Class 30	Mid-term exam	
Week 11	**Robotics application in CAM**	
Class 31	Advantages of Robotics in CAM	
Class 32	Limitations of Robotics in CAM	
Class 33	Applications	
Week 12	**Shell plate development**	
Class 34	Methodology of shell plate development	
Class 35	Methodology of shell plate development	
Class 36	Methodology of shell plate development	
Week13	**Modern ship production methods in a total ship system and concurring engineering context**	CT 3, Final Exam
Class 37	Terms associated	
Class 38	Methods	
Class 39	Methods and their limitations	
Week 14	**Basic fabrication and material handling processes, process planning and scheduling**	
Class 40	Handling Processes, Process planning and scheduling	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous	Class Test/	20%	CO1	C2, C6

<table>
<tr><td rowspan="8">Assessment
(40%)</td><td rowspan="5">Assignment 1-3</td><td rowspan="5"></td><td>CO2</td><td>C3, C3</td></tr>
<tr><td>CO3</td><td>C5, C6</td></tr>
<tr><td>CO4</td><td>C6</td></tr>
<tr><td>CO5</td><td>C6</td></tr>
<tr><td>CO6</td><td>C3, C5</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO1</td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>CO3</td><td>C3,C4C6</td></tr>
<tr><td>CO4</td><td>A1, C6</td></tr>
<tr><td colspan="2" rowspan="6">Final Exam</td><td rowspan="6">60%</td><td>CO1</td><td>C2, C3, C4 C6</td></tr>
<tr><td>CO2</td><td>C3, C4,C5</td></tr>
<tr><td>CO3</td><td>C5 C6</td></tr>
<tr><td>CO4</td><td>C5, C6, A4,P1</td></tr>
<tr><td>CO5</td><td>C6, A2, P1</td></tr>
<tr><td>CO6</td><td>C3, C5</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Computer aided applications in ship technology, by C.Kuo, K. J. MacCallum.
2. Computer Aided Ship Design and Numerically Controlled Production of Towing Tank Models by D.F. Rogers, F. Rodriguez, S.G. Satterfield
3. Ship Production, Hammon and Moore.

COURSE INFORMATION

Course Code: NAME 437 **Credit Hours:** 3.00
Course Title: Inland Water Transportation System **Contact Hours:** 3.00
Level and Term: Level 4 Term 1/2

PRE-REQUISITE

Course Code: NA
Course Title: NA

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Optional Theoretical Course which emphasises the Inland Water Transportation System, operations and efficient movement of freight and passengers. Students are exposed to the processes used for managing inland waterway operations to managing system-wide operations. . It will benefit students wishing to pursue engineering employment in waterway industries with a shipping company or governmental agency or a company providing services to the industry.

OBJECTIVES

1. To enable the students to identify the pattern and develop a network for inland water system.
2. To enable for selection suitable vessel for inland water transportation.
3. To make decisions on the mode of inland water transportation.
4. To provide the students with a basic understanding to identify and comply with the rules and regulations for inland water transportation system

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the pattern of inland water transportation.
2. **Develop** network system for inland water.
3. **Identify** the suitable vessels and their characteristics for inland transportation.
4. **Design** of the suitable vessels for inland transportation.
5. **Make** decisions on the modes of inland water transportation
6. **Identify** special regulations for inland transportations.

COURSE CONTENTS

1. Inland Water Transport System: Advantage, limitation, Government strategy, Responsibilities of different organizations.
2. Inland waterways & their peculiarities, Classification, Development constraint, Recommendation relating to waterway network.
3. Maintenance of navigational channel: siltation, bank erosion & dredging.
4. Requirements for dredging, dredging technique, disposal of sediments, dredging of fairways.
5. Inter-modal transportation, Specialized inter-modal transportation vessel.
6. Design of inland waterway transportation system, Design & operational aspects of small craft.

7. Design of specialized inland vessel, tug-barge system.
8. Different type of tug, barge & connection system, Shallow draft tug, inland passenger vessels, research vessel, pontoon, hydrofoil, Ro- ro vessel, etc., Marine Salvage.
9. Inter-modalism and multi-modalism, advantage and disadvantage, Intermodal Transport Chain,
10. Intermodal Transport Units, Techniques & Costs, Inter-modality at Inland Water Transport,
11. Intermodal Transportation networks, Transport system & network design, SSCA & MEA
12. Intermodal design process guideline, Framework for intermodal networks design at IWT.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES:

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the pattern of inland water transportation	√											
CO2	**Develop** network system for inland water			√									
CO3	**Identify** the suitable vessels and their characteristics for inland transportation	√											
CO4	**Design** of the suitable vessels for inland transportation			√									
CO5	**Make decisions** on the modes of inland water transportation				√								
CO6	**Identify** special regulations for inland transportations						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the pattern of inland water transportation	C2	1		1, 4-6	CT/ ASG, F
CO2	**Develop** network system for inland water	C2	1,3		5-6	CT/ ASG, MT, F
CO3	**Identify** the suitable vessels and their characteristics for inland transportation	C4, C5	1,3		5-6	CT/ ASG, F
CO4	**Design** of the suitable vessels for inland transportation	C2, C4, C6	1		6	CT/ ASG, MT, F
CO5	**Make decisions** on the modes of inland water transportation	C2, C5	3		1,5	CT/ ASG, F
CO6	**Identify** special regulations for inland transportations	C4, C5	1,3		7	CT/ ASG, MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics, science and engineering fundamentals have to be applied to explain the pattern of inland water transportation.
CO2-PO3	In order to design network system for inland water transportation.
CO3-PO1	The knowledge of mathematics, science and engineering fundamentals have to be applied to identify the suitable vessel with desired characteristics.
CO4-PO3	In order to design suitable vessel for inland water transportation.
CO5-PO4	In order to provide decision on the mode of inland water transportation by investigations including experiments, analysis etc.
CO6-PO6	In order to identify special regulation for inland transportations.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	**CT 1 Final Exam**
Class 1	Introduction to Inland Water Transport System	
Class 2	Advantage and limitation	
Class 3	Inland waterways, classification & their peculiarities	
Week 2	**Inland waterways**	
Class 4	Inland waterways, classification & their peculiarities	
Class 5	Government Strategy, Responsibilities of different Organizations	
Class 6	Development Constraint of Inland Waterways	
Week 3	**Maintenance**	
Class 7	Maintenance of navigational channel; siltation, bank erosion & dredging	
Class 8	Requirements for dredging, disposal of sediments, dredging of fairways	
Class 9	Dredging technique	

Week 4	**Inter-modal transportation**	**CT 2 Final Exam**
Class 10	Recommendation relating to waterway network	
Class 11	Inter-modal transportation	
Class 12	Specialized inter-modal transportation vessel	
Week 5	**Design of inland waterway transportation system**	
Class 13	Design of inland waterway transportation system (Contd)	
Class 14	Design of inland waterway transportation system	
Class 15	Design & operational aspects of small craft (Contd)	
Week 6	**Design of small craft and specialized vessel**	
Class 16	Design & operational aspects of small craft	
Class 17	Design of specialized inland vessel (Contd)	
Class 18	Design of specialized inland vessel	
Week 7	**Tug-barge system**	**Mid Term Final Exam**
Class 19	Tug-barge system	
Class 20	Different type of tug, barge & connection system	
Class 21	Shallow draft tug, inland passenger vessels, research vessel	
Week 8	**Other system**	
Class 22	Pontoon, hydrofoil, Ro- Ro vessel	
Class 23	Marine Salvage	
Class 24	Inter-modalism and multi-modalism	
Week 9	**Inter-modalism and multi-modalism**	
Class 25	Advantage and disadvantage of Inter-modalism and multi-modalism	
Class 26	Intermodal Transport Chain, Intermodal Transport Units	
Class 27	Intermodal Transport Techniques	
Week 10	**Intermodal Transport Costs**	**CT 3 Final Exam**
Class 28	Intermodal Transport Costs	
Class 29	Inter-modality at Inland Water Transport	
Class 30	Intermodal Transportation networks	
Week 11	**Transport system & network design**	
Class 31	Transport system & network design (Contd)	
Class 32	Transport system & network design (Contd)	
Class 33	Transport system & network design	
Week 12	**Intermodal design process guideline**	
Class 34	SSCA & MEA	
Class 35	Intermodal design process guideline (Contd)	
Class 36	Intermodal design process guideline	
Week13	**IWT Framework**	**Final Exam**
Class 37	Framework for intermodal networks design at IWT	
Class 38	Organogram of various regulation authorities	
Class 39	Differences and similarities of different regulation authorities	
Week 14	**Rules and regulations**	
Class 40	Rules and regulations of different authorities	
Class 41	Analysis of some important accidents in Inland Waterways	
Class 42	Future developments in Inland Waterways	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C2, C4, C6
			CO4	C2, C4, C6
	Class Participation	5%	CO6	
	Mid term	15%	CO1, CO3, CO5	C1, C2, C3
Final Exam		60%	CO1	C1, C2, C3
			CO2	C1, C2, C3
			CO3	C4, C5
			CO4	C2, C4, C6
			CO5	C2, C3 C5
			CO6	C4, C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Inland Water Transportation Systems Series, Authors: Dr. Sulaiman Olanrewaju Oladokun
2. Inland Waterway Transport: Challenges and Prospects, edited by Bart Wiegmans, Rob Konings
3. UNECE Resolutions
4. CCNR Regulations
5. Inland Shipping Ordinance, 1976 (Ordinance No. LXXII of 1976)
6. European Policy for the Promotion of Inland Waterway Transport – A Case Study of the Danube River: By Svetlana Dj. Mihic and Aleksandar Andrejevic

COURSE INFORMATION

Course Code: NAME 445 **Credit Hours:** 3.0
Course Title: Dredger and Dredging Technology **Contact Hours:** 1.5
Level and Term: Level 4 Term1

PRE-REQUISITE

Course Code: NAME 307
Course Title: Design of Special Ships

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Optional Theoretical Course based on existing and advanced logistics and technologies of dredger & dredging. This course provides an inventory of the dredging equipment and disposal techniques used in Bangladesh and provide guidance for activities associated with new work and maintenance projects. This course further provides guidance on the evaluation and selection of equipment and evaluation of disposal alternatives.

OBJECTIVES

1. To introduce with concepts of different dredging processes and dredging equipment.
2. To familiarize with the procedures for planning and the design considerations for meeting the objectives of a dredging project and associated problems.
3. To give an overview about dredging prospects of Bangladesh.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Identify** and **explain** about dredging methods, dredging technologies and dredging equipment;
2. **Analyze** dredging techniques and methods, output and productions;
3. **Estimate** the performance and output of various types of dredging and dredgers;
4. **Make** decisions for use of type of dredging equipment for different type of soil conditions;
5. **Plan** and **organize** effective dredging teams and dredging projects.

COURSE CONTENTS

1. **Introduction to Dredging**
   a. Definitions of Dredging, requirements of Dredging, Various purpose of dredging, Dredging requirement areas, Stages of Dredging;
   b. Dredging operation layout, Dredging procedure (Pretreatment, Extraction, and Disposal);
   c. Selection of Dredging Equipment: Criteria/Boundary Conditions, Factors in Selection.

2. **Dredger Classification**
   a. Mechanical Dredger: application, advantages and limitations, types (Bracket, Grab, Backhoe with description);
   b. General outline of Hydraulic dredger, Suction dredger, Cutter Suction Dredger, Trailing

Suction Hopper Dredger, Reclamation Dredger, Barge Unloading Dredger, others (Airlift, Augur suction, pneumatic, amphibious, water injection);
   c. Mechanical vs Hydraulic Dredger

3. **Cutter Suction Dredger (CSD)**
   a. General Description (Area of application, History, Working Method),
   b. Design (Production Capacity, Dredging Depth, Max/Min Dredging Depth, Width of the cut, type of soil, transport distance, access to site),
   c. Dredging equipment,
   d. The drives,
   e. Spud Systems,
   f. General Layout

4. **Trailing Suction Hopper Dredger**
   a. General Description (characteristics, application area, history, working method),
   b. The design (Productive capacity, main dimensions, dredge installation, propulsive power, power balance, main layout),
   c. Technical Construction,
   d. Dredging Calculation (estimating discharge-head, effect of dredge material characteristics, pump performance characteristics, estimation of output of various types of dredging. Special features of dredge pump)

5. **Type of accessories, pipes and floaters**
   a. pipeline fittings, rubber hose, ball socket, etc.
   b. Pump and pipeline characteristics,
   c. Working point, working range,
   d. Operation of a pump and pipeline system.
   e. Environmental aspects of dredging.

6. **Brief review of dredging need**
   a. dredging operation and dredging process for Bangladesh

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** and **explain** about dredging methods, dredging technologies and dredging equipment;		√										
CO2	**Analyze** dredging techniques and methods, output and productions;		√										
CO3	**Estimate** the performance and output of various types of dredging and dredgers;		√										
CO4	**Make** decisions for use of type of dredging equipment for different type of soil conditions;			√									
CO5	**Plan** and **organize** effective dredging teams and dredging projects;						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** and **explain** about dredging methods, dredging technologies and dredging equipment;	C3, C4			1-4	CT
CO2	**Analyze** dredging techniques and methods, output and productions;	C3			1-4	CT/ASG, F
CO3	**Estimate** the performance and output of various types of dredging and dredgers;	C2			5	Mid Term Exam, F
CO4	**Make** decisions for use of type of dredging equipment for different type of soil conditions;	P7	3		1	
CO5	**Plan** and **organize** effective dredging teams and dredging projects;	C6	1	1	7	CT, F
C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	Identifying various dredging methods, dredging technologies and dredging equipment, student will be able to explain these.
CO2-PO2	Students will be able to analyze dredging techniques and methods, output and productions.
CO3-PO2	Based on various operating criteria, students will be able to estimate the performance and output of various types of dredging and dredgers.
CO4-PO3	Student will be able familiar with the procedures for planning and the design considerations for meeting the objectives of a dredging project and associated problems. Hence able to make decision to design solutions of using dredging equipment and technologies for different type of soil conditions.
CO5-PO6	Students will be able to work as a team and learn about concerns and precautions for the prevention of adverse effects on the environment and animal habitats and utilization of dredged material for beneficial disposal are considered. Organizing skill will help the learner to decide possible solutions which are safer to society while designing a system.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	

Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction to Dredging**	CT 1
Class 1	Definitions of Dredging, requirements of Dredging,	
Class 2	Various purpose of dredging, Dredging requirement areas, Stages of Dredging	
Class 3	Dredging operation layout	
Week 2	**Introduction to Dredging (Contd.)**	
Class 4	Dredging procedure (Pretreatment, Extraction, and Disposal)	
Class 5	Selection of Dredging Equipment: Criteria/Boundary Conditions, Factors in Selection.	
Class 6	Review Class	
Week 3	**Dredger Classification**	
Class 7	Mechanical Dredger: application, advantages and limitations	
Class 8	Types of dredging (Bracket, Grab, Backhoe with description)	
Class 9	General outline of Hydraulic dredger, Suction dredger, Cutter Suction Dredger	CT 2, Final Exam
Week 4	**Dredger Classification (Contd.)**	
Class 10	General outline of Trailing Suction Hopper Dredger, Reclamation Dredger, Barge Unloading Dredger	
Class 11	General outline of other types (Airlift, Augur suction, pneumatic, amphibious, water injection)	
Class 12	Assement-1 (CT-1)	
Week 5	**Cutter Suction Dredger (CSD)**	
Class 13	Mechanical vs Hydraulic Dredger	
Class 14	General Description (Area of application, History, Working Method)	
Class 15	Design (Production Capacity, Dredging Depth, Max/Min Dredging Depth, Width of the cut, type of soil, transport distance, access to site)	
Week 6	**Cutter Suction Dredger (CSD) (Contd.)**	
Class 16	Design (Production Capacity, Dredging Depth, Max/Min Dredging Depth, Width of the cut, type of soil, transport distance, access to site)	
Class 17	Review Class	
Class 18	Assement-2 (CT-2)	

Week 7	**Cutter Suction Dredger (CSD) (Contd.)**	Mid Term, Final Exam, Presentation
Class 19	Dredging equipment	
Class 20	The drives, Spud Systems	
Class 21	General Layout	
Week 8	**Trailing Suction Hopper Dredger**	
Class 22	General Description (characteristics, application area, history, working method)	
Class 23	The design (Productive capacity, main dimensions, dredge installation, propulsive power, power balance, main layout)	
Class 24	The design (Productive capacity, main dimensions, dredge installation, propulsive power, power balance, main layout)	
Week 9	**Trailing Suction Hopper Dredger (Contd.)**	Final Exam
Class 25	Technical Construction	
Class 26	Dredging Calculation (estimating discharge-head, effect of dredge material characteristics)	
Class 27	Dredging Calculation (pump performance characteristics, estimation of output of various types of dredging. Special features of dredge pump)	
Week 10	**Trailing Suction Hopper Dredger (Contd.)**	
Class 28	Review Class	
Class 29	Review Class	
Class 30	Assesment-3(Mid Term Exam)	
Week 11	**Type of accessories, pipes and floaters**	CT 3, Final Exam
Class 31	Pipeline fittings, rubber hose, ball socket, etc.	
Class 32	Pump and pipeline characteristics	
Class 33	Working point, working range	
Week 12		
Class 34	Operation of a pump and pipeline system.	
Class 35	Special features of dredge pump. Types of floaters.	
Class 36	**Environmental aspects of dredging**	
Week13	**Brief review of dredging need in Bangladesh**	
Class 37	Brief review of dredging need in Bangladesh	
Class 38	Dredging operation and dredging process for Bangladesh	
Class 39	Visit in an ongoing dredging project	
Week 14		
Class 40	Assessment -4 (CT-3)	
Class 41	Review Class	
Class 42	Review Class	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO5	C1,C2,C3
			CO2	C2,C3
	Class Participation	5%	CO1-CO6	
	Mid term	15%	CO3, CO6	C1, C3

Final Exam	60%	CO2	C2,C3
		CO3	C3
		CO4	C2
		CO5	C1,A2
		CO6	C1
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Designing Dredging Equipment, Prof.Ir. W.J.Vlasblom. Pagina 14 van 79. May 2005
2. Dredging-A handbook for Engineers by R.N. Bray, A. D. Bates J. M. Land December 1995
3. Fundamentals of Hydraulic Dredging Second Edition, Thomas M. Turner, published by ASCE Press American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191-4400
4. Hydraulic structures, equipment and water data acquisition systems – vol. ii – Dredging Technology - Rudolf van den Bosch

COURSE INFORMATION

Course Code: NAME 447
Course Title: Marine Transportation System
Level and Term: Level 4 Term 2
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The main purpose of this course for its graduates is to develop the competencies and corresponsive abilities in thinking and applying the major theories and techniques regarding the general science of transports, in area of maritime transport and port management, in order understand the ship/port operations, the harbours' activity and shipyard industry particularities. The main topics of this course as introductory module in maritime problems of study are limited to: maritime transport components, maritime market study and instruments, maritime voyage operations and financing support, contract operations in shipping, merchandise expeditions, fluvial transports, and containerization procedures.

OBJECTIVES

1. To enable to get a clear understanding of the Shipping Market.
2. To enable to evaluate the economics and pattern of the Maritime Trade.
3. To familiarize with the regulatory framework of Maritime Trade.
4. To enable to analyze maritime forecasting and market research.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Analyze** the working aspects of different types of economic organization of the shipping market.
2. **Evaluate** the different types of special features of shipping market.
3. **Predict** the global pattern of maritime trade and freight rate.
4. **Perform** maritime forecasting and market research.
5. **Make** decision regarding ship design to fulfill the demand of ship economics.

COURSE CONTENTS

1. The Economic Organization of the Shipping Market
2. The Shipping Market Cycle, The Shipping Markets
3. Supply, Demand and Freight rates
4. Cost, Revenue and Financial Performance, Financing Ships and Shipping Company
5. The Economic Principles of Maritime Trade, The global pattern of Maritime Trade
6. Bulk cargo and the economics of bulk shipping
7. The general cargo and the economics of liner shipping
8. The economics of ships and ship designs, The regulatory framework of maritime economics
9. The economics of shipbuilding and scrapping, Maritime forecasting and Market research

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Analyze** the working aspects of different types of economic organization of the shipping market.		√										
CO2	**Evaluate** the different types of special features of shipping market.	√											
CO3	**Predict** the global pattern of maritime trade and freight rate.		√										
CO4	**Perform** maritime forecasting and market research.		√										
CO5	**Make** decision regarding ship design to fulfill the demand of ship economics.			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Analyze** the working aspects of different types of economic organization of the shipping market.	C3			1-4	CT, F
CO2	**Evaluate** the different types of special features of shipping market	C2			1-4	CT, MT, F
CO3	**Predict** the global pattern of maritime trade and freight rate..	C3			5	CT/ASG, F
CO4	**Perform** maritime forecasting and market research.	A2			8	MT, F
CO5	**Make** decision regarding ship design to fulfill the demand of ship economics.	C5			5	CT, MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	In order to analyze the economic aspects of Shipping market.
CO2-PO1	In order to identify the features of the shipping market.
CO3-PO2	In order to study the maritime trade and be able to make a prediction about the global trade.
CO4-PO2	In order to perform maritime forecasting and research with sufficient research.
CO5-PO3	In order to modify ship designs to cater the demands of the shipping market.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Case Studies, Industry Evaluation.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	**Contents**	**Assessment**
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction	
Class 2	Introduction to the Shipping Market	
Class 3	The Economic Organization of the Shipping Market	
Week 2	**The Shipping Market**	
Class 4	The Shipping Market Cycle	
Class 5	Shipping Market's Supply and Demand	
Class 6	Freight Rates	
Week 3	**Freight Market**	
Class 7	Cost, Revenue and Financial	
Class 8	Financing Ships and Shipping Company	
Class 9	Freight Market and Operating Economics	
Week 4	**Maritime Trade Market**	CT 2, Final Exam
Class 10	The Economic Principles of Maritime Trade	
Class 11	The Economic Principles of Maritime Trade(Continued)	
Class 12	Assessment 01	
Week 5	**Global Pattern of Maritime Trade**	
Class 13	The Global Pattern of Maritime Trade	
Class 14	Prediction of Global Pattern of Maritime Trade	
Class 15	Case Study regarding Maritime Trade	
Week 6	**Bulk Cargo Shipping**	
Class 16	Bulk Cargo Shipping	
Class 17	Bulk Carrier Design Aspects to Meet global demand	
Class 18	Economics of Bulk Shipping	

Week 7	**Liner Shipping**	Mid Term, Final Exam
Class 19	Global Cargo Shipping	
Class 20	The Economics of Liner Shipping	
Class 21	Assessment 02	
Week 8	**Economics of Ship Design**	
Class 22	Important Technical and Economic Features of Ship	
Class 23	The Economics of Ship and Ship Design	
Class 24	Ship Design to Meet Global Demands	
Week 9	**Maritime Economics**	
Class 25	Tendering and Contracts	
Class 26	Commercial and Marketing Aspects of Shipbuilding and Shipping	
Class 27	Legal and Financial Aspects of Shipbuilding and Shipping	Mid Term, Final Exam
Week 10	**Regulatory Framework of Maritime Economics**	
Class 28	The Regulatory Framework of Maritime Economics	
Class 29	The Regulatory Framework of Maritime Economics(continued)	
Class 30	Mid-Term Exam	
Week 11	**Economics of Shipbuilding and Scrapping**	
Class 31	Management Practices in Shipbuilding Projects	
Class 32	Environmental Considerations in Scrapping Trade	
Class 33	The Economics of Shipbuilding and Scrapping	
Week 12	**Maritime Trade Forecasting**	
Class 34	Study of Global Pattern of Maritime Trade for Prediction	
Class 35	Perform Maritime Trade Forecasting	
Class 36	Case Study Regarding Maritime Trade Forecasting	
Week13	**Maritime Market Research**	CT 3, Final Exam
Class 37	Market Research Aspects	
Class 38	Data Collection	
Class 39	Presentation of Results	
Week 14	**Course Review**	
Class 40	Assessment 03	
Class 41	Course review	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2, C4
			CO4	C3, C4
	Class Participation	5%	CO4	
	Mid term	15%	CO2, CO3	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Maritime Economics – Martin Stopford
2. Sea Transport - P.M. Alderton
3. The geography of Transport System – Jean-Paul Rodrigue
4. Maritime Logistics – Dong Wook Song

COURSE INFORMATION

Course Code: NAME 453 **Credit Hours:** 3.0

Course Title: Power and Propulsion System **Contact Hours:** 3.0

Level and Term: Level 4 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Power and Propulsion system course is designed to teach students about the concepts of ships propulsors that is different types of Engines, details of components & operation, advances in Diesel engines & Gas Turbine for marine applications, Fuel cells, Nuclear power and Wind power. This course also provides the idea of Ships Shafting system in details. Students will be able to select the suitable marine engine, shafting system and propeller for the desired ships including necessary calculations. It is expected that students will be able to analyze critically for the selection of correct machinery and propulsion system for the designed ship. Students will also be able to analyze the defects of machinery and ships shafting system while working as Marine engineer on board.

OBJECTIVE

1. To introduce and analyze with the working aspects of power and propulsion system of a ship;
2. To enable evaluating the type of ship's drive system and their relevant equipment for marine propulsion;
3. To enable make decision for suitable types of propeller for different ships;
4. To enable the knowledge in ship propulsion and drive system design;

COURSE OUTCOMES (COS)

On successful completion of this course, students should be able to:

1. **Describe** the different Power System for ships.
2. **Evaluate** the type of ship's drive system and their relevant equipment for marine propulsion.
3. **Decide** in selecting suitable types of propeller for different ships.
4. **Apply** the knowledge in ship propulsion and drive system design.

COURSE CONTENT

1. **Sources of Propulsion Power**

   a. Air dependent and air independent propulsion
   b. Advances in Diesel Engines for marine applications
   c. Advances in Gas Turbine for marine applications
   d. Fuel cells

e. Nuclear power and
f. Wind power.

2. **Propulsors**

a. Types of different propeller (FPP, CPP, Screw propeller, Paddle wheel etc.)
b. Comparative studies of different propulsors, Ship power and propulsion systems
c. Special Propulsive devices, Surface piercing
d. Contra rotating and other special propellers.

3. **Ship Drive System**

a. Straight drive,
b. Multiple and multistage propulsion drive
c. Universal drive, Diesel electric drive
d. Propulsion engine and propeller matching.

4. **Ship's Shafting System**

a. Description of ship's shafting system
b. Description and construction of components of shafting system
c. Shaft alignment methods (rough and precision alignment of shaft).

5. **Ship Resistance and Power Calculation**

a. Frictional, Residuary and total resistance calculation
b. Holtrop-Menon method to calculate the ship resistance.
c. Admiralty Coefficient and fuel coefficient
d. Power Calculation (Total power requirement for a ship)

6. **Selection of Propulsor and Propulsion System**

a. Criteria for selecting the suitable propulsor.
b. Criteria for selecting the suitable propulsion Sytsem
c. Criteria for selecting the suitable propeller

7. **Application of Marine Diesel Engine, Gas Turbine, Steam Turbine, Nuclear Power Plant.**

MAPPING OF COURSE OUTCOME AND ROGRAM OUTCOME

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the different Power System for ships	√											
CO2	**Evaluate** the type of ship's drive system and their relevant equipment for marine propulsion		√										
CO3	**Decision** for selecting suitable types of propeller for different ships							√					

CO4	**Apply** the knowledge in ship propulsion and drive system design						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the different Power System for ships	C1	1	1	1-4	CT, F
CO2	**Evaluate** the type of ship's drive system and their relevant equipment for marine propulsion	C3	1	1	1-4	CT/ASG, MT, F
CO3	**Decision** for selecting suitable types of propeller for different ships	A3	3	3	5	CT/ASG, MT, F
CO4	**Apply** the knowledge in ship propulsion and drive system design	A2	4	2	1-4	F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of components to analyze the working aspects of power and propulsion system of a ship
CO2-PO2	To Evaluate the type of ship's drive system and their relevant equipment for marine propulsion
CO3-PO4	To be able to make decision for suitable types of propeller for different ships
CO4-PO3	This is required in order to apply the knowledge in ship propulsion and drive system design

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introductory class	
Class 2	Marine Engines: Thermodynamics and Types of ICE	
Class 3	Marine Engines: Major components of ICE	
Week 2	**Combustion of CI &SI Engine**	
Class 4	Study of CI engine: Combustion of CI engine	
Class 5	Study of CI engine: Combustion of CI engine	
Class 6	Study of CI engine: Combustion of SI engine	
Week 3	**Low load running & Supercharging**	
Class 7	Study of engine: Low load running	
Class 8	Study of engine: Effects of Low load running and methods to overcome	
Class 9	Study of CI engine: Supercharging, Turbocharging, Sequential Supercharging	
Week 4	**Supercharging, Scavenging and Governor**	CT 2, Final Exam
Class 10	Study of CI engine: Supercharging, Turbocharging, Sequential Supercharging	
Class 11	Study of CI engine: Scavenging	
Class 12	Study of CI engine: Types of Governor, Basic Operation of Governor	
Week 5	**Gas Turbine**	
Class 13	Study of CI engine: Components & Working principle of Governor	
Class 14	Gas Turbine: Classifications, Advantage & disadvantage	
Class 15	Gas Turbine: Description of major components	
Week 6	**Gas Turbine**	
Class 16	Gas Turbine: Working principle of GT	
Class 17	Gas Turbine: Practical session on GT propulsion & working principle	
Class 18	Gas Turbine: Description of Compressor and combustion chamber of GT	
Week 7	**Fuel Cells and Nuclear Power**	Mid Term, Final Exam
Class 19	Description of Fuel cells, Types of Fuel cells	
Class 20	Description of Nuclear power, Types of Nuclear power	
Class 21	Assessment 02	
Week 8	**Nuclear Power and Safety**	
Class 22	Construction and Operation of ship borne nuclear System	
Class 23	Application of nuclear system on board ship	
Class 24	Safety methods	
Week 9	**Wind Power**	
Class 25	Description of Wind power	
Class 26	Types of wind power	
Class 27	Mid-term exam	Mid Term, Final Exam
Week 10	**Ship Resistance and Power Calculation**	
Class 28	Frictional, Residuary and total resistance calculation	
Class 29	Holtrop-Menon method to calculate the ship resistance.	
Class 30	Admiralty Coefficient and fuel coefficient , Power Calculation (Total power requirement for a ship)	
Week 11	**Ship Drive System**	
Class 31	Construction and operation of Wind power	
Class 32	**Ship Drive System:** Straight drive, Multiple and multistage propulsion drive, Universal drive	
Class 33	**Ship Drive System:** Diesel electric drive, Propulsion	

	engine and propeller matching	
Week 12	**Propulsor**	
Class 34	**Propulsors:** Comparative studies of different propulsors	
Class 35	**Propulsors:** Operation of FPP and CPP	
Class 36	**Propulsors**: Problems related to propeller	
Week13	**Ship's Shafting System**	CT 3, Final Exam
Class 37	Power transmission: Description of ship's shafting system & description of components	
Class 38	Power transmission: Construction & Operation of Thrust block, Plummer block, Bulkhead gland	
Class 39	Power transmission : Construction & Operation of Stern tube, Loose coupling	
Week 14	**Shaft Alignment Methods**	
Class 40	Power transmission : Rough methods Shaft alignment	
Class 41	Power transmission : Precision methods of Shaft alignment	
Class 42	Assessment	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Marine Diesel Engine, (Maintenance, Troubleshooting and Repair), Nigel Calder
2. Pounder's Marine Diesel Engines and Gas Turbines, Doug Woodyard
3. Internal Combustion Engine, V Ganesan
4. Marine Internal Combustion Engine, A.B. Kane, MIR Publishers
5. Fundamentals of Ship Resistance and Propulsion, S.A. Harvard, 1983, Wiley Publishers Ltd.
6. Fundamentals of Ship Resistance & Propulsion, A.J.W.Lap & Ir.J.D. Van Manen,
7. Principles of Naval Architecture, Vol. 2
8. Hydrodynamics of Ship Propellers, J.P. Breslin & P. Anderson, First paperback Edition 1996, Cambridge University Press

COURSE INFORMATION

Course Code: NAME 463 **Credit Hours:** 3.00
Course Title: Ship Performance **Contact Hours:** 3.00
Level and Term: Level 4 Term 1/2

PRE-REQUISITE

Course Code: NAME 253, NAME 403
Course Title: Marine Hydrodynamics, Dynamics of Marine Vehicles

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Ship Performance course is designed to teach students about the dynamics and performance application in ship design retrospect, namely types of ship and floating structures. Students will be able to perform necessary calculations related to the vessel performance, optimization and efficiency calculations in designing an efficient ship once the course is completed.

OBJECTIVES

1. To enable to impart knowledge on vessel performance parameters.
2. Achieving ability to familiarize the students with the principle of hull efficiency optimization and performance assessment.
3. To enable in being proficient to produce ships' efficiency calculations.
4. To enable to conduct experiments and derive parameters.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Identify** and **justify** the factors affecting the sea keeping and manoeuvrability of ships in a seaway.
2. **Explain** and **predict** the added resistance applying numerical methods to **investigate** the reasons for the speed and efficiency losses.
3. **Illustrates** the effects of hull and propeller roughness on propulsive performance.
4. **Apply** numerical approach to predict propeller performance and optimize the propeller design.

COURSE CONTENTS

1. **Hull Roughness**
    a. Hull roughness measurement, bottom condition and speed loss, propeller roughness
    b. Propeller and hull interaction
    c. Various factors for speed loss
    d. Methods of predicting resistance increase due to hull and propeller roughness

2. **Momentum Analysis of Flow Round Hull**
    a. Leading to wave pattern, viscous and induced resistance components
    b. Wave resistance from wave pattern measurements
    c. Methods of wave analysis

d. Measurement of resistance due to surface shear stress and measurement of pressure drag
e. Maximizing the propulsive efficiency of ships advances in ship performance
f. control of the fluid flow around the hull creating resistance, interaction of the hull wake with the propulsor and optimization of the propulsor based on the operational profile of the ship.
g. On-going advances of the International Towing Tank Conference
h. Wake: methods of measurement, detailed wake surveys, mean wake and radial distribution; wake scale effects. Tangential wake components; influence on blade velocity diagram. Influence of tangential wake variations on propeller loading.

3. **Propeller Design**
   a. Review of theoretical approaches to propeller design including lifting surface approaches, panel methods and blade-element-momentum theories
   b. Blade-element-momentum theory, Goldstein correction factors, flow curvature effects and corrections to section design, optimum radial loading.
   c. Propeller performance at design and the use of computational fluid dynamic based approaches
   d. Wake adapted propellers
   e. Water jet efficiency and design examples using Cavitation Erosion.
   f. Added resistance due to ship motion; wave reflection, wind, yawing and drift; rudder resistance; speed loss of a ship in a seaway.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** and **Justify** the factors affecting the sea keeping and manoeuvrability of ships in a seaway		√										
CO2	**Explain** and **predict** the added resistance applying numerical methods to **investigate** the reasons for the speed and efficiency losses.				√								
CO3	**Illustrate** the effects of hull and propeller roughness on propulsive performance			√									
CO4	**Apply** numerical approach to predict propeller performance and optimize the propeller design			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** and **Justify** the factors affecting the sea keeping and manoeuvrability of ships in a seaway	C1, C5	1	1	1-4	CT, F
CO2	**Explain** and **predict** the added resistance applying numerical methods	C3, C5, C6	1	2	1-4	CT, MT, F

	to **investigate** the reasons for the speed and efficiency losses.					
CO3	**Illustrate** the effects of hull and propeller roughness on propulsive performance	C4	3	2	5	CT/ASG, F
CO4	**Apply** numerical approach to predict propeller performance and optimize the propeller design	A5	1	1	5	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	Identification with formulation of the factors affecting the sea keeping and maneuverability of ships in a seaway will be done for designing an efficient ship.
CO2-PO4	Students have to apply the research based knowledge to apply the numerical method to predict and explain the added resistance to investigate the reasons for the speed and efficiency losses.
CO3-PO3	Knowledge of the effects of hull and propeller roughness on propulsive performance will support practical ship design in the shipbuilding area.
CO4-PO3	Students will be able to design and optimize an efficient propeller applying numerical technique like CFD approach.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction to Course	
Class 2	Hull Roughness concept	
Class 3	Propeller Hull Interaction concept	
Week 2	**Hull Roughness**	
Class 4	Hull roughness measurement concept	
Class 5	Bottom criteria	
Class 6	Speed loss due to hull roughness	
Week 3	**Propeller Roughness**	
Class 7	Propeller roughness concept	
Class 8	Factors for interaction performance	
Class 9	Speed loss due to propeller roughness	
Week 4	**Resistance Prediction**	CT 2, Final Exam
Class 10	Concept of Resistance prediction	
Class 11	Assessment 01	
Class 12	Speed and power loss calculation due to roughness	
Week 5	**Flow Around Hull**	
Class 13	Flow around hull wave and momentum analysis	
Class 14	Wave Analysis and pressure drag calculation	
Class 15	Wave reflection	
Week 6	**Propulsive Efficiency**	
Class 16	Efficiency maximization concept	
Class 17	Hull wake generation	
Class 18	Calculation and analysis of wake	
Week 7	**Propeller Loading**	Mid Term, Final Exam
Class 19	Propeller Loading concept	
Class 20	Wake radial distribution	
Class 21	Assessment 02	
Week 8	**Blade Velocity Concept**	
Class 22	Blade velocity diagram	
Class 23	Factors affecting blade velocity	
Class 24	Calculation of blade velocity	
Week 9	**Propeller Design**	
Class 25	Theoretical approaches for propeller design	
Class 26	Blade design concept	
Class 27	Propeller efficiency factors	Mid Term, Final Exam
Week 10	**Propeller Theory**	
Class 28	Panel Method	
Class 29	Blade element method	
Class 30	Mid-term exam	
Week 11	**Propeller Performance**	
Class 31	Flow curvature effect	
Class 32	Goldstein correction factors	
Class 33	Optimum loading	

Week 12	**Waterjet Performance**	
Class 34	Water jet dynamics and concept	
Class 35	Water jet efficiency calculation	
Class 36	Assessment 03	
Week13	**Cavitation and Speed loss**	CT 3, Final Exam
Class 37	Speed loss calculation die to cavitation	
Class 38	Erosion measurement	
Class 39	Performance loss	
Week 14	**Course summarize**	
Class 40	Course Summary	
Class 41	Assessment results	
Class 42	Course feedback and review from students	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C5, C6, C4, A5
	Class Participation	5%	CO1, CO2, CO3, CO4	C5, C6, C4, A5
	Mid term	15%	CO2, CO4	C6, A5
Final Exam		60%	CO1	C5
			CO2	C6
			CO3	C4
			CO4	A5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Ship Performance – C. N. Hughes
2. Ship Performance: Some Technical and Commercial Aspects – C. N. Hughes
3. Ship Design and Performance for Masters and Mates – Bryan Barras
4. Assessment of Ship Performance in a Seaway – Nordforsk
5. The Maritime Engineering Reference Book: A Guide to Ship Design – Anthony F. Molland

COURSE INFORMATION

Course Code: NAME 465 **Credit Hours:** 3.00
Course Title: Navigation and Maritime Regulations **Contact Hours:** 3.00
Level and Term: Level 4 Term 1/2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Marine Safety and Pollution course is designed to teach students about the maritime regulations, marine safety rules, pollution regulations theory, namely types of ship and floating structures. Students will be able to perform necessary calculations related to the basic design, freeboard, trim and stability calculations using established formulas once the course is completed.

OBJECTIVES

1. To provide basic concepts of maritime boundaries, design and operational safety regulations.
2. To know about various tidal sequences, zones, pollution regulations in the marine industry.
3. To analyze and design various vessels using freeboard and other mandatory regulatory based calculations.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Describe** the concept of freeboard calculation and **Identify** different factors and navigational aids for safe operation of the vessel.
2. **Construct** a regulatory database and **apply** safety regulations in vessel design calculation.
3. **Explain** tide and tidal formation as well as **justify** a vessel design in tidal application.
4. **Assist** marine industry for surveying and registration of ships based on life saving appliances.

COURSE CONTENTS

1. **Outline of Navigation, Navaid and Tide**
   a. Outline of navigation
   b. Navigational aids and aids to navigation
   c. Tide and tidal theory

2. **International Rules and Freeboard:**
   a. International conventions on loadline
   b. Freeboard calculation
   c. International Maritime Organizations (IMO)
   d. law of the seas,

e. The International Convention for the Prevention of Pollution from Ships (MARPOL)
f. The International Convention for the Safety of Life at Sea (SOLAS)
g. International Regulations for Preventing Collisions at Sea (COLREG)

3. **Inland Rules**
   a. Merchant shipping act
   b. inland shipping ordinance 1976
   c. Marine fishers' ordinance 1983
   d. Inland lifesaving rules 2001

4. **Marine Pollution**
   a. Pollution and pollutants
   b. MARPOL and legal instrument
   c. Ship breaking in Bangladesh
   d. Green Ship Technology

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	**COURSE OUTCOMES (COs)**	**PROGRAM OUTCOMES (POs)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Describe** the concept of freeboard calculation and **Identify** different factors and navigational aids for safe operation of the vessel.	√											
CO2	**Construct** a regulatory database and **apply** safety regulations in vessel design calculation.	√											
CO3	**Explain** tide and tidal formation as well as **Justify** a vessel design in tidal application.			√									
CO4	**Assist** marine industry for surveying and registration of ships based on life saving appliances.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	**COURSE OUTCOMES (COs)**	**Bloom's Taxonomy**	**CP**	**CA**	**KP**	**Assessment Methods**
CO1	**Describe** the concept of freeboard calculation and **Identify** different factors and navigational aids for safe operation of the vessel.	C1	1	1	1-4	CT, F
CO2	**Construct** a regulatory database and **apply** safety regulations in vessel design calculation.	C3	1	1	1-4	CT/ASG, F
CO3	**Explain** tide and tidal formation as well as **Justify** a vessel design in tidal application.	A3	3	3	5	CT/ASG, MT, F

CO4	**Assist** marine industry for surveying and registration of ships based on life saving appliances.	A2	4	2	1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of binary mathematics and science has to be applied to understand basic computer programming concepts
CO2-PO1	To construct a pseudocode and apply the knowledge in programming, understanding of flow chart and algorithm concepts is required.
CO3-PO3	To be able to explain and justify a program, understanding detailed programming concepts is required.
CO4-PO2	This is required in order to conduct any investigation of complex problems related to computer programing architecture.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	
Week 1	**Outline of Navigation, NAVAID**	CT 1, Final Exam
Class 1	Introduction to the Course, Assessment Procedure	
Class 2	General and Basic Outline of Navigation	
Class 3	Navigational Aids & Aids to Navigation	
Week 2	**NAVAID Segment 2**	
Class 4	Aids to Navigation	

Class 5	Navigational Math – class 1	
Class 6	Navigational Math – class 2	
Week 3	**Tide and Tidal Theory**	
Class 7	Tide basic definitions	
Class 8	Tidal Theories	
Class 9	Assessment 01/Assignment 01	
Week 4	**International Load Line Rules**	CT 1, Final Exam
Class 10	International Conventions on Load line	
Class 11	Freeboard Regulations and initial concept	
Class 12	Guidelines on Freeboard Calculation	
Week 5	**Freeboard Calculation**	
Class 13	Freeboard Calculation – Class 1	
Class 14	Freeboard Calculation – Class 2	
Class 15	Freeboard Calculation – Class 3 (On Class Practice)	
Week 6	**International Regulatory Bodies**	
Class 16	International Maritime Organizations (IMO) – Class 1	
Class 17	International Maritime Organizations (IMO) – Class 2	
Class 18	Law of The Seas – Class 1	
Week 7	**International Regulatory Bodies**	
Class 19	Law of The Seas – Class 2	
Class 20	Midterm Exam	
Class 21	MARPOL	
Week 8	**International Regulatory Bodies**	Mid Term, Final Exam
Class 22	SOLAS – Class 1	
Class 23	SOLAS – Class 2	
Class 24	COLREG– Class 1	
Week 9	**International Regulatory Bodies**	
Class 25	COLREG– Class 2	
Class 26	Safe Marine Vessel Operation	
Class 27	Summary of International Regulatory Bodies	
Week 10	**Inland Regulatory Bodies**	
Class 28	Introduction to Inland Rules	
Class 29	Assessment 02/Assignment 02	
Class 30	Inland Life Saving Rules 2001	
Week 11	**Inland Rules**	
Class 31	Marchant Shipping Act	
Class 32	Inland Shipping Ordinance 1976	
Class 33	Marine Fishers Ordinance 1983	
Week 12	**Marine Pollution**	CT 3, Final Exam
Class 34	Pollutions	
Class 35	Pollutants and their effect	
Class 36	Assessment -3	
Week 13	**Ship Breaking and MARPOL**	
Class 37	MARPOL and Legal Instrument	
Class 38	Ship Breaking in Bangladesh	
Class 39	Green ship Technology	
Week 14	**Course Summarization**	
Class 40	Course summary	
Class 41	Assessment Result	

Class 42	Student Feedback	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C3, A3
	Class Participation	5%	CO1, CO2, CO3, CO4	C1, C3, A3, A2
	Mid term	15%	CO2, CO3	A3, A2
Final Exam		60%	CO1	C1
			CO2	C3
			CO3	A3
			CO4	A2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Marine Pollution by R B Clark
2. Marine Pollution by Judith S Weis
3. Prevention of pollution of environment form marine vessel, Saiful Karim

COURSE INFORMATION

Course Code: NAME 477 **Credit Hours:** 3.00
Course Title: Control Engineering **Contact Hours:** 3.00
Level and Term: Level 4 Term 2

PRE-REQUISITE

Course Code: EECE 281
Course Title: Marine Electrical and Electronics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is designed to provide theoretical as well as conceptual understanding on control systems with especial attention to on-board machinery and systems for marine environment. Obviously, it will help the naval architecture and marine engineering graduates to perform the duties properly during installations and operations of marine equipment and systems at shipyard, dockyard and fleet with certain level of confidence.

OBJECTIVES

1. To introduce the students with the basic concepts of control system functions and design.
2. To enable the students in implementing and testing dynamic system models
3. To enable the students to interpret dynamic system models with sufficient mathematical reasoning.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the issues of control engineering as dynamic system models.
2. **Apply** the concepts of control engineering for ship borne machineries and systems.
3. **Select** appropriate dynamic control models for different classes of control design problems.
4. **Design** control modules in line with ship machineries.

COURSE CONTENTS

1. **Introduction to theory of controls**
   e. Concepts of mechanical, hydraulic, pneumatic, thermal and electro-mechanical controls
   f. Different modes and methods of control systems and their representation by different equations
   g. Laplace transforms, transfer functions and characteristic functions,
   h. Stability, Routh’s criterion for stability.

2. **Block diagrams and signal flow graphs**
   a. Physical systems modelling
   b. Root locus analysis
   c. Time domain and frequency domain analysis of control systems.

3. **Useful problem and solution of a simple level control**
    a. Flow control, pressure control and temperature control of a physical system.

4. **Computer solution of system equations**
    a. System response, control action and system types
    b. System compensation, analogues of control system
    c. application of servomechanisms on-board systems for steering, stabilizer etc.
    d. Introduction to digital computerized control and simple control development using software.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the issues of control engineering as dynamic system models.	√											
CO2	**Apply** the concepts of control engineering for ship borne machineries and systems		√										
CO3	**Select** appropriate dynamic control models for different classes of control design problems.					√							
CO4	**Design** control modules in line with ship machineries						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the issues of control engineering as dynamic system models.	C2	2	A1	1-4	CT, F
CO2	**Apply** the concepts of control engineering for ship borne machineries and systems	C4	3	A1	1-5	CT, MT, F
CO3	**Select** appropriate dynamic control models for different classes of control design problems.	C6	3	A2	5-7	CT/ASG, F
CO4	**Design** control modules in line with ship machineries	A3	6	A2	5-7	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications

CO1-PO1	The knowledge of science has to be applied to understand and address the control phenomena for marine use.
CO2-PO2	In order to identify control and monitoring mechanisms in general and apply it for the ship borne systems for propulsion, power generation and auxiliary operations.
CO3 –PO5	Creating and applying appropriate mathematical tools for both open and closed loop control systems.
CO4 –PO6	Designing the controls for steering, stabilizer and fire fire fighting systems on board ships.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1 & 2	**Introduction to the Theory of Controls**	CT 1, Final Exam
Class 1	Concepts of mechanical, hydraulic, pneumatic, thermal and electro-mechanical controls	
Class 2	Different modes and methods of control systems and their representation by different equations	
Class 3		
Class 4	Laplace transforms, transfer functions and characteristic functions, stability, Routh's criterion for stability	
Class 5		
Class 6		
Week 3 & 4	**Block diagrams and signal flow graphs**	
Class 7	Physical systems modeling, root locus analysis	
Class 8		
Class 9	Time domain and frequency domain analysis of control systems	
Class 10		
Class 11	Steady state frequency response and stability margins	
Class 12		

Week 5 & 6	**Useful problem and solution of a simple level control**	CT 2, Final Exam
Class 13	Flow control, pressure control and temperature control of a physical system	
Class 14		
Class 15	State feedback pole placement design	
Class 16		
Class 17	State space modelling of discrete time linear systems	
Class 18		
Week 7 & 8	**Computer solution of system equations**	Mid Term, Final Exam
Class 19	System response, control action and system types	
Class 20		
Class 21	System compensation, analogues of control system, application of servomechanisms onboard systems for steering, stabilizer etc	
Class 22		
Class 23	Transformation of system models with MATLAB	
Class 24		
Week 9 & 10	**Control System Analysis and Design by the Frequency-Response Method**	Final Exam
Class 25	Bode diagrams, polar plots, Nyquist stability criterion	
Class 26		
Class 27	Log-magnitude-versus-phase plots	
Class 28		
Class 29	Lead compensation, lag compensation, lead-lag compensation	
Class 30		
Week 11 & 12	**Control System Design in State Space**	CT 3, Final Exam
Class 31	Design of regulator systems with observers	
Class 32		
Class 33	Quadratic optimal regulator systems	
Class 34		
Class 35	Robust control systems	
Class 36		
Week 13 & 14	**PID Controllers and Modified PID Controllers**	
Class 37	Ziegler-Nichols rules for tuning PID controllers, design of PID controllers with frequency response approach	
Class 38		
Class 39	Design of PID controllers with computational optimization approach	
Class 40	**Revision class-1**	
Class 41	**Revision class-2**	
Class 42	**Assessment**	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2, C4, C6
			CO3	C6
	Class Participation	5%	CO1-CO4	C2, C4, C6

	Mid term	15%	CO2, CO4	C4, A3
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C6
			CO4	A3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Modern Control Engineering – Ogata, Katsuhiko.
2. Control Engineering: An Introduction with the Use of MATLAB – Derek Atherton
3. Reed's Marine Engineering Series: Volume 10: Instrumentation and Control Systems – Jackson, Leslie
4. Control Engineering: Theory and Practice – Bandyopadhyay, M N
5. Control Engineering – V U Bakshi and U A Bakshi

COURSE INFORMATION

Course Code: NAME 481
Course Title: Optimization Methods in Ship Design
Level and Term: Level 4 Term 2

Credit Hours: 3.00
Contact Hours: 3.00

RE-REQUISITE

Course Code: NAME 363
Course Title: Numerical Methods

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This optional theoretical course will introduce the students to the basic fundamentals of optimization methods that can be used during a design process. Considering the computational aspect of the subject especially in higher dimensions, the course will involve significant amount of computational assignments and a term project in the general area of engineering optimization. At the end of the course students will develop critical thinking and learn to frame engineering minima maxima problems in the framework of optimization problems.

OBJECTIVES

1. To enable the students to enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems.
2. To enable the students to learn classical optimization techniques and numerical methods of optimization.
3. To enable the students to know the basics of different evolutionary algorithms.
4. To enable the students to explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the fundamental knowledge of Linear Programming and Dynamic Programming problems.
2. **Describe** the basics of different evolutionary algorithms.
3. **Apply** the theoretical concepts and knowledge of optimization method in analysis, design, and development of ship design.
4. **Enumerate** fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from various engineering problem as well as ship design.

COURSE CONTENTS

1. **Introduction to linear programming:** construction of the LP model, graphical LP solution, slack, surplus and unrestricted variables.
2. **The simplex method:** standard LP form, the simplex algorithm, the M-method, the two-phase method, special cases in simplex method application.

3. **Duality and sensitivity analysis:** Definition of the dual problem, relationship between the optimal primal and dual solutions, dual simplex method, Integer linear programming: B & B algorithm, cutting plane algorithm.
4. **Nonlinear Programming:** unconstrained problem, constrained problem: Jacobian method, Lagrangean method, Kuhn-Tucker conditions.
5. **Numerical techniques for unconstrained optimization:** The Newton-Raphson method, direct search method, steepest ascent method.
6. **Numerical techniques for constrained optimization:** sequential linear programming (SLP), sequential quadratic programming (SQP), sequential unconstrained minimization techniques (SUMT)
7. **Modern methods of optimization:** Genetic algorithm, simulated annealing, particle swarm optimization, ant colony optimization.
8. **Project scheduling:** project development, critical path method, optimum scheduling by critical path method.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the fundamental knowledge of Linear Programming and Dynamic Programming problems.		√										
CO2	**Describe** the basics of different evolutionary algorithms.		√										
CO3	**Apply** the theoretical concepts and knowledge of optimization method in analysis, design, and development of ship design.			√									
CO4	**Enumerate** fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from various engineering problem as well as ship design.												√

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the fundamental knowledge of Linear Programming and Dynamic Programming problems.	C4			1-4	CT, F
CO2	**Describe** the basics of different evolutionary algorithms.	C2			1-4	CT, MT, F
CO3	**Apply** the theoretical concepts and knowledge of optimization method in analysis, design, and development of ship design.	C3,C4	3		5	CT/ASG, F

CO4	**Enumerate** fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from various engineering problem as well as ship design.	C5	1	3	8	MT, F
C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	**Justifications**
CO1-PO2	The knowledge of mathematical principles will help the students to apply the same to formulate solutions for engineering problems
CO2-PO2	Different computational problems can be identified, formulated, explained, reviewed and conclusions can be reached.
CO3-PO3	Theoretical concepts and knowledge of optimization method will help the students to analysis, design, and development of ship design as well as other related engineering problems.
CO4-PO12	Students will be able to identify the complexity of various design optimization related problem in their professional lifesup and find out optimization technique to solve them.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1 & 2	**Introduction**	CT 1, Final Exam
Class 1	Introduction to linear programming	
Class 2	Construction of the lp model, graphical lp solution,	
Class 3		
Class 4	Slack, surplus and unrestricted variables.	
Class 5		
Class 6		
Week 3 & 4	**The simplex method**	
Class 7	Standard LP form, the simplex algorithm, the M-method	
Class 8		
Class 9	The two-phase method	
Class 10		
Class 11	Special cases in simplex method application	
Class 12		
Week 5 & 6	**Duality and sensitivity analysis**	CT 2, Final Exam
Class 13	Definition of the dual problem, relationship between the optimal primal and dual solutions	
Class 14		
Class 15	Dual simplex method, integer linear programming	
Class 16		
Class 17	B & b algorithm, cutting plane algorithm	
Class 18		
Week 7 & 8	**Nonlinear programming**	Mid Term, Final Exam
Class 19	Unconstrained problem	
Class 20		
Class 21	Constrained problem: Jacobian method, Lagrangean method, Kuhn-tucker conditions.	
Class 22		
Class 23	Lagrangean method, Kuhn-tucker conditions.	
Class 24		
Week 9 & 10	**Numerical techniques for unconstrained optimization**	
Class 25	The Newton-Raphson method	
Class 26		
Class 27	Direct search method	
Class 28		
Class 29	Steepest ascent method.	
Class 30		
Week 11 & 12	**Numerical techniques for constrained optimization**	CT 3, Final Exam
Class 31	Sequential linear programming (slp)	
Class 32		
Class 33	Sequential quadratic programming (sqp)	
Class 34		
Class 35	Sequential unconstrained minimization techniques (sumt)	
Class 36		
Week 7	**Modern methods of optimization**	

Class 37	Genetic algorithm	
Class 38		
Class 39	Simulated annealing, particle swarm optimization	
Class 40		
Class 41	Ant colony optimization.	
Class 42	Review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Hamdy A Taha: Operations Research: An Introduction, Tenth Edition, Prentice Hall of India, 2016.
2. P. Venkataraman: Applied Optimization with MATLAB Programming, John Wiley & Sons, Inc. New York, 2002
3. Singiresu S. Rao: Engineering Optimization: Theory and Practice, Fourth Edition, John Wiley & Sons, Inc. New York, 2009.
4. S. R. Yadav and A. K. Malik: Operations Research, Oxford University Press, 2014.

COURSE INFORMATION

Course Code: NAME 483
Course Title: Theory of Hydrofoils
Level and Term: Level 4 Term 1/2

Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

Course Code: NAME 353
Course Title: Ship Resistance and Propulsion

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Theory of Hydrofoils course is designed to teach students hydrofoil shapes and enrich their pertinent knowledge. Students will be able to perform necessary calculations related to hydrofoils which will improve the vessel performance, optimization and efficiency calculations once the course is completed. It is expected that students will develop critical thinking about how to contrast & justify speed affecting factor, categorize & relate reasons of speed thus solves efficiency related error calculation.

OBJECTIVES

1. To impart knowledge on hydrofoils.
2. To familiarize the students with the theory of hydrofoils that enhance the hull efficiency, optimization and performance.
3. To make proficient to produce ships' efficiency calculations.
4. To enable to conduct experiments and derive parameters.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Contrast** and **Justify** the factors affecting the speed and efficiencies of ships.
2. **Categorize** and **Relate** reasons for the speed and efficiency due to hydrofoils.
3. **Illustrates** the effects of hydrofoils on propulsive performance.
4. **Display** and **Solve** efficiency related error calculations.

COURSE CONTENTS

1. Definition and geometry of hydrofoils.
2. Introduction to the fundamentals of lifting surfaces related to the selection, design, experimental and numerical modelling, as well as optimization of hydrofoils, propellers, and turbines.
3. Analytic investigation of flow past a hydrofoil
4. Theory of thin hydrofoils.
5. Theory of hydrofoils having arbitrary shapes.
6. 2-D and 3- D hydrofoils
7. Design and analysis of hydrofoil sections
8. Cavitating hydrofoils
9. Application of hydrofoils to high-speed craft, control surface and propeller.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Contrast** and **Justify** the factors affecting the speed and efficiencies of ships	√											
CO2	**Categorize** and **Relate** reasons for the speed and efficiency due to hydrofoils		√										
CO3	**Illustrates** the effects of hydrofoils on propulsive performance			√									
CO4	**Displays** and **Solves** efficiency related errors calculation			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Contrast** and **Justify** the factors affecting the speed and efficiencies of ships	C5	1	1	1-4	CT, F
CO2	**Categorize** and **Relate** reasons for the speed and efficiency due to hydrofoils	C6	1	2	1-4	CT, MT, F
CO3	**Illustrates** the effects of hydrofoils on propulsive performance	C4	3	2	5	CT/ASG, F
CO4	**Displays** and **Solves** efficiency related errors calculation	A5	1	1	5	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	Details knowledge of mathematics and science has to be applied to calculate performance parameters and develop the effects of change related to hydrofoils.
CO2-PO2	Students will learn the reasons of speed and efficiency variance due to hydrofoils and how to categorize & relate those.
CO3-PO3	Fundamental idea about propulsive performance and the relation & effects of hydrofoils on this.
CO4-PO3	Know about efficiency errors, and how to calculate, display & solve them.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction	
Class 2	Definition of hydrofoils	
Class 3	Geometry of hydrofoils	
Week 2	**Fundamentals of lifting surfaces related to the selection of hydrofoils**	
Class 4	Introduction to the fundamentals of lifting surfaces related to the selection of hydrofoils	
Class 5	Fundamentals of lifting surfaces related to the design of hydrofoils	
Class 6	Fundamentals of lifting surfaces related to the design of hydrofoils	
Week 3	**Fundamentals of lifting surfaces of hydrofoils**	
Class 7	Fundamentals of lifting surfaces related to the experimental and numerical modeling of hydrofoils	
Class 8	Fundamentals of lifting surfaces related to the selection, design, experimental and numerical modeling, as well as optimization of hydrofoils, propellers, and turbines.	
Class 9	Fundamentals of lifting surfaces related to the selection, design, experimental and numerical modeling, as well as optimization of hydrofoils, propellers, and turbines.	
Week 4	**Optimization of hydrofoils**	CT 2,
Class 10	Fundamentals of lifting surfaces related to the selection, design, experimental and numerical modeling, as well as optimization of hydrofoils, propellers, and turbines.	
Class 11	Analytic investigation of flow past a hydrofoil	
Class 12	Analytic investigation of flow past a hydrofoil	
Week 5	**Analytic investigation of flow past hydrofoil**	
Class 13	Analytic investigation of flow past a hydrofoil	

Class 14	Analytic investigation of flow past a hydrofoil	Final Exam
Class 15	Assessment	
Week 6	**Analytic investigation of flow past a hydrofoil**	
Class 16	Analytic investigation of flow past a hydrofoil	
Class 17	Analytic investigation of flow past a hydrofoil	
Class 18	Analytic investigation of flow past a hydrofoil	
Week 7	**Theory of thin hydrofoils**	Mid Term, Final Exam
Class 19	Review of previous topics	
Class 20	Theory of thin hydrofoils	
Class 21	Theory of thin hydrofoils	
Week 8	**Theory of thin hydrofoils**	
Class 22	Theory of thin hydrofoils	
Class 23	Theory of thin hydrofoils	
Class 24	Assessment	
Week 9	**Theory of hydrofoils having arbitrary shapes**	
Class 25	Theory of hydrofoils having arbitrary shapes	
Class 26	Theory of hydrofoils having arbitrary shapes.	
Class 27	2-D and 3- D hydrofoils	Mid Term, Final Exam
Week 10	**2-D and 3- D hydrofoils**	
Class 28	2-D and 3- D hydrofoils	
Class 29	Design of hydrofoil sections	
Class 30	Mid-term exam	
Week 11	**Design and analysis of hydrofoil sections**	
Class 31	Design and analysis of hydrofoil sections	
Class 32	Cavitating hydrofoils	
Class 33	Assessment	
Week 12	**Cavitating hydrofoils**	
Class 34	Cavitating hydrofoils	
Class 35	Cavitating hydrofoils	
Class 36	Cavitating hydrofoils	
Week13	**Application of hydrofoil**	CT 3, Final Exam
Class 37	Review of previous topic	
Class 38	Application of hydrofoils to control surface	
Class 39	Application of hydrofoils to propeller	
Week 14	**Application of hydrofoil**	
Class 40	Application of hydrofoils to high-speed craft	
Class 41	Assessment	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C5, C6, C4, A5
	Class Participation	5%	CO1, CO2, CO3, CO4	C5, C6, C4, A5

	Mid term	15%	CO2, CO4	C6, A5
Final Exam		60%	CO1	C5
			CO2	C6
			CO3	C4
			CO4	A5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Hydrofoils, Design, Build, Fly – Ray Vellinga
2. Theory of wing section – Abbott and Doenhoff
3. Hydrofoil without formula series – Hook and Karmode
4. Lift and drag of hydrofoils: Application of theory to experimental results – Korvin-Kroukovosky

COURSE INFORMATION
Course Code: NAME 489
Course Title: Introduction to Offshore Structure
Level and Term: Level 4, Term 2
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE
Course Code: None
Course Title: None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
The aim of this optional theoretical course is to provide the students with the complete and up-to-date overview of offshore structure. This course will enable students to gain knowledge of different types of offshore structures, their design characteristics, environmental loads on them, stationkeeping etc. This course also deals with the suitability of particular type of offshore platforms in Bangladesh.

OBJECTIVES
1. Enable students to identify different types of offshore structures and their characteristics.
2. To be able to estimate environmental (wind, wave and current) loads on both fixed and floating type of offshore structures.
3. To be able to design mooring system for floating offshore structures.
4. To select a particular type of offshore structure suitable for offshore areas of Bangladesh.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. To **comprehend** and **distinguish** design characteristics of different types of offshore structures.
2. To be able to **compute** environmental loads on offshore structures.
3. To **design** mooring system for floating offshore structures.
4. To **appraise** safety features of offshore structures.

COURSE CONTENTS

1. **Introduction**: Challenges in offshore environment, Types of offshore structures, Typical motion characteristics of offshore structures, important seakeeping and wave load problems.
2. **Types of offshore structures** Fixed offshore structures: jacket, jackup, TLP and gravity platforms, Floating offshore platforms: Semi-submersible, drill ships
3. **Loads on offshore structure** Types of loads on offshore structures, Hydrodynamic classification of structures.
4. **Wave loads on offshore structures** Wave theories and their uses, Assumption of linear (Airy) Wave theory, Difference between linear and non-linear wave theory, Wave particle orbit and velocity, Horizontal velocity and pressure distribution in linear and non-linear wave theory, Time domain vs. frequency domain, wave spectrum: P-M, JONSWAP spectrum, Creation of an irregular wave from a wave spectrum, Assumption of potential flow, dynamic pressure, Wave

breaking, Wave excitation loads: Froude-Kriloff and diffraction forces and moments. Added mass, damping and restoring terms, Morison 's equation and its application for Wave Load problems.

5. **Wind and Current loads on Offshore Structures** Wind speed profiles, Turbulence, Wind spectra, Wind pressure, Effect of current, Types of Current, Current velocity sunniest profile
6. **Design of Fixed offshore Structures** Introduction to fixed offshore structures: Sizing & layout, Design of Jacket Structures, Base shear, Over-turning moment and buckling in Jacket structures, Design of TLP structures: Tension in tethers, restoring forces, Design of spar platforms.
7. **Design of Floating Offshore Structures** General Arrangement and sizing of a semi-submersible platform, Hydrodynamic features of floating offshore platforms, Stability requirement of floating offshore platforms, Problem solving, General Arrangement and design characteristics of a drill ship, Hydrodynamic features of a drillship.
8. **Fatigue of offshore structures** Basic concepts, fatigue in offshore structures, Fatigue damage assessment, Effect of salinity and temperature on fatigue, S-N Curves.
9. **Buoy and Mooring system of Offshore Structures** Station keeping: mooring, thruster forces and dynamic positioning, Assumption and derivation of catenary mooring equation, Problem solving on minimum length of a catenary mooring.
10. **Safety of Offshore Structures** Life cycle phases of an offshore structure, causes of structural failures and risk reduction measures, Accidental experiences and lesson learned.
11. **Offshore Structures for Bangladesh** Suitability of Offshore Structures for Bangladesh.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To **comprehend** and **distinguish** design characteristics of different types of offshore structures		√										
CO2	To be able to **demonstrate** environmental loads on offshore structures				√								
CO3	To **design** mooring system for floating offshore structures			√									
CO4	To **appraise** safety features of offshore structures.						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To **comprehend** and **distinguish** design characteristics of different types of offshore structures.	C2	1		1-4	CT, F
CO2	To be able to **demonstrate** environmental loads on offshore structures.	C3	1		8	CT, Mid Term, F

CO3	To **design** mooring system for floating offshore structures.	C6	2		5	CT/ASG, F
CO4	To **appraise** safety features of offshore structures.	C5	5		7	Mid Term, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	The knowledge of mathematics and science has to be applied to calculate hydrostatic parameters and develop the effects of draught change on them.
CO2-PO4	In order to identify the role and extent of hydrostatic parameters on the principles of intact and damage stability of ships.
CO3-PO3	To analyze vessels' hydrostatic and hydrodynamic parameters for docking and launching calculations.
CO4-PO6	In order to ascertain the level of stability of the vessel and maintenance of upright position at lightship/ designated loading conditions.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	
Class 1	Introduction, course administration and motivation lecture	
Class 2	Challenges in offshore environment, Types of offshore structures	

Class 3	Typical motion characteristics of offshore structures, important seakeeping and wave load problems	CT 1, Final Exam
Week 2	**Types of offshore structures**	
Class 4	Fixed offshore structures: jacket, jackup, TLP and gravity platforms.	
Class 5	Floating offshore platforms: Semi-submersible, drill ships	
Class 6		
Week 3	**Loads on offshore structure**	
Class 7	Types of loads on offshore structures	
Class 8	Hydrodynamic classification of structures	
Class 9	Class Test-1	
Week 4	**Wave loads on offshore structures**	CT 2, Final Exam
Class 10	Wave theories and their uses, Assumption of linear (Airy) Wave theory, Difference between linear and non-linear wave theory.	
Class 11	Wave particle orbit and velocity, Horizontal velocity and pressure distribution in linear and non-linear wave theory	
Class 12	Time domain vs. frequency domain, wave spectrum: P-M, JONSWAP spectrum, Creation of an irregular wave from a wave spectrum	
Week 5	**Wave loads on offshore structures**	
Class 13	Assumption of potential flow, dynamic pressure, Wave breaking	
Class 14	Wave excitation loads: Froude-Kriloff and diffraction forces and moments. Added mass, damping and restoring terms.	
Class 15	Morison 's equation and its application for Wave Load problems.	
Week 6	**Wind and Current loads on Offshore Structures**	
Class 16	Wind speed profiles, Turbulence, Wind spectra, Wind pressure	
Class 17	Effect of current, Types of Current, Current velocity sunniest profile	
Class 18	Class Test-2	
Week 7	**Design of Fixed offshore Structures**	Mid Term, Final Exam
Class 19	Introduction to fixed offshore structures: Sizing & layout	
Class 20	Design of Jacket Structures	
Class 21	Base shear, Over-turning moment and buckling in Jacket structures	
Week 8	**Design of Fixed offshore Structures**	
Class 22	Mid Term Exam	
Class 23	Design of TLP structures: Tension in tethers, restoring forces.	
Class 24	Design of spar platforms	
Week 9	**Design of Floating Offshore Structures**	
Class 25	General Arrangement and sizing of a semi-submersible platform	
Class 26	Hydrodynamic features of floating offshore platforms	
Class 27	Stability requirement of floating offshore platforms	Mid Term, Final Exam
Week 10	**Design of Floating Offshore Structures**	
Class 28	Problem solving	
Class 29	General Arrangement and design characteristics of a drill ship	
Class 30	Hydrodynamic features of a drillship	
Week 11	**Fatigue of offshore structures**	
Class 31	Basic concepts, fatigue in offshore structures	
Class 32	Fatigue damage assessment, Effect of salinity and temperature on fatigue	
Class 33	S-N Curves	
Week 12	**Buoy and Mooring system of Offshore Structures**	
Class 34	Stationkeeping: mooring, thruster forces and dynamic positioning	
Class 35	Assumption and derivation of catenary mooring equation	
Class 36	Problem solving on minimum length of a catenary mooring.	
Week13	**Safety of Offshore Structures**	
Class 37	Class Test-3	

Class 38	Life cycle phases of an offshore structure, causes of structural failures and risk reduction measures	CT 3, Final Exam
Class 39	Accidental experiences and lesson learned.	
Week 14	**Offshore Structures for Bangladesh**	
Class 40	Suitability of Offshore Structures for Bangladesh	
Class 41	Course review (Lec - 01 ~ Lec 21)	
Class 42	Course review (Lec - 22 ~ Lec 42)	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Offshore Engineering: An Introduction by Angus Mather
2. Sea Loads on Ships and Offshore Structures by Odd Magnus Faltinsen
3. Construction of marine and offshore structure, Ben C Gerwick Jr.
4. Elements of ocean Engineering. Dr. Ashoke Bhar
5. Introduction to offshore structures, Design, fabrication, Installation, W.J.Geatt
6. Safety of offshore structures by Torgeir Moan
7. DNVGL RP-C205, Environmental conditions and Environmental Loads

COURSE INFORMATION

Course Code: NAME 493
Course Title: Marine Acoustics
Level and Term: Level 4 Term 1/2
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Marine Acoustics is an optional theoretical course which is designed to impart students the fundamental knowledge about ocean engineering sonar system design with basic acoustic experiments. Students will understand the mechanism of underwater sound propagation system and processing unit by which they can gain the skill of solving equations for estimating necessary velocity parameters.

OBJECTIVES

1. To provide the basic and applied knowledge of underwater sound generation, propagation and reception.
2. To enable to achieve understanding of the sonar equation and basic signal processing concepts essential to sonar system design.
3. To familiarize with the design of basic sonar systems and basic ocean acoustic experiments.
4. To familiarize with various sources of ambient noise in the sea.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the fundamentals of sound propagation, sound of seismic, ships, wind and rain, bioacoustics.
2. **Identify** the effects of sound in ocean dynamics, and imaging and mapping the seafloor.
3. **Devise** the skill to formulate the combined forward/inverse problem, from tracing ray
4. **Estimate** sound levels to solve equations for rainfall or current velocity.

COURSE CONTENTS

1. **Fundamentals:** Simple propagation, rays, sources and receivers, radiated sound, bioacoustics, waveguides, scattering by bubbles, interior fluctuations, and rough surfaces, upper ocean boundary layer and rain precipitation.

2. **Marine Bioacoustics:** Introduction to the role of active and passive acoustic technology in studying organisms in the marine environment, Marine animal hearing, marine animal acoustic communication, Remote sensing and the impacts of sound on marine animals, Sensing of plankton and nekton, passive acoustics and marine animals, marine mammals, The use of acoustics as a tool in oceanographic instrumentation, The use of acoustics in the study of ocean

processes.

3. **Ocean Dynamics:** Tomography, time reversal, turbulence, Noise sources and spectra, Propeller Noise, Cavitation Noise, Depth dependence and directionality and slope-conversion effects Theoretical basis for noise modeling, Ambient noise and beam-noise statistics models Volume and boundary scattering, Cell scattering and point scattering techniques.

4. **Propagation:** Basic concepts, boundary interactions, attenuation and absorption, Frequency-domain wave equation formulations including ray theory, normal mode, multipath expansion.

5. **Non-linear acoustics and Acoustics in Fluid Media:** The propagation of finite amplitude waveforms, Acoustics streaming, Parametric and stimulated scattering effects in liquids, Superposition of simple courses, free space Green's functions, Kirchhoff-Helmholtz integral theorem, Rayleigh integral, radiation from cylinders and spheres Introduction to acoustic finite elements and acoustic boundary elements.

6. **Ocean Bottom:** Imaging hydrothermal vents, large scale mapping, mesoscale mapping. Principles of transduction and sonar transducer design.

7. **Other topics:** noise from pile driving, ocean energy devices, etc.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the fundamentals of sound propagation, sound of seismic, ships, wind and rain, bioacoustics.	√											
CO2	**Identify** the effects of sound in ocean dynamics, and imaging and mapping the seafloor		√										
CO3	**Devise** the skill to formulate the combined forward/inverse problem, from tracing ray					√							
CO4	**Estimate** sound levels to solve equations for rainfall or current velocity.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the fundamentals of sound propagation, sound of seismic, ships, wind and rain, bioacoustics	C2	1,3	5	1-3	CT, F
CO2	**Identify** the effects of sound in ocean dynamics, and imaging and mapping the seafloor	C1	3	3	2-3	CT, MT, F
CO3	**Devise** the skill to formulate the	C6	2	2	6-8	CT, F

	combined forward/inverse problem, from tracing ray					
CO4	**Estimate** sound levels to solve equations for rainfall or current velocity.	C5	7	5	2	MT, ASG, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	Use of theoretical and numerical models will enable the students to understand sound propagation and distinguishing the mechanism of bioacoustics.
CO2-PO2	By analyzing the ocean dynamics and their effect in acoustic propagation, students will use the fundamental knowledge of sound propagation for imaging and mapping of seafloor.
CO3-PO5	Students will develop capability of using the tracing ray method for dealing with forward/inverse problem in acoustic measurement.
CO4-PO2	Students will formulate mathematical and theoretical model for estimating sound levels to find out rainfall or current velocity.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Fundamentals of Acoustics**	

Class 1	A review of basic vibration theory and acoustic theory	CT 1, Final Exam
Class 2	The physics of sound propagation, reflection, and absorption phenomena.	
Class 3	Introduction to acoustic propagation	
Week 2	**Marine Bioacoustics**	
Class 4	Introduction to the role of active and passive acoustic technology in studying organisms in the marine environment.	
Class 5	Marine animal hearing, marine animal acoustic communication	
Class 6	Remote sensing and the impacts of sound on marine animals.	
Week 3	**Marine Acoustic Remote Sensing**	
Class 7	The use of acoustics as a tool in oceanographic instrumentation,	
Class 8	The use of acoustics in the study of ocean processes	
Class 9	Assessment 01	
Week 4	**Acoustical Oceanography**	CT 2, Final Exam
Class 10	Distribution of physical and chemical properties in the oceans	
Class 11	Sound-speed calculation, measurement and distribution	
Class 12	Surface and bottom boundary conditions and biological effect	
Week 5	**Ocean Dynamics**	
Class 13	Noise sources and spectra, Propeller Noise, Cavitation Noise	
Class 14	Depth dependence and directionality and slope-conversion effects	
Class 15	Theoretical basis for noise modeling	
Week 6	**Ocean Dynamics**	
Class 16	Ambient noise and beam-noise statistics models	
Class 17	Volume and boundary scattering	
Class 18	Cell scattering and point scattering techniques	
Week 7	**Propagation**	Mid Term, Final Exam
Class 19	Basic concepts, boundary interactions, attenuation and absorption	
Class 20	Frequency-domain wave equation formulations including ray theory, normal mode, multipath expansion,	
Class 21	Assessment 02	
Week 8	**Acoustic radiation**	
Class 22	Radiation efficiency- noise level, spectra and bandwith	
Class 23	Tomography	
Class 24	Prediction uncertainties in complex environments	
Week 9	**Devices for under water sound production and reception**	
Class 25	Principles of transduction and sonar transducer design	
Class 26	Commercial applications of underwater acoustics	
Class 27	Mid-term exam	Mid Term, Final Exam
Week 10	**Oceanic ray bending**	
Class 28	Oceanic ray bending reflection of sound waves	
Class 29	Transmission loss	
Class 30	Bottom reflections	
Week 11	**Non-linear acoustics**	
Class 31	The propagation of finite amplitude waveforms	
Class 32	Acoustics streaming	
Class 33	Parametric and stimulated scattering effects in liquids.	
Week 12	**Acoustics in Fluid Media**	

Class 34	Superposition of simple courses, free space Green's functions	
Class 35	Kirchhoff-Helmholtz integral theorem, Rayleigh integral, radiation from cylinders and spheres	
Class 36	Introduction to acoustic finite elements and acoustic boundary elements	
Week13	**Ocean Bottom**	CT 3, Final Exam
Class 37	Imaging hydrothermal vents	
Class 38	large scale mapping, mesoscale mapping	
Class 39	Vibration measurements	
Week 14	**Transducer Materials and Devices**	
Class 40	Principles of transduction and sonar transducer design	
Class 41	Ocean energy devices	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C1, C2, P3
			CO3	P6, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A4
	Mid term	15%	CO1, CO4	C1, C4, A3
Final Exam		60%	CO1	C1, C2, C4
			CO2	A2,C4
			CO3	C3, A4
			CO4	P1, P5, C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Sound in the Sea, Medwin, Cambridge University Press, 2005
2. Principles of Sonar Performance Modeling, Ainslie, Springer, 2010
3. Underwater Acoustics: Analysis, Design and Performance of Sonar, Hodges, Wiley, 2010
4. Inverse Problems in Underwater Acoustics, Taroudakis and Makrakis, Springer, 2001
5. Fundamentals of Acoustical Oceanography, Medwin and Clay, Associated Press, 1998
6. Ocean Acoustic Tomography, Munk, Worcester, and Wunsch, Cambridge University Press, 1995

COURSE INFORMATION

Course Code: NAME 499
Course Title: Shipyard Management
Level and Term: Level 4, Term 2

Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

Course Code: GELM 275
Course Title: Leadership and Management

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Optional theoretical course designed to teach students about the organizational structures of shipyards, management of a shipyard's workforce and performance evaluation of employees. After taking this course, students will acquire knowledge of various shipbuilding process and activities such as tendering, estimation, engineering, procurement, construction and timely delivery. Finally, students shall be able to make decisions to select alternative design, production process or equipment to increase shipyard productivity and to reduce risk.

OBJECTIVES

1. To be familiar with the management of various shops and plants at shipyard.
2. Gain knowledge of shipbuilding process at various stages.
3. Be able to plan and manage shipyard's daily activities.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Comprehend** various processes of shipbuilding at different stages.
2. **Evaluate** design and process alternatives for selection of appropriate one.
3. **Plan** shipbuilding processes to maximize results.

COURSE CONTENTS

1. Shipbuilding: Phase-wise work contents, initial estimation procedures and practice, information flow, agreements.
2. Handling of material and material flow: Plant location, layout and construction, plant safety, Designer's roles, owner's requirements, builder's profit and society's rules.
3. Material and technological constraints: Alternative designs and acceptance of a compromise design, Post-production assessment for future guidance.
4. Cost evaluation in shipyard
5. Work flow of ship construction
6. Material procurement and handling
7. Overhead parameters in shipyard
8. Protection against fire and physical accidents
9. Docking & undocking precautions
10. Workers job environment and safety instructions

11. Precautions for entering in confined corporation
12. Gas freeness certificate

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Comprehend** various processes of shipbuilding at different stages.	√											
CO2	**Evaluate** design and process alternatives for selection of the appropriate one.				√								
CO3	**Plan** shipbuilding processes to maximize results.											√	

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Comprehend** various processes of shipbuilding at different stages.	C2	1		1-4	CT, F
CO2	**Evaluate** design and process alternatives for selection of the appropriate one.	C5	1		8	CT, Mid Term, F
CO3	**Plan** shipbuilding processes to maximize results.	C6	-		-	CT/ASG, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of engineering fundamentals and shipbuilding has to be applied to understand various processes in shipbuilding at different stages.
CO2-PO4	Design and process alternatives are to be analyzed critically based upon existing facilities at shipyards in order to select the appropriate one.
CO3-PO11	Various shipbuilding processes and schedule are to be planed after discussion with other departments at shipyard.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 30 21 21
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Course introduction, administration and motivation lecture	
Class 2	Introduction to shipbuilding, Shipbuilding in Bangladesh.	
Class 3	The maritime cluster: Linkage between shipyard, ship owner, manufacturers, suppliers, service Providers etc.	
Week 2	**Introduction to Shipbuilding**	
Class 4	Typical shipbuilding process	
Class 5	Challenges in shipbuilding.	
Class 6	Three dimensions of shipbuilding: Functional (what), Spatial (where) and Temporal (when)	
Week 3	**Phase-wise work contents**	
Class 7	Shipbuilding phases	
Class 8	Work done in each phase	
Class 9	Class Test - 1	
Week 4	**Cost estimation procedures and practice in shipyards**	CT 2, Final Exam
Class 10	Procedures for initial estimation and required inputs	
Class 11	Risks and margin in initial estimation, control, classification using code (SFI code)	
Class 12	Demonstration with examples, sharing of lessons learnt	
Week 5	**Information flow and Procurement**	
Class 13	Shipyard Layout, information flows in shipbuilding process	
Class 14	Procurement, prioritizing resources	
Class 15	Purchase process, project procurement	
Week 6	**Agreements**	
Class 16	Contract agreements and other documentation	
Class 17	Discussion on build specification	
Class 18	Class Test -2	
Week 7	**Plant location, layout and construction and plant safety & Handling of material and material flow**	
Class 19	Material handling strategy, yard layout, shipyard main store, shop stores	
Class 20	Transport, lifting facility	

Class 21	Time thief and automation ideas	Mid Term, Final Exam
Week 8	**Designer's roles, owner's requirements, builder's profit and society's rules**	
Class 22	Owner's requirement for project development, designer's roles	
Class 23	Appointing class, class requirement, survey and compliance	
Class 24	Mid-Term Exam	
Week 9	**Alternative designs and acceptance of a compromise design, Post-production assessment for future guidance**	
Class 25	Design comparison, assessment criteria among design alternatives,	
Class 26	Material and technological constraints, post-production assessment	
Class 27	Examples, case study	Mid Term, Final Exam
Week 10	**Overhead Parameters in Shipyard**	
Class 28	Definition of overhead in shipbuilding context.	
Class 29	Ways to reduce and control overhead:	
Class 30	Case study on overhead	
Week 11	**Docking and Undocking Precautions**	
Class 31	Docking-undocking methods; advantage and disadvantages of various docking-undocking methods	
Class 32	Capacity of winch, pulley, wire, trolley checking with calibration and certifications	
Class 33	Air bag pressure test, launching way slope check	
Week 12	**Workers' Job Environment and Safety Instructions**	
Class 34	Concept of risk and safety	
Class 35	Shipyard safety standard, safety in various shop	
Class 36	Risk assessment and compliance with shipyard safety standard	
Week13	**Precautions for entering in confined compartment**	CT 3, Final Exam
Class 37	Associated risks for working in confined spaces	
Class 38	Access, light, ventilation, oxygen level check, attendant requirement.	
Class 39	Class Test - 3	
Week 14	**Gas Free Certificates**	
Class 40	Accident case study in confined space	
Class 41	Procedure to obtain gas free certificate	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C4
			CO3	C3, C4
	Class Participation	5%	CO1, CO2, CO3, CO4	C6, A2
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4

		CO4	C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Shipyard Project Management Paperback – August 24, 2017, by Fernando Remolina
2. Workshop process, Practice and Materials by Bruce J. Black
3. Shipboard Accident Response By Eric Murdoch BSc, MSc, C. Eng
4. Fisher Maritime Consulting Group Florham Park, New Jersey, USA
5. Cost Management in Shipbuilding, By Fischer, Jan O.; Holbach, Gerd

COURSE INFORMATION

Course Code: CSE 115	**Credit Hours:** 3.00
Course Title: Computer Programming Language	**Contact Hours:** 3.00
Level and Term: Level 1 Term 2	

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
Computer Programming course is designed to teach students about the basic programming theory in software and programming, namely types of ship and floating structures. Students will be able to perform necessary calculations related to the basic design, trim and stability calculations using computer programming once the course is completed.

OBJECTIVES
1. To provide basic concepts of compilers, interpreters and IDE
2. To know about various syntax, semantics of programming languages.
3. To analyze and design various applications using different library functions of programming language.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **Describe** the concept of programming language and **Identify** syntax, semantics of programming language
2. **Construct** a computer programming pseudocode and **Apply** pseudocode in a computer program.
3. **Explain** a programming architecture and **Justify** program design and development.
4. **Assist** for testing and debugging tools to discover errors

COURSE CONTENTS
1. **Introduction to Programming and OOP:** Programing basics, Programming concepts, Programming and coding; Algorithm, Philosophy of Object Oriented Programming (OOP); Advantages of OOP over structured programming; Program development stages; Encapsulation, classes and objects, access specifiers, static and non-static members; Constructors, destructors and copy constructors; Array of objects, object pointers, and object references; Compilers, interpreters and IDE; Syntax and semantics; Flow charts.
2. **Inheritance and Polymorphism:** Single and multiple inheritance; overloading, abstract classes, virtual functions and overriding; Exceptions; Object Oriented I/O; Template functions and classes; Multi-threaded Programming.
3. **Structured Programming Language:** Data types, operators, expressions, control structures.

4. **Functions and Program Structure:** Parameter passing conventions, scope rules and storage classes, recursion; Header files; Preprocessor; Pointers and arrays; Strings; Multidimensional array; User defined data types: structures, unions, enumerations; Input and Output: standard input and output, formatted input and output, file access; Variable length argument list; Command line parameters; Error Handling; Exception Handling, Graphics; Linking; Library functions, Type casting.
5. **Memory Allocation:** Static and Dynamic; Recursive Functions;
6. **Introduction to Data Structure:** Stack, Queue; File I/O; Graphics

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Describe** the concept of programming language and **Identify** syntax, semantics of programming language	√											
CO2	**Construct** a computer programming pseudocode and **Apply** pseudocode in a computer program.	√											
CO3	**Explain** a programming architecture and **Justify** program design and development.			√									
CO4	**Assist** for testing and debugging tools to discover errors		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Describe** the concept of programming language and **Identify** syntax, semantics of programming language	C1			1-4	CT, F
CO2	**Construct** a computer programming pseudocode and **Apply** pseudocode in a computer program.	C3			1-4	CT/ASG, MT, F
CO3	**Explain** a programming architecture and **Justify** program design and development.	A3			5	CT/ASG, MT, F
CO4	**Assist** for testing and debugging tools to discover errors	A2			1-4	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications

CO1-PO1	The knowledge of binary mathematics and science has to be applied to understand basic computer programming concepts
CO2-PO1	To construct a pseudocode and apply the knowledge in programming, understanding of flow chart and algorithm concepts is required.
CO3-PO3	To be able to explain and justify a program, understanding detailed programming concepts is required.
CO4-PO2	This is required in order to conduct any investigation of complex problems related to computer programing architecture.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Programming Concepts, IDE and Compiler	
Class 2	Structured Programming	
Class 3	Object-oriented programming	
Week 2	**Numbering System and Memory Allocation**	
Class 4	Concept of Number System and Memory Allocation	
Class 5	Binary, Octal and Decimal Number System	
Class 6	Memory allocation in programming	
Week 3	**Introduction to Data Types, Variables and Statement**	
Class 7	Concept of Header file types, Data types and Keywords	
Class 8	Concept of Variables, Constant and their declarations	
Class 9	Concept of Statement and Expression	
Week 4	**Operators and Basic Library functions**	CT 2,
Class 10	Operators and their types	
Class 11	Basic library functions	
Class 12	Assessment 01	
Week 5	**Flowchart and Algorithm**	

Class 13	Introduction to Pseudocode, Algorithm and Flow chart	Final Exam
Class 14	Concept of Structure: Sequence, Decision and Repetition	
Class 15	Case wise Structure	
Week 6	**Conditionals Segment 1**	
Class 16	Concepts of Conditionals, Expression for conditionals and their types.	
Class 17	The If else conditional	
Class 18	The do-while and while conditional	
Week 7	**Conditionals Segment 2**	Mid Term, Final Exam
Class 19	Switch Case conditional	
Class 20	Loop and Nested loop conditionals	
Class 21	Operators and Functions in Conditional	
Week 8	**Loop and Nested Loop**	
Class 22	Detailed concepts and control structures of Loop and Nested loop	
Class 23	Assessment 02	
Class 24	Application of Loop and Nested Loop	
Week 9	**Function**	
Class 25	Concepts of Function and function types	
Class 26	Function process, parameter passing and creation	
Class 27	Advance recursivity in function	Mid Term, Final Exam
Week 10	**Function and loop Combination**	
Class 28	Concept of Class and Object	
Class 29	Allocation and creation of loop and function in program	
Class 30	Application of loop and function in class and object	
Week 11	**Array and pointer**	
Class 31	Concept of Array, Pointer and String	
Class 32	Concept of Multidomain array and pointer	
Class 33	Dynamic memory allocation	
Week 12	**Introduction to File System**	
Class 34	Concept of File input output, user definition and preprocessor	
Class 35	User defined data type, union and enumeration	
Class 36	Assessment 03	
Week13	**Error Handling**	CT 3, Final Exam
Class 37	Concept of Bitwise operations and linking	
Class 38	Concept of Stack and Que	
Class 39	Concept on Error handling	
Week 14	**Course Summarization**	
Class 40	Summarization of the syllabus and course contents	
Class 41	Assessment report to Students	
Class 42	Course Feedback and review from students	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C3, A3
	Class Participation	5%	CO1, CO2, CO3, CO4	C1, C3, A3, A2
	Mid term	15%	CO2, CO3	A3, A2
Final Exam		60%	CO1	C1
			CO2	C3
			CO3	A3

		CO4	A2
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. You Can Do It! A Beginner's Introduction to Computer Programming by Francis Glassborow
2. Computer Programming for Beginners: Fundamentals of Programming Terms and Concepts by Nathan Clark
3. The Pragmatic Programmer: From Journeyman to Master by Andrew Hunt and David Thomas
4. Teach Yourself C - Herbert Schidlt
5. Programming in Ansi C - E Balagurusam
6. C: The Complete Reference - Herbert Schildt
7. C Programming Language – Dennis M. Ritchel

Military Institute of Science and Technology
Department of Naval Architecture and Marine Engineering

COURSE INFORMATION
Course Code: CSE 116 **Contact Hours:** 3.00
Course Title: Computer Programming Lab **Credit Hours:** 1.50
Level and Term: Level 1 Term 2

PRE-REQUISITE
Course Code:NAME 115
Course Title: Computer Programming Language

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
Computer Programming Lab course is designed to teach students about the basic programming application is ship design retrospect, namely types of ship and floating structures. Students will be able to perform necessary calculations related to the basic design, trim and stability calculations using computer programming once the course is completed. It is expected that students can develop critical thinking behind developing a computer program and able to check their calculations.

OBJECTIVES
1. To enable students to be familiarized and implement different programming concepts in application.
2. To familiarize the students with applied and calculative concept of computer programming
3. To enable students to compute different parameters of ships using programming concept.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **Solve** programming problems and **Perform** computations with the aid of computer **develop** lines plan of ship.
2. **Apply** computer tools in problem solving and assignments**.**
3. **Analyse** and **Contrast** ideas to solve complicated problems.

COURSE CONTENTS
1. **Introduction, Structured programming language**
   a. Introduction to C and C++ Programming Language
   b. Data types, Variable declaration, Program Statements, Operators, Expressions
   c. Problem solving approaches, Basic Input / Output
   d. Control Structure: if else, switch case
   e. Control Structures: loop (different types), nested Loop
   f. Array and its uses, Array Operations, 2D Array
   g. Strings, Function, Recursion, Pointer, File Access, Object
2. **Oriented Programming:**
   a. Introduction to C++ (Object Oriented)
   b. Class & Object
   c. Application of the programming language in solving ship related problems.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Solve** programming problems and **Perform** computations with the aid of computer		√										
CO2	**Apply** computer tools in problem solving and assignments					√							
CO3	**Analyse** and **Contrast** ideas to solve complicated problems			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Solve** programming problems and **Perform** computations with the aid of computer	A5	1	1	1-4	R,Q,T
CO2	**Apply** computer tools in problem solving and assignments	C3	1	2	6	R,Q,T
CO3	**Analyse** and **Contrast** ideas to solve complicated problems	C4	1	2	5	R,Q,T
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	In order to develop problem solving skill.
CO2-PO5	To learn modern programming tools to solve problems.
CO3-PO3	In order to assess the analysing and deconstructing a problem for solution.

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Lab Work	30
Self-Directed Learning	
Preparation of Lab Assignment	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20

Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

COURSE SCHEDULE

Week	Topics
Week 1	Course introduction, Introduction to Programming and Object-Oriented programming
Week 2	IDE and Code blocks, data-type, variables and keywords
Week 3	Basic Library functions and Demonstration
Week 4	Conditionals (If Else) and problem Demonstration
Week 5	Conditionals (while/do-while) and problem Demonstration
Week 6	Loop (for) and problem Demonstration
Week 7	Mid Quiz/Lab test
Week 8	Nested Loop (for/if-else/while/do-while) and problem Demonstration
Week 9	Functions and Problem demonstration
Week 10	Array and Pointer
Week 11	File system
Week 12	Course feedback and Overall Review
Week 13	Final Lab Test
Week 14	Final Quiz

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Lab participation and Report</td><td rowspan="3">15%</td><td>CO 1</td><td>A5</td></tr>
<tr><td>CO 2</td><td>C3</td></tr>
<tr><td>CO 3</td><td>C4</td></tr>
<tr><td rowspan="3">Mid-quiz or lab-test</td><td rowspan="3">25%</td><td>CO 1</td><td>A5</td></tr>
<tr><td>CO 2</td><td>C3</td></tr>
<tr><td>CO 3</td><td>C4</td></tr>
<tr><td colspan="2" rowspan="2">Final Lab Test</td><td rowspan="2">25%</td><td>CO 1</td><td>A5</td></tr>
<tr><td rowspan="2">CO 2</td><td rowspan="2">C3</td></tr>
<tr><td colspan="2" rowspan="2">Final Quiz</td><td rowspan="2">35%</td></tr>
<tr><td>CO 3</td><td>A5</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. You Can Do It! A Beginner’s Introduction to Computer Programming by Francis Glassborow
2. Computer Programming for Beginners: Fundamentals of Programming Terms and Concepts by Nathan Clark
3. The Pragmatic Programmer: From Journeyman to Master by Andrew Hunt and David Thomas
4. Teach Yourself C - Herbert Schidlt
5. Programming in Ansi C - E Balagurusam
6. C: The Complete Reference - Herbert Schildt
7. C Programming Language – Dennis M. Ritchel

COURSE INFORMATION

Course Code: EECE 281
Course Title: Marine Electrical and Electronics
Level and Term: Level 2 Term 2

Credit Hours: 4.00
Contact Hours: 4.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Compulsory theoretical course based on application of electrical and electronic technology in marine field.

OBJECTIVES

1. Be familiarized with electrical technology, able to investigate and analyse electrical circuits and get introduced with power generation and distribution system, relevant SOLAS regulation applicable for ship and marine establishments.
2. To develop a basic foundation on electrical machines with a special focus on operating principle, identification of parts and accessories, constructional features, types, characteristics features, efficiency and loss measurement, application and maintenance etc.
3. To have a basic understanding on electronic components and its applications in marine electronics
4. To develop a broad idea on navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log etc.

COURSE OUTCOMES (COs)

On successful completion of this course, students should:

1. **Be able to describe** basic theories of electric circuits, analyse electrical circuits and its application in electrical equipment, identify power generation and distribution system with relevant SOLAS regulation applicable for ship and marine establishments
2. **Be capable to describe** basic theories of electrical machines and explain principle of operation, constructional features and **evaluate** the characteristics and find out their efficiency and losses, applications and maintenance etc.
3. **Be able to explain** theories of electronic components and identify its applications in marine electronics sector.
4. **Be capable to explain** the principles of navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log, GPS etc and communication equipment used on board ships.

COURSE CONTENTS

1. **DC and AC circuit analysis:** Kirchhoff's law, Thevenin theorem, Norton theorem, Node Pair voltage theorem etc.

2. **Three phase induction motors:** Basic Theory, Principle of operation, Types, construction, Equivalent circuit, Starting, speed control, Maintenance, applications.
3. **Single phase induction motors:** Basic Theory, Principle of operation, Equivalent circuit, types, starting, Maintenance, applications.
4. **AC generators:** Basic Theory, Principle of operation, Construction, excitation system, generator on load, voltage regulation, synchronization, Maintenance and applications.
5. **Synchronous motor:** Principle of operation, starting, application, maintenance Steering system.
6. Electronic Diodes, BJTs, diode and BJT circuits, IC, MOSFET and SCR as power switching devices.
7. **Controlled rectifiers and inverters.**
8. **Radar and wireless equipment:** Principle, block diagram, different parameters, Maintenance. Navigational and Electronic navigational aids (GPS, Gyro compass. Echo sounder, speed log, LORAN, RDF and Decca Chain).
9. Power generation and distribution (PGT) system onboard ship

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Be able to describe** basic theories of electric circuits, analyse electrical circuits and its application in electrical equipment, identify power generation and distribution system with relevant SOLAS regulation applicable for ship and marine establishments	√											
CO2	**Be capable to describe** basic theories of electrical machines and explain principle of operation, constructional features and **evaluate** the characteristics and find out their efficiency and losses, applications and maintenance etc.	√											
CO3	Be able to **explain** theories of electronic components and identify its applications in marine electronics sector.			√									
CO4	Be capable to explain the principles of navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log, GPS etc and communication equipment used on board ships.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Be able to describe** basic theories of	C3	1		1-4	CT/ ASG, F

	electric circuits, analyse electrical circuits and its application in electrical equipment, identify power generation and distribution system with relevant SOLAS regulation applicable for ship and marine establishments					
CO2	**Be capable to describe** basic theories of electrical machines and explain principle of operation, constructional features and **evaluate** the characteristics and find out their efficiency and losses, applications and maintenance etc.	C1	1		1-4	CT/ ASG, MT, F
CO3	Be able to **explain** theories of electronic components and identify its applications in marine electronics sector.	C3	2		5	CT/ ASG, F
CO4	Be capable to explain the principles of navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log, GPS etc and communication equipment used on board ships.	C2, C3	1		6	CT/ ASG, MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics, science and engineering fundamentals have to be applied to calculate the parameters of electrical equipment and circuit in a ship/ marine vessel.
CO2-PO1	In order to identify the parameters of various electrical and electronics machineries of ships.
CO3-PO3	To design a sophisticated ship with specialized electronic equipment for specific purpose/ research.
CO4-PO2	The knowledge of mathematics, natural science and engineering science have to be applied to identify, analyze and solve complex engineering problems.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 56

Practical / Tutorial / Studio Student-Centred Learning	- -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 28 28
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	160

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**DC Circuit analysis**	**CT 1 Final Exam**
Class 1	Nodal analysis and examples	
Class 2	Super node with examples, Basic circuit theorems	
Class 3	Thevenin's theorem with examples	
Class 4	Norton's theorem with examples	
Week 2	**Alternator**	
Class 5	Synchronous Generator: Operating principle,	
Class 6	Losses in Alternator	
Class 7	equivalent circuit of synchronous Generator, Excitation systems of Synchronous Generator	
Class 8	Emf equation of synchronous generator, Mathematical problems	
Week 3	**Alternator (Cont..)**	
Class 9	synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations	
Class 10	Vector diagram under different loads	
Class 11	factors affecting voltage regulation	
Class 12	Load sharing and parallel operation	
Week 4	**Induction Motor**	**CT 2 Mid Term Final Exam**
Class 13	Three phase induction motor: principle	
Class 14	Rotating magnetic field	
Class 15	Construction of squirrel cage IM, equivalent circuit	
Class 16	vector diagram, torque-speed characteristics	
Week 5	**Induction Motor (Cont..)**	
Class 17	no-load test, blocked rotor test	
Class 18	starting and braking, speed control	
Class 19	Single phase induction motor: Types of operation	
Class 20	starting and torque speed characteristics	
Week 6	**Synchronous Motor**	
Class 21	Synchronous motor: Operation	
Class 22	Vector diagrams of synchronous motor	
Class 23	effect of loading under different excitation condition.	
Class 24	Starting method of synchronous motor	

Week 7	**Synchronous Motor (Cont..)**	**CT 3 Mid Term Final Exam**
Class 25	effect of changing excitation, Armature reactions	
Class 26	Variations of power factor with armature reactions, Mathematical Problems.	
Class 27	Maximum load angle	
Class 28	Mathematical Problems	
Week 8	**Diode**	
Class 29	Introduction to semiconductor devices and its classifications	
Class 30	P-type and N-type materials and doping, Semiconductor diode and its band diagram	
Class 31	Biasing of semiconductor diodes, I-V characteristics of diode and equivalent circuit of diodes	
Class 32	Zener diode and related maths of zener diode,	
Week 9	**Diode (Cont..)**	
Class 33	Applications of diode, HWR and FWR using diode	
Class 34	Diode bridge rectifier and Centre tapped transformer rectifier, Clipper circuit and related problems	
Class 35	Clamper circuit and related problems	
Class 36	Ripple factor and related mathematical problems	
Week 10	**BJT**	**CT 4 Final Exam**
Class 37	Introduction to BJT and construction, Principle and operation of BJT	
Class 38	Operating regions of BJT and its different configurations	
Class 39	CB and CE configurations and characteristics curves	
Class 40	Mathematical problems related to CB and CC configurations.	
Week 11	**MOSFET**	
Class 41	Introduction to MOSFET, Construction and operating principle of MOSFET	
Class 42	Types of MOSFET, Construction and operating principle of depletion type and enhancement type MOSFET	
Class 43	Biasing of MOSFET and related problems, Characteristics curve of MOSFET	
Class 44	threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET	
Week 12	**SCR**	
Class 45	Introduction to power semiconductors witches, Introduction to triggering devices	
Class 46	Introduction to SCR and IGBT, Controlled single phase and three phase Rectifiers	
Class 47	Introduction to AC voltage controllers	
Class 48	Introduction to Single and three phase Choppers, Working principle of Single and three phase Choppers	
Week13	**Radar and wireless equipment**	
Class 49	Principle, block diagram, different parameters	
Class 50	Maintenance Navigational and Electronic navigational aids	

Class 51	GPS, Gyro compass	
Class 52	Echo sounder, speed log	
Week 14	**Radar and wireless equipment (Cont...)**	
Class 53	Introduction to LORAN	
Class 54	RDF and Decca Chain	
Class 55	Power generation and distribution (PGT) system	
Class 56	Review class	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>COs</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="5">Continuous Assessment (40%)</td><td rowspan="2">Class Test/ Assignment 1-3</td><td rowspan="2">20%</td><td>CO1, CO2, CO3</td><td>C1, C3</td></tr>
<tr><td>CO3</td><td>C3</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO1, CO2, CO3, CO4</td><td>C1, C2, C3</td></tr>
<tr><td>Mid term</td><td>15%</td><td>CO1, CO2, CO3</td><td>C1, C3</td></tr>
<tr><td colspan="2" rowspan="4">Final Exam</td><td rowspan="4">60%</td><td>CO1</td><td>C3</td></tr>
<tr><td>CO2</td><td>C1</td></tr>
<tr><td>CO3</td><td>C3</td></tr>
<tr><td>CO4</td><td>C2, C3</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Electric Machinery Fundamentals- Stephen J. Chapman;
2. A Text book of Electrical Technology (V-II) - B.L. Theraja and A. K. Theraja;
3. Electronic Devices & Circuit Theory-Robert L. Boylestad.
4. Principles of Electronics: V.K. Mehta
5. Practical Marine Electrical Knowledge by Dennis T. Hall
6. Marine Electrical Practice G. O. Watson
7. Marine Electrical Equipment and Practice by H. D. McGeorge
8. The Marine Electrical and Electronics Bible by John C. Payne

COURSE INFORMATION

Course Code: EECE 382 | **Credit Hours:** 1.50

Course Title: Marine Electrical and Electronics Lab | **Contact Hours:** 3.00

Level and Term: Level 3 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

To help the students to explore various DC and AC machines and to teach about the concepts, principles and working of basic electronic devices and circuits by hand-held experiments. Our mission is to expose students to the constructions of electrical machines and basic electronic circuit to analyze their performance. This course is targeted to verify the properties of generator, motor, diode, BJT, MOSFET and relate them with their theoretical knowledge.

OBJECTIVES

1. To familiarize the students with the basic electrical machines like transformer, dc generator, dc motor, synchronous machines, induction machines etc.
2. To calculate various parameters of machines like voltage regulation, efficiency etc., observe their behaviour under various load conditions and compare them.
3. To enable the students to be familiarized and implement different semiconductor diode circuits (e.g. rectifier**,** regulator), their output characteristics and their practical implication in real life.
4. To familiarize the students with input and output characteristics of different BJTs, FETs and also the operation of each device in terms of junction bias voltage and charge carrier movement.

COURSE OUTCOMES (COs)

On successful completion of this course, students should:

1. **Be able to compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, induction motor etc. and **justify** these characteristics under various loading condition.
2. **Be able to compare** the starting and operating characteristics of various induction machines like squirrel cage induction motor, wound rotor induction motor, capacitor start & run motor.
3. **Developing capability to compare** the input and output characteristics of different electronic component obtained by both simulations and hand-held experiments.
4. **Becoming proficient in interpreting** the behaviour of FET with different configurations and design electronic circuits adapting to the specified requirements using both simulating tools and hardware.
5. **Developing collaborative nature by discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations

COURSE CONTENT

1. Computing the regulation of the Transformer in Various Loads.
2. Study the properties of Three-Phase Alternator in various loads
3. Study the properties of Three Phase Induction motor.
4. Study the properties of Capacitor-Start & Run Motor.
5. Study the properties of synchronous motor.
6. Study the characteristics of diode.
7. Study of diode rectifier circuits.
8. Study of the characteristics of SCR.
9. Study of common base bipolar junction transistor characteristics.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Be able to compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, induction motor etc. and **justify** these characteristics under various loading condition.	√											
CO2	**Be able to compare** the starting and operating characteristics of various induction machines like squirrel cage induction motor, wound rotor induction motor, capacitor start & run motor.		√										
CO3	**Developing capability to compare** the input and output characteristics of different electronic component obtained by both simulations and hand-held experiments.			√									
CO4	**Becoming proficient in interpreting** the behaviour of FET with different configurations and design electronic circuits adapting to the specified requirements using both simulating tools and hardware.			√									
CO5	**Developing collaborative nature by discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations											√	

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods

CO1	**Be able to compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, induction motor etc. and **justify** these characteristics under various loading condition.	C3, C5		1	2	R, Q, T
CO2	**Be able to compare** the starting and operating characteristics of various induction machines like squirrel cage induction motor, wound rotor induction motor, capacitor start & run motor.	C1, P3	1	1	1,3 ,6	R, Q, T
CO3	**Developing capability to compare** the input and output characteristics of different electronic component obtained by both simulations and hand-held experiments.	C4, C5, P1	1		2, 3, 5, 6	R,Q,T
CO4	**Becoming proficient in interpreting** the behaviour of FET with different configurations and design electronic circuits adapting to the specified requirements using both simulating tools and hardware.	C2, P6, P7	1,2		2, 3, 5, 6	R,Q,T
CO5	**Developing collaborative nature by discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	A1, A2, A3, A4		1	7	PR, Pr
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	In order to calculate voltage regulation and efficiency, the knowledge of natural science and mathematics would be required.
CO2-PO2	In order to perform the experiments, the knowledge of engineering fundamentals is also required.
CO3-PO3	Ability to design electronic circuits with the perfect values of active and passive components is required in order to achieve input-output characteristics.
CO3-PO5	Circuit simulating tools and numerical tools are required for solving large scale complex electronic circuits.
CO4-PO3	Ability to design electronic circuits with the perfect values of active and passive components is required in order to achieve transfer characteristics.
CO5-PO11	For achieving project management skills and develop decision making

	qualities, actively participating in group projects is necessary.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 9 9 5 20
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week1	Introduction to the lab equipment, rules and norms of the laboratory and safety guidelines.
Week2	Expt-01: Computing the regulation of the Transformer in Various Loads.
Week3	Expt-02: Study the properties of Three-Phase Alternator in various loads
Week4	Expt-03: Study the properties of Three Phase Induction motor.
Week5	Expt-04: Study the properties of Capacitor-Start & Run Motor.
Week6	Expt-05: Study the properties of synchronous motor.
Week7	Expt-06: Study the characteristics of diode.
Week8	Expt-07: Study of diode rectifier circuits.
Week9	Expt-08: Study of the characteristics of SCR.
Week10	Expt-09: Study of common base bipolar junction transistor characteristics.
Week11	Practice Lab
Week12	Lab Test + Viva
Week13	Quiz test
Week14	Project submission

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment	Lab Participation and Report	20%	CO1	C3, C5
			CO2	C1, P3

(40%)			CO3	C4, C5, P1
			CO4	C2, P6, P7
	Labtest-1, Labtest-2	30%	CO1	C3, C5
			CO2	C1, P3
			CO 3	C4, C5, P1
			CO4	C2, P6, P7
	Project and Presentation	25%	CO5	A1, A2, A3, A4
Lab Quiz		25%	CO1	C3, C5
			CO2	C1, P3
			CO3	C4, C5, P1
			CO4	C2, P6, P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Electric Machinery Fundamentals- Stephen J. Chapman;
2. A Text book of Electrical Technology (V-II) - B.L. Theraja and A. K. Theraja;
3. Electronic Devices & Circuit Theory-Robert L. Boylestad.
4. Principles of Electronics: V.K. Mehta
5. Practical Marine Electrical Knowledge by Dennis T. Hall
6. Marine Electrical Practice G. O. Watson
7. Marine Electrical Equipment and Practice by H. D. McGeorge
8. The Marine Electrical and Electronics Bible by John C. Payne

COURSE INFORMATION

Course Code: ME 150
Course Title: Mechanical Engineering Drawing
Level and Term: Level 1 Term I
Contact Hours: 3.00
Credit Hours: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The aim of this course is to provide the concept of designing and drawing accurate schematics for simple blocks, orthographic, auxiliary drawing, sectional drawing and isometric representations, dimensioning, etc., which will be helpful during project, work in later semesters, as well as professionally.

OBJECTIVES

1. To introduce the principles and perspectives of geometric drawing that includes the standardization, drafting, dimensions and etc.
2. To introduce the technique of engineering graphics as a basis of engineering communication and expression of idea and thought.
3. To familiarize with the proper and standard technique in lettering, basic geometric constructions, sketching, dimensioning methods to describe size, shape and position accurately on an engineering drawing.
4. To introduce orthographic projection auxiliary, sectional views, and apply 3D pictorials to choose the best view to present the drawings.
5. To expose final drawings during the design process including assembly, machine and working drawings.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Demonstrate** use of appropriate standards and conventions in drawing sheet preparation and layout.
2. **Apply** the correct methods of referencing relevant specifications in the interpretation of Mechanical engineering drawings.
3. **Perform** the correct conventions and techniques in drawing orthographic, sectional and auxiliary views.
4. **Produce** isometric and oblique pictorial form from third angle orthogonal drawings.

COURSE CONTENTS

1. Introduction, Familiarization with drawing tools and types of projections.
2. Hands on skill on object drawing.

3. Drawing orthographic views of simple blocks, drawing orthographic views of objects with round features, drawing orthographic views of objects with fillets, rounds.
4. Drawing sectional views and Drawing auxiliary views.
5. Drawing isometric views of simple blocks, drawing isometric views with circle, drawing isometric views with missing lines, drawing isometric views.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Demonstrate** use of appropriate standards and conventions in drawing sheet preparation and layout.												√
CO2	**Apply** the correct methods of referencing relevant specifications in the interpretation of Mechanical engineering drawings.												√
CO3	**Perform** the correct conventions and techniques in drawing orthographic, sectional and auxiliary views.	√											
CO4	**Produce** isometric and oblique pictorial form from third angle orthogonal drawings.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Demonstrate** use of appropriate standards and conventions in drawing sheet preparation and layout.	C3				R, Q
CO2	**Apply** the correct methods of referencing relevant specifications in the interpretation of Mechanical engineering drawings.	C3				R,CT,Q
CO3	**Perform** the correct conventions and techniques in drawing orthographic, sectional and auxiliary views.	A2	1		1-4	R,CT,Q
CO4	**Produce** isometric and oblique pictorial form from third angle orthogonal drawings.	C3	1		1-4	R,CT,Q
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO12	In order to develop concept of appropriate standards and conventions in drawing sheet preparation and layout.
CO2-PO12	In order to develop concept of correct methods on referencing relevant specifications in the interpretation of Mechanical engineering drawings.
CO3-PO1	The knowledge of science has to be applied to perform the correct conventions and techniques in drawing orthographic, sectional and auxiliary views.
CO4-PO1	In order to apply the engineering knowledge to develop the isometric and oblique pictorial form from third angle orthogonal drawings.

TEACHING METHODOLOGY

Lecture followed by hands on drawing session and discussion, co-operative and collaborative method, project based method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

COURSE SCHEDULE

Week 1	Introduction, Familiarization with drawing tools and types of projections.
Week 2	Drawing orthographic views of simple blocks
Week 3	Drawing orthographic views of objects with round features.
Week 4	Drawing orthographic views of objects with fillets, rounds.
Week 5	Class test on orthographic views.
Week 6	Drawing sectional views.
Week 7	Drawing auxiliary views.
Week 8	Class test on sectional and auxiliary views.
Week 9	Drawing isometric views of simple blocks.
Week 10	Drawing isometric views with circle.
Week 11	Drawing isometric views with missing lines.

Week 12	Drawing isometric views with view.
Week 13	Class test on isometric views.
Week 14	Final Quiz.

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Bloom's Taxonomy**
Continuous Assessment	Lab participation and Report	20%	CO 1	C1, C3,A1
			CO 2	C4, C5, A1
			CO 3	C3, C4
			CO 4	C3
	Labtest-1,Labtest-2	30%	CO 1	C1, C3,C4
			CO 2	C4, C5, P1
			CO 3	C3, C4
			CO 4	C3
	Project and Presentation	25%	CO 1, CO 2, CO 3	A1, A2, A3, A4
Lab Quiz		25%	CO 1	CO 2
			CO 2	CO 3
			CO 3	C3, P6, P7
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanical Engineering drawing By Dr. Md. Quamrul Islam
2. Textbook of Engineering Drawing By K. Venkata Reddy

COURSE INFORMATION
Course Code: SHOP 180 **Credit Hours:** 1.5
Course Title: Workshop Practice (Foundry, Welding and Machine Shop) **Contact Hours:** 3.0
Level and Term: Level 1 Term 1

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

RATIONALE
Foundry, Welding and Machine Shop Sessional course is designed to provide students with the theoretical and practical skills needed to develop their future professional activity in the areas of foundry and/or welding, on production management, casting design and product control, areas of safety, speed and feed calculations, layout equipment, cutting tools, and machine tool equipment. Attention is given to the methodologies of casting design, as well as to the techniques of identification, characterization and resolution of product defects. Also introduces and studies the more technical shop operations of threading, tapping, boring, carbide tooling, and principles of metal cutting. Principles of metal cutting include the machining ability of metals and how it relates to chip formation.

OBJECTIVES
1. To provide students with the theoretical and practical skills needed to develop their future professional activity in the areas of foundry and/or welding, on production management
2. To impart knowledge on casting design and product control
3. To enable to acknowledge the safety precautions required to run an abrasive grinding machine
4. To enable to recognize surface grinder types, grinding wheel care, grinding wheels and abrasive products, mount a grinding wheel, true and dress a grinding wheel.

COURSE OUTCOMES (COs)
On successful completion of this course, students should be able to:
1. **Design** simple patterns and pattern plates for the casting process.
2. **Specify** and **select** foundry and welding equipment.
3. **Identify** and **establish** correcting measures to eliminate casting and welding defects.
4. **Identify** the characteristics of an abrasive grinding machine, drilling machine, lathe machine, shaper machine, milling machine.

COURSE CONTENTS
1. **Foundry**
   a. Introduction to foundry, tools and equipment;
   b. Patterns: function, pattern making;
   c. Molding: molding materials sand preparation, types of mold, procedure;
   d. Cores: types, core making materials;
   e. Metal melting and casting; Inspection of casting and casting defects.

2. **Welding**
    a. Metal joints: riveting, grooving, soldering, welding;
    b. Welding practice: electric arc - steel, aluminum; Types of electrode;
    c. Welding defects: visual, destructive and non-destructive tests of welding.
    d. Gas welding and equipment; Types of flame; Welding of different types of materials;
    e. Gas welding defects; Test of gas welding.

3. **Tools**
    a. Common bench and hand tools, marking and layout tools;
    b. Measuring tools, cutting tools, machine tools, Bench work on jobs;
    c. Practices on machine tools: drilling machine, lathe machine, shaper machine, milling machine, grinding machine.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Design** simple patterns and pattern plates for the casting process	√											
CO2	**Specify** and **select** foundry and welding equipment.	√											
CO3	**Identify** and **establish** correcting measures to eliminate casting and welding defects.				√								
CO4	**Identify** the characteristics of an abrasive grinding machine, drilling machine, lathe machine, shaper machine, milling machine					√							

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Design** simple patterns and pattern plates for the casting process	C3	1		1-4	CT, F
CO2	**Specify** and **select** foundry and welding equipment.	C2	1		1-4	CT, Mid Term, F
CO3	**Identify** and **establish** correcting measures to eliminate casting and welding defects.	C3	3		5	CT/ASG, F
CO4	**Identify** the characteristics of an abrasive grinding machine, drilling machine, lathe machine, shaper machine, milling machine	A2	1		8	Mid Term, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to calculate hydrostatic parameters and develop the effects of draught change on them.
CO2-PO1	In order to identify the role and extent of hydrostatic parameters on the principles of intact and damage stability of ships.
CO3-PO4	To analyze vessels' hydrostatic and hydrodynamic parameters for docking and launching calculations.
CO4-PO5	In order to ascertain the level of stability of the vessel and maintenance of upright position at lightship/ designated loading conditions.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method, Practical use of tools and Production

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

COURSE SCHEDULE

Week	Contents
Week 1-3	**Foundry**
Class 1	Preparation for moulding
Class 2	Casting
Class 3	Final Product
Week 4-6	**Welding**
Class 4	Basic concepts
Class 5	Preparation
Class 6	Formation of a welded joint
Week 7-9	**Lathe Operation**
Class 7	Orientation with a lathe
Class 8	Setting measurement
Class 9	Making a threaded screw

Week 10 -11	**Milling machine**
Class 10	Operation of a Milling Machine
Class 11	Hands on experiment
Week 12-13	**Shaper Machine**
Class 12	Operation of a Shaper Machine
Class 13	Hands on experiment
Week 14	**Quiz/Viva**

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Lab participation and Report	20%	CO1, CO2, CO3, CO4	
	Labtest-1,Labtest-2	30%	CO1, CO2, CO3, CO4	
	Project and Presentation	25%	CO1, CO3	
Lab Quiz		25%	CO1	C1,,C3
			CO2	C1,C2
			CO3	C3, A2
			CO4	C1,C2, C3
Total Marks		100%		

REFERENCE BOOKS

1. Manufacturing Technology Volume 1 (Foundry, Forming & Welding) (3rd Edition) PN RAO
2. Machining Fundamentals-John R Walker
3. Principles of Foundry Technology- P. L. Jain.
4. Machine Tool Practices-Richard R Kibbe.

COURSE INFORMATION

Course Code:ME 277 | **Credit Hours:** 3.00

Course Title: Heat Transfer | **Contact Hours:** 3.00

Level and Term: Level 2 Term 2

PRE-REQUISITE

Course Code:NAME 177

Course Title: Thermal Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Compulsory Theoretical course based on heat related equipment design and problem to solve effectively and efficiently.

OBJECTIVES

1. Compare why certain materials are better than others for transferring heat.
2. Apply to real-world problems regarding heat transfer and materials.
3. Apply heat transfer principles to design and to evaluate performance of thermal systems.
4. Develop the design of heat exchangers.
5. Evaluate the impacts of initial and boundary conditions on the solutions of a particular heat transfer problem.
6. Evaluate the relative contributions of different modes of heat transfer.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Measure** rate of heat transfer under various condition through solid, liquid and gas.
2. **Analyze** temperature distribution while heat transfer takes place.
3. **Analyze** performance of a heat exchanger.
4. **Design** insulation and heat exchanger devices.

COURSE CONTENTS

1. **Introduction to Heat Transfer:** Conduction Heat Transfer, Thermal Conductivity, Convection Heat Transfer, Radiation Heat Transfer.

2. **Steady-State Conduction—One Dimension:** The Plane Wall Insulation and R Values, Radial Systems, Heat-Transfer Coefficient, Critical Thickness of Insulation, Heat-Source Systems, Cylinder with Heat Sources, Conduction-Convection Systems, Fins, Thermal Contact Resistance.

3. **Steady-State Conduction—Multiple Dimensions:** Mathematical Analysis of Two-Dimensional, Heat Conduction, Graphical Analysis, The Conduction Shape Factor, Numerical Method of Analysis, Numerical Formulation in Terms of Resistance Elements, Gauss-Seidel Iteration, Accuracy Considerations, Electrical Analogy for Two-Dimensional Conduction.

5. **Unsteady-State Conduction:** Lumped-Heat-Capacity System, Transient Heat Flow in a Semi-Infinite Solid, Convection Boundary Conditions, Multidimensional Systems, Transient Numerical Method, Thermal Resistance and Capacity Formulation.
6. **Principles of Convection:** Introduction, Viscous Flow, Inviscid Flow, Laminar Boundary Layer on a Flat Plate, Energy Equation of the Boundary Layer, The Thermal Boundary Layer, The Relation Between Fluid Friction and Heat Transfer, Turbulent-Boundary-Layer Heat Transfer, Turbulent-Boundary-Layer Thickness, Heat Transfer in Laminar Tube Flow, Turbulent Flow in a Tube, Heat Transfer in High-SpeedFlow.
7. **Empirical and Practical Relations for Forced-Convection Heat Transfer:** Introduction, Empirical Relations for Pipe and Tube Flow, Flow Across Cylinders and Spheres, Flow Across Tube Banks, Liquid-Metal Heat Transfer.
8. **Natural Convection Systems:** Free-Convection Heat Transfer on a Vertical Flat Plate, Empirical Relations for Free Convection, Free Convection from Vertical Planes and Cylinders, Free Convection from Horizontal Cylinders, Free Convection from Horizontal Plates, Free Convection from Inclined Surfaces, Non-Newtonian Fluids, Simplified Equations for Air, Free Convection from Spheres, Free Convection in Enclosed Spaces, Combined Free and ForcedConvection.
9. **Radiation Heat Transfer:** Physical Mechanism, Radiation Properties, Radiation Shape Factor, Relations Between Shape Factors, Heat Exchange Between Non-black bodies, Infinite Parallel Surfaces, Radiation Shields, Gas Radiation, Radiation Network for an Absorbing and Transmitting Medium, Radiation Exchange with Specular Surfaces, Radiation Exchangewith Transmitting, Reflecting, and Absorbing Media, Formulation for Numerical Solution, Solar Radiation, Radiation Properties of the Environment, Effect of Radiation on Temperature Measurement, The Radiation Heat-Transfer Coefficient.
10. **Condensation and Boiling Heat Transfer:** Introduction, Condensation Heat-Transfer Phenomena, The Condensation Number, Film Condensation Inside Horizontal Tubes, Boiling Heat Transfer, Simplified Relations for Boiling Heat Transfer with Water, The Heat Pipe.
11. **Heat Exchangers:** Introduction, The Overall Heat-Transfer Coefficient, Fouling Factors, Types of Heat Exchangers, The Log Mean Temperature Difference, Effectiveness-NTU Method, Compact Heat Exchangers, Analysis for Variable Properties, Heat-Exchanger Design Considerations.
12. **Heat transfer cases in ship design:** Insulation in bulkheads, refrigerated spaces, fish holds in trawlers.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Measure** rate of heat transfer under various condition through solid, liquid and gas	√											
CO2	**Analyze** temperature distribution while heat transfer takes place.	√											
CO3	**Analyze** performance of a heat exchanger.		√										
CO4	**Design** insulation and heat exchanger devices.			√									

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Measure** rate of heat transfer under various condition through solid, liquid and gas	C3	1		1-4	CT, F
CO2	**Analyze** temperature distribution while heat transfer takes place.	C2	1		1-4	CT, MT, F
CO3	**Analyze** performance of a heat exchanger.	C3	3		5	CT/ASG, F
CO4	**Design** insulation and heat exchanger devices	A2	1		8	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics and science has to be applied to measure the rate of heat transfer for any mode of heat transfer.
CO2-PO1	The knowledge of mathematics, science and engineering has to be applied to analyze the temperature distribution.
CO3-PO2	To analyze and evaluate the performance of a heat exchanger
CO4-PO3	Design of insulation and heat exchanger.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3

Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction**	CT 1, Final Exam
Class 1	Introduction	
Class 2	Revision of Thermodynamics	
Class 3	Control mass and control volume approach	
Week 2	**Fundamental Laws**	
Class 4	Definition of fundamental law and subsidiary Law	
Class 5	Fundamental laws that governs heat transfer issues	
Class 6	Subsidiary laws for heat transfer problems	
Week 3	**Conditions and Mode of Heat Transfer**	
Class 7	Steady state condition and isentropic, isobaric condition	
Class 8	Heat conduction mechanism and convection mechanism	
Class 9	Heat radiation mechanism	
Week 4	**Equations**	CT 2, Final Exam
Class 10	Equations for control mass and control volume applying law of conservation of mass	
Class 11	Equations for control mass and control volume applying Newton’s second law of motion	
Class 12	Equations for control mass and control volume applying 1st law of thermodynamics	
Week 5	**Subsidiary Laws**	
Class 13	Fourier’s law of heat conduction and thermal conductivity	
Class 14	Newton’s law of cooling and heat transfer coefficient	
Class 15	Stephan-Boltzman law	
Week 6	**Heat Conduction**	
Class 16	Heat conduction equation through a infinite solid	
Class 17	Heat conduction equation through infinite long hollow cylinder	
Class 18	Thermal resistance.	
Week 7	**Equations**	Mid Term, Final Exam
Class 19	General heat conduction equation for an infinite slab in unsteady state	
Class 20	General heat conduction equation for a long hollow cylinder	
Class 21	Problems	
Week 8	**Thermal Radiation**	
Class 22	Basic concepts	
Class 23	Laws of black body radiation	
Class 24	Subsidiary laws that governs thermal radiation	
Week 9	**Thermal Radiation**	
Class 25	Emissive Power of a black surface	
Class 26	Value of wavelength for emissive power	
Class 27	Planks law and Stephan-Boltzman law	
Week 10	**Thermal Radiation**	
Class 28	Directional nature of thermal radiation	

Class 29	Heat exchange by radiation between two finite black surfaces	Mid Term, Final Exam
Class 30	Rate of radiate heat exchange in an enclosure consisting of number of black surfaces	
Week 11	**Fluid Mechanics**	
Class 31	Review of fluid mechanics	
Class 32	Review of fluid mechanics	
Class 33	Forced convection	
Week 12	**Forced Convection**	
Class 34	Forced convection relation with fluid flow	
Class 35	Heating with constant wall heat flux	
Class 36	Heating with constant wall temperature	
Week13	**Natural Convection**	CT 3, Final Exam
Class 37	Natural convection heat transfer	
Class 38	General equation	
Class 39	Various conditions	
Week 14	**Boiling and Condensation**	
Class 40	Heat exchangers	
Class 41	Boiling and Condensation	
Class 42	Mass Transfer	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1CO3	C1, C2
			CO2	C2, C4
			CO3	C3, C4
	Class Participation	5%	CO4	
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2,C3
			CO2	C1, C2,C4
			CO3	C3, C4
			CO4	C3, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Heat Transfer: JackHolman
2. Principles of Heat Transfer by Frank Kreith, Raj M. Manglik , Mark S.Bohn
3. Engineering Thermodynamics: Work and Heat Transfer, G.F.C. Rogers & Y. R. Mathew, 1967, English Language Book Society & Longmans Green & Co.Ltd.
4. Fundamentals of Heat and Mass Transfer: C. P.Kothandaraman
5. Fundamentals of Heat and Mass Transfer: Incropera

COURSE INFORMATION

Course Code: CHEM 101
Course Title: Fundamentals of Chemistry
Level and Term: Level 1 Term 1
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

To learn the basic concepts of inorganic, organic and physical chemistry

OBJECTIVES

1. To define the different parameter and concepts of inorganic chemistry
2. To apply different chemical theory to evaluate structure of molecules.
3. To explain the basic concepts of physical chemistry
4. To describe basic reaction mechanism of selective organic reactions.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.
2. **Apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.
3. **Classify** hydrocarbon and explain the mechanism of selective organic reactions
4. **Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.

COURSE CONTENT

1. **Atomic Structure:** Atomic structure & quantum theory, Different atom models, Heisenberg's uncertainty principle
2. **Periodic Table:** Electronic configurations, Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases
3. **Alkali metals**: Chemical properties and uses
4. **Chemical Bonding:** Types and properties, Lewis theory, VBT, MOT, Hybridization and shapes of molecules
5. **Basic concepts of organic chemistry**: History, Physical and chemical properties, Classification
6. **Hydrocarbon:** Chemistry of hydrocarbon, Nomenclature, Properties
7. **Selective organic reactions:** Oxidation-reduction, Substitution, Addition, Polymerization, Alkylation reactions
8. **Acids-Bases/Buffer Solution:** Different concepts of acids-bases, Buffer solution, Mechanism

of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water

9. **Solutions:** Solutions and their classification, Unit expressing concentration, Colloid and colloidal solution, Colligative properties and dilute solutions, Raoult's law, Van't Hoff isotherm
10. **Thermochemistry:** Laws of thermochemistry, Enthalpy, Hess's law, Heat of formation, Heat of neutralization, Heat of reaction
11. **Electrochemistry:** Electrolytic conduction and its mechanism, Faraday's law, Kohlrausch Law, Debye-Huckel-Onsagar theory, Conductrometric titrations, Different types of cells
12. **Chemical Equilibria:** Equilibrium law/constant, Kp and Kc, Homogeneous and heterogeneous equilibria, Le Chatelier's principle
13. **Phase Rule:** Basic terms and phase rule derivation, Phase Diagram of water and carbon dioxide
14. **Chemical Kinetics:** Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	√											
CO2	**Apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.	√											
CO3	**Classify** hydrocarbon and explain the mechanism of selective organic reactions	√											
CO4	**Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.		√										

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.					CT, F, ASG
CO2	**Apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.					CT, MT, F
CO3	**Classify** hydrocarbon and explain the mechanism of selective organic reactions					MT, F, ASG
CO4	**Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.					
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term						

Exam)

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 30 21 21
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	**120**

COURSE SCHEDULE

Week	**Contents**	**Assessment**
Week 1	**Atomic Structure**	CT 1, Final Exam
Class 1	Concepts of atomic structure, Different atom models	
Class 2	Concepts of atomic structure, Different atom models	
Class 3	Hydrogen spectral lines, Quantum numbers	
Week 2	**Atomic Structure/Periodic Table**	
Class 4	Heisenberg's uncertainty principle	
Class 5	Electronic configuration, periodic classification of elements	
Class 6	Electronic configuration, periodic classification of elements	
Week 3	**Periodic Table/Alkali Metals/Chemical Bonding**	
Class 7	Periodic properties of elements, Properties and uses of noble gases	
Class 8	Alkali metals: Chemical properties and uses	
Class 9	Chemical bonding (types, properties, Lewis theory, VBT)	
Week 4	**Chemical Bonding**	CT 2, Final Exam
Class 10	Molecular Orbital Theory (MOT)	
Class 11	Molecular orbital theory (MOT)	
Class 12	Hybridization and shapes of molecules	
Week 5	**Chemical Bonding/Organic Chemistry**	
Class 13	Hybridization and Shapes of Molecules	
Class 14	Hybridization and Shapes of Molecules	
Class 15	Basic concepts of organic chemistry: History, physical and chemical	

	properties, classification	
Week 6	**Organic Chemistry**	
Class 16	Chemistry of hydrocarbon, nomenclature and properties	
Class 17	Selective organic reactions: oxidation-reduction, substitution	
Class 18	Selective organic reactions: addition, polymerization, alkylation	
Week 7	**Acids-Bases**	Mid Term, Final Exam
Class 19	Different concepts of acids-bases	
Class 20	Buffer solution, mechanism of buffer solution	
Class 21	Henderson-Hasselbach equation	
Week 8	**Acids-Bases/Solutions**	
Class 22	Water chemistry and pH of water	
Class 23	Solutions and their classification, unit expressing concentration	
Class 24	Colloid and colloidal solution	
Week 9	**Solutions/Thermochemistry**	
Class 25	Colligative properties and dilute solutions	
Class 26	Raoult's law, Van't Hoff isotherm	
Class 27	Thermochemistry: Laws of thermochemistry	Mid Term, Final Exam
Week 10	**Thermochemistry/Electrochemistry**	
Class 28	Enthalpy, Hess's law	
Class 29	Heat of formation, heat of neutralization, heat of reaction	
Class 30	Electrolytic conduction and its mechanism	
Week 11	**Electrochemistry**	
Class 31	Faraday's law, Kohlrausch law, Debye-Huckel-Onsagar theory	
Class 32	Conductrometric titrations	
Class 33	Different types of cells	
Week 12	**Chemical Equilibrium**	
Class 34	Equilibrium law/constant, K_p and K_c	
Class 35	Homogeneous and heterogeneous equilibria	
Class 36	Le Chatelier's principle	
Week13	**Phase Rule/Chemical Kinetics**	CT 3, Final Exam
Class 37	Phase rule: Basic terms and phase rule derivation	
Class 38	Phase diagram of water and carbon dioxide	
Class 39	Pseudo and zero order reaction, Half-life	
Week 14	**Chemical Kinetics**	
Class 40	Determination and factors affecting the rate of a reaction	
Class 41	First order reaction, Second order reaction	
Class 42	Collision theory, transition state theory	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
			CO2	C3
	Class Participation	5%	CO3	C3

	Mid term	15%	CO2, CO3	C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Modern Inorganic Chemistry- S. Z. Haider
2. Concise Inorganic Chemistry- J. D. Lee
3. A Textbook of Organic Chemistry-Arun Bahl and B. S. Bahl
4. Organic Chemistry-Morrison and Boyd
5. Principles of Physical Chemistry-Haque and Nawab
6. Essentials of Physical Chemistry-Bahl and Tuli
7. Physical Chemistry-Atkins

Military Institute of Science and Technology
Department of Naval Architecture and Marine Engineering

COURSE INFORMATION

Course Code: CHEM 102 **Credit Hours:** 1.5
Course Title: Chemistry Lab **Contact Hours:** 3.00
Level and Term: Level 1 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

To learn the basic concepts of inorganic and physical chemistry.

OBJECTIVES

To learn inorganic and physical chemistry quantitative analysis techniques.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Define** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.
2. **Explain** the different phenomena regarding iodimetric and iodometric method, complexometric titration etc.
3. **Estimate** zinc, ferrous content in water sample by using various titrimetric methods.
4. **Summarize** a report of any project work and apply in real life

COURSE CONTENTS

1. Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate (C2H2O4.2H2O) Solution.
2. Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.
3. Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na2CO3) Solution.
4. Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate (CaCl2.2H2O) Solution with Standard Di-Sodium Ethylene Diamine Tetra Acetic acid (Na2-EDTA) Solution.
5. Standardization of Sodium Thiosulphate Pentahydrate (Na2S2O3.5H2O) Solution with Standard Potassium Dichromate (K2Cr2O7) Solution.
6. Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate (CuSO4.5H2O) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$) Solution.
7. Standardization of Potassium Permanganate (KMnO4) Solution with Standard Oxalic Acid dihydrate (C2H2O4.2H2O) Solution.
8. Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr`s Salt) [FeSO4.(NH4)2SO4.6H2O] Solution with Standard Potassium Permanganate (KMnO4)

Solution.

9. Determination of Zinc (Zn) Content in a Zinc Sulphate Heptahydrate ($ZnSO_4.7H_2O$) Solution with Standard Di-Sodium EthyleneDiamineTetraAcetic acid (Na_2-EDTA) Solution by using Eriochrome black T indicator.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	√											
CO2	**Explain** the different phenomena regarding iodimetric and iodometric method, complexometric titration etc.	√											
CO3	**Estimate** zinc, ferrous content in water sample by using various titrimetric methods.	√											
CO 4	**Summarize** a report of any project work and apply in real life	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	C1-C2	1		3	Class Performance, Experimental Exam, Viva, Quiz
CO2	**Explain** the different phenomena regarding iodimetric and iodometric method, complexometric titration etc.	C3	1		3	Class Performance, Experimental Exam, Viva
CO3	**Estimate** zinc, ferrous content in water sample by using various titrimetric methods.	C3	1		3	Class Performance, Experimental Exam
CO4	**Summarize** a report of any project work and apply in real life					Report Writing

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

COURSE SCHEDULE

Week	**Contents**
Week 1	
Class 1	Introduction
Week 2	
Class 2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate (C2H2O4.2H2O) Solution.
Week 3	
Class 3	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.
Week 4	
Class 4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na2CO3) Solution.
Week 5	
Class 5	Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate (CaCl2.2H2O) Solution with Standard Di-Sodium Ethylene DiamineTetraAceticAcid (Na2-EDTA) Solution.
Week 6	
Class 6	Standardization of Sodium Thiosulfate Pentahydrate (Na2S2O3.5H2O) Solution with Standard Potassium Dichromate ((K2Cr2O7) Solution.
Week 7	
Class 7	Estimation of Copper (Cu) Content in a Copper Sulfate Pentahydrate (CuSO4.5H2O) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium Thiosulphate Pentahydrate (Na2S2O3.5H2O Solution.
Week 8	

Class 8	Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution.
Week 9	
Class 9	Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr`s Salt) [$FeSO_4.(NH_4)_2SO_4.6H_2O$] Solution with Standard Potassium Permanganate ($KMnO_4$) Solution.
Week 10	
Class 10	Determination of Zinc (Zn) Content in a Zinc Sulphate Heptahydrate ($ZnSO_4.7H_2O$) Solution with Standard Di-Sodium EthyleneDiamineTetraAcetic acid (Na_2-EDTA) (Na -EDTA) Solution by using Eriochrome black T indicator.
Week 11	
Class 11	Practice lab
Week 12	
Class 12	Lab test
Week 13	
Class 13	Quiz test
Week 14	
Class 14	Viva

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class performance	10%	CO1, CO2,CO3	C1, C2
	Report writing	30%	CO4	C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Practical Chemistry-A Jabbar & M Haque
2. Quantitative Chemical Analysis-A I Vogel
3. Analytical Chemistry-Gary D. Christian

COURSE INFORMATION

Course Code: PHY 101 **Credit Hours:** 3.00
Course Title: Wave Oscillation, Geometrical Optics and Modern Physics **Contact Hours:** 3.00
Level and Term: Level 1 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

To learn the basic concepts of Waves and Oscillations, Optics and Modern physics

OBJECTIVES

1. To define the different parameter and concepts of Waves and Oscillations, Optics and Modern physics.
2. To explain the basic concepts of Waves and Oscillations, Optics and Modern physics.
3. To solve analytical problems regarding Waves and Oscillations, Optics and Modern physics

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Define** the different parameters such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.
2. **Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding modern physics such as special theory of relativity, Compton theory, materials according to magnetic properties, nuclear transformation, and nuclear reaction etc.
3. **Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.

COURSE CONTENTS

1. **<u>Waves and Oscillations</u>**

   Simple Harmonic Motion (SHM) and its properties, Differential equation of a SHM and its solution, total energy of a body executing SHM, average kinetic and potential energy of a body executing SHM, LC oscillatory circuit, Pendulum: simple, compound and torsional pendulum, spring-mass system, two body oscillation and reduced mass, damped harmonic motion and its different condition, forced oscillation and its different condition, resonance, equation of a progressive wave, differential equation of a progressive wave, energy density of wave motion, average kinetic and potential energy of a body executing SHM, Stationary wave

2. **Optics**

   Lens, equivalent lens and power, defects of images and different aberrations, Interference of light, Young's double slit experiment, Interference in thin film and Newton's ring method, diffraction of light, diffraction by single slit, diffraction by double slits, Fraunhofer and Fresnel bi-prism, diffraction gratings, polarization of light, Brewster's law, Malus law, polarization by double refraction Nicole prism, optical activity and polarimeters, optical instruments, resolving power of optical instrument, Laser: spontaneous and stimulated emission

3. **Modern Physics**

   Galilean relativity & Reference frame, Special theory of relativity postulates, Galilean transformation, Lorentz Transformation, Length contraction, Time dilation, Velocity addition, relativity of mass, mass energy relation, Momentum energy relation, Photoelectric effect, Compton effect, de Broglie matter wave, Bohr atom model and explanation, atomic orbital and energy equation, classification of nucleus, nuclear binding energy, radioactivity, radioactive decay law, half-life, mean life, nuclear reaction, introduction to nuclear reactor

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** the different parameters such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	√											
CO2	**Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theories regarding modern physics such as special theory of relativity, Compton theory, materials according to magnetic properties, nuclear transformation and nuclear reaction etc.	√											
CO3	**Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the different parameters such as	C1-C2	1		3	CT, F,

	periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.					ASG
CO2	**Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theories regarding modern physics such as special theory of relativity, Compton theory, materials according to magnetic properties, nuclear transformation and nuclear reaction etc.	C3	1		3	CT, MT, F
CO3	**Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	C3	1		3	MT, F, ASG
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1		CT 1, Final Exam
Class 1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	
Class 2	Simple harmonic motion (SHM) and its differential equations, graphical representation of SHM	
Class 3	Average K.E and total energy	
Week 2		
Class 4	Spring-mass system , electric oscillatory circuit	
Class 5	Simple, compound and torsional pendulum	
Class 6	Combination of two SHM	
Week 3		
Class 7	Combination of two SHM	
Class 8	Two body oscillations, reduced mass	
Class 9	Damped oscillations and its differential equation	
Week 4		CT 2, Final Exam
Class 10	Displacement equation of damped oscillation, electric damped oscillatory circuit	
Class 11	Forced oscillation and its differential equation	
Class 12	Displacement equation of forced oscillation, resonance	
Week 5		
Class 13	Plane progressive wave, energy density of wave	
Class 14	Stationary wave	
Class 15	Lens and combination of lenses, power of lens	
Week 6		
Class 16	Defects of images and different aberrations	
Class 17	Defects of images and different aberrations	
Class 18	Interference of light, young's double slit experiment	
Week 7		Mid Term, Final Exam
Class 19	Interference in Thin films, Newton's ring	
Class 20	Diffraction : Fresnel & Fraunhofer diffraction	
Class 21	Diffraction by single slit	
Week 8		
Class 22	Diffraction by double slit, Diffraction gratings	
Class 23	Polarization and Production and analysis of polarized light	
Class 24	Optics of crystals, Nicole prism	
Week 9		
Class 25	Brewster's and Malus law	
Class 26	Optical activity and polarimeter	
Class 27	Laser & its applications	Mid Term, Final Exam
Week 10		
Class 28	Theory of relativity: Frame of Reference, Postulates of special relativity, Galilean Transformation	
Class 29	Theory of relativity: Lorentz Transformations, Length Contraction and Time dilation	
Class 30	Velocity addition, Relativistic mass: Concept of relativistic mass and its expression	
Week 11		
Class 31	Theory of relativity: Mass and Energy equivalence equation and concept of Massless particle and its expression. Related numerical problems	

Class 32	Photoelectric Effect, photocurrent and work function, kinetic energy, stopping potential	
Class 33	photoelectric equation, characteristics of photoelectric effect	
Week 12		
Class 34	Compton effect: Definition, Compton wavelength shift, limitation	
Class 35	De Broglie Concept, Condition for wave and particle behavior, Bohr atomic model	
Class 36	Expression for Bohr radii and orbital energy for hydrogen atom	
Week13		CT 3, Final Exam
Class 37	Classification of Nucleus, nuclear binding energy	
Class 38	Radioactivity and its transformation, Radioactive Decay Law	
Class 39	Half- life, Mean life, nuclear reaction	
Week 14		
Class 40	Concept of Fusion, Fission and nuclear chain reaction	
Class 41	General idea on nuclear reactor and nuclear power plant	
Class 42	Follow up of the course	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
			CO2	C3
	Class Participation	5%	CO3	C3
	Mid term	15%	CO2, CO3	C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. **Fundamentals of Physics** : Halliday, Resnick and Walker
2. **Physics for Scientists and Engineers**: Serway and Jewett
3. **Concept of Modern Physics**: Arthur Beiser
4. **University Physics with Modern Physics**: Hugh D. Young and Roger A. Freedman
5. **Modern Physics for Science and Engineering**: Marshall L. Burns
6. **Waves and Oscillations**: Walter Fox Smith
7. **The Physics of Vibrations and Waves**: H. J. Pain
8. **Waves and Oscillations** : BrijLal and Subramannyam
9. **Fundamental of Optics**: Francis A. Jenkins and Harvey E.White
10. **Introduction to Modern Optics**: Grant R. Fowles
11. **Fundamental Optical Design**: Michael J. Kidger

COURSE INFORMATION

Course Code: PHY 102
Course Title: Physics Lab
Level and Term: Level 1 Term 1
Credit Hours: 3.00
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

To learn the basic concepts of Waves and Oscillations, Optics and Modern physics

OBJECTIVES

To develop basic engineering knowledge practically.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.
2. **Describe** different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.
3. **Construct** experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.
4. **Prepare** a report for an experimental work.

COURSE CONTENTS

1. Determination of specific resistance of materials of a wire by using Meter Bridge,
2. Determination of a high resistance by the method of deflection,
3. Determination of ECE of copper by using copper voltameter,
4. Determination of the wavelength of light by using diffraction grating,
5. Determination of the focal length of a plano-convex lens by Newton’s ring method,
6. Determination of the specific rotation of sugar by poralimeter
7. Determination of the conductivity of a bad conductor by Lee’s method,
8. Determination of the acceleration due to gravity by means of compound pendulum,
9. Determination of the spring constant and the rigidity modulus of a spiral spring,
10. Verification of the law of conservation of linear momentum,
11. Determination of the Young’s modulus of bar by bending method,
12. Determination of the Planck’s constant using photoelectric effect,
13. Determination of focal length of a concave lens by auxiliary lens method,
14. Determination of specific heat of a liquid by the method of cooling

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	√											
CO2	**Describe** different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	√											
CO3	**Construct** experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	√											
CO 4	**Prepare** a report for an experimental work.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	C1-C2	1		3	Class Performance, Experimental Exam, Viva, Quiz
CO2	**Describe** different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	C3	1		3	Class Performance, Experimental Exam, Viva
CO3	**Construct** experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	C3	1		3	Class Performance, Experimental Exam
CO4	**Prepare** a report for an experimental work.	C4				Report Writing

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	9
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	**120**

COURSE SCHEDULE

Week	Contents
Week 1	
Class 1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, evaluation system of the course, grouping, visit different section of the laboratory, introduction to different basic equipment's
Week 2	
Class 2	Determination of specific resistance of materials of a wire by using Meter Bridge / Determination of focal length of a concave lens by auxiliary lens method.
Week 3	
Class 3	Determination of a high resistance by the method of deflection/ Determination of specific heat of a liquid by the method of cooling
Week 4	
Class 4	Determination of ECE of copper by using copper voltameter / Determination of the Young's modulus of bar by bending method
Week 5	
Class 5	Determination of the wavelength of light by using diffraction grating
Week 6	
Class 6	Determination of the focal length of a plano-convex lens by Newton's ring method
Week 7	
Class 7	Determination of the specific rotation of sugar by poralimeter
Week 8	
Class 8	Determination of the conductivity of a bad conductor by Lee's method / Verification of the law of conservation of linear momentum
Week 9	
Class 9	Determination of the acceleration due to gravity by means of compound pendulum
Week 10	
Class 10	Determination of the spring constant and the rigidity modulus of a spiral spring
Week 11	
Class 11	Determination of the Planck's constant using photoelectric effect

Week 12	
Class 12	Viva & experimental exam

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class performance	10%	CO1, CO2,CO3	C1, C2
	Report writing	30%	CO4	C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. **Practical Physics**: G. L. Squires
2. **Practical Physics**: Dr Giasuddin and Md. Sahabuddin.
3. **B.Sc. Practical Physics**: C. L Arora
4. **Practical Physics**: S.L. Gupta and V. Kumar

COURSE INFORMATION

Course Code: PHY 113 | **Credit Hours:** 3.00
Course Title: Structure of Matter, Electricity and Magnetism | **Contact Hours:** 3.00
Level and Term: Level 1 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is one of the basic physics in the field of Solid State Physics and Electricity & Magnetism. The course will be emphasized the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.

OBJECTIVES

1. To define the different parameters and concepts of Structure of Matter and Electricity & Magnetism.
2. To explain the basic theories of Structure of Matter and Electricity & Magnetism.
3. To solve numerical problems regarding Structure of Matter and Electricity & Magnetism.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Define** different basic parameters and laws in the field of Structure of Matter and Electricity & Magnetism such as lattice, crystal structure, bonds in solids, non-crystalline solids, alloys, Bragg's law, Coulomb's law, Gauss' law, dielectrics, capacitance, resistance etc.
2. **Explain** different basic theories in the field of Structure of Matter and Electricity & Magnetism such as band theory of solids, Inter atomic distances and forces of equilibrium, resistivity-an atomic view, atomic view of dielectrics, magnetization curves etc.
3. **Solve** quantitative problems in the field of Structure of Matter and Electricity & Magnetism such as energy of packing factor in solids; inter atomic distances, Calculation of electric potential, capacitance for different capacitors, energy store in a capacitor, inductance of solenoid etc.

COURSE CONTENTS

1. **Structure of Matter:**
   a. States of matter: solid, liquid, and gas
   b. Classification of solids: amorphous, crystalline, ceramic and polymers
   c. Atomic arrangement in solid & Crystal systems, lattice parameters, different crystal structure, packing factor in solids, Miller indices,
   d. Zinc blend structure, diamond structure
   e. Allotropy and polymorphism

f. Bragg's law, X-ray diffraction
g. different types of bonds in solids, Inter atomic distances and forces of equilibrium
h. Defects in solids, band theory of solids,
i. Distinction between metal, insulator and semiconductor
j. Intrinsic and extrinsic semiconductor, plasmons, polariotons, polarons, exitons, phonons, non-crystalline solids, alloys
k. Extensive and Intensive properties of matter, some techniques for materials characterization.

2. **Electricity & Magnetism:**
a. Electric charges and Coulomb's law, quantization of charge, electric field, electric field due to point charge, dipole, charged rod and charged ring
b. electric flux and calculation of flux, Gauss' law, application of Gauss' law for point charge and infinite charged rod
c. electric potential energy and electric potential, Calculation of electric potential due to point charge, dipole, charged rod, charged ring and charged disc, capacitors, capacitance for different capacitors, energy store in a capacitor, dielectrics and atomic view of dielectrics and Gauss' law with dielectrics
d. Current density, drift speed, resistances, ohm's law and resistivity-an atomic view, Ampere's law, solenoid, toroid.
e. Faraday's law, self-inductance and mutual inductance, inductance of solenoid, magnetic field intensity, permeability, susceptibility
f. Magnetization, classification of magnetic materials, magnetization curves, M-H hysteresis loop, soft and hard magnetic materials, Super paramagentism, Maxwell equations.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	**COURSE OUTCOMES (COs)**	**PROGRAM OUTCOMES (PO)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Define** different basic parameters and laws in the field of Structure of Matter and Electricity & Magnetism such as lattice, crystal structure, bonds in solids, non-crystalline solids, alloys, Bragg's law, Coulomb's law, Gauss' law, dielectrics, capacitance, resistance etc.	√											
CO2	**Explain** different basic theories in the field of Structure of Matter and Electricity & Magnetism such as band theory of solids, Inter atomic distances and forces of equilibrium, resistivity-an atomic view, atomic view of dielectrics, magnetization curves etc.	√											
CO3	**Solve** quantitative problems in the field of Structure of Matter and Electricity & Magnetism such as energy of packing factor in solids, Inter atomic distances, Calculation of electric potential, capacitance for different capacitors, energy store in a capacitor, inductance of solenoid etc.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** different basic parameters and laws in the field of Structure of Matter and Electricity & Magnetism such as lattice, crystal structure, bonds in solids, non-crystalline solids, alloys, Bragg's law, Coulomb's law, Gauss' law, dielectrics, capacitance, resistance etc.	C1	-	-	1	CT, F, MT
CO2	**Explain** different basic theories in the field of Structure of Matter and Electricity & Magnetism such as band theory of solids, Inter atomic distances and forces of equilibrium, resistivity-an atomic view, atomic view of dielectrics, magnetization curves etc.	C1	-	-	1	F, MT
CO3	**Solve** quantitative problems in the field of Structure of Matter and Electricity & Magnetism such as energy of packing factor in solids, Inter atomic distances, Calculation of electric potential, capacitance for different capacitors, energy store in a capacitor, inductance of solenoid etc.	C2	-	-	2	CT, F, MT, ASG
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The conceptual knowledge of the natural sciences applicable to the engineering discipline
CO2-PO1	The theory-based knowledge of the natural sciences applicable to the engineering discipline
CO3-PO1	The numerical analysis based knowledge of the natural sciences applicable to the engineering

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement

	(hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1		CT 1, Final Exam
Class 1	Introduction of course and elementary discussion	
Class 2	States of matter: solid, liquid, and gas, classification of solids: amorphous, crystalline, ceramic and polymers	
Class 3	atomic arrangement in solid & Crystal systems	
Week 2		
Class 4	atomic arrangement in solid & Crystal systems	
Class 5	lattice parameters, different crystal structure	
Class 6	packing factor in solids	
Week 3		
Class 7	packing factor in solids	
Class 8	Miller indices	
Class 9	Zinc blend structure, diamond structure, allotropy and polymorphism,	
Week 4		CT 2, Final Exam
Class 10	Bragg's law, X-ray diffraction	
Class 11	different types of bonds in solids	
Class 12	different types of bonds in solids	
Week 5		
Class 13	Inter atomic distances and forces of equilibrium	
Class 14	Defects in solids	
Class 15	Defects in solids	
Week 6		
Class 16	Band theory of solids, Distinction between metal, insulator and semiconductor	
Class 17	Intrinsic and extrinsic semiconductor	
Class 18	Plasmons, polariotons, polarons, exitons, phonons	
Week 7		Mid Term, Final Exam
Class 19	Non-crystalline solids, alloys	
Class 20	Extensive and Intensive properties of matter, some techniques for materials characterization	
Class 21	Some techniques for materials characterization	
Week 8		
Class 22	Electric charges and Coulomb's law, quantization of charge	
Class 23	Electric field, electric field due to point charge	

Class 24	Electric field due to dipole, charged rod and charged ring	
Week 9		
Class 25	Electric flux and calculation of flux	
Class 26	Gauss' law, Gauss' law and Coulomb's law for a point charge	
Class 27	Application of Gauss' law for infinite charged rod	Mid Term, Final Exam
Week 10		
Class 28	electric potential energy and electric potential, Calculation of electric potential from field and vice versa	
Class 29	Calculation of electric potential due to point charge, dipole	
Class 30	Calculation of electric potential due to charged rod, charged ring and charged disc	
Week 11		
Class 31	capacitors, capacitance for different capacitors	
Class 32	energy store in a capacitor, dielectrics and atomic view of dielectrics and Gauss' law with dielectrics	
Class 33	Current density, drift speed, resistances	
Week 12		
Class 34	ohm's law and resistivity-an atomic view, Biot-Severt law	
Class 35	Ampere's law, solenoid, toroid	
Class 36	Faraday's law, self-inductance and mutual inductance, inductance of solenoid	
Week13		CT 3, Final Exam
Class 37	magnetic field intensity, permeability, susceptibility, magnetization	
Class 38	classification of magnetic materials	
Class 39	magnetization curves, susceptibility curves	
Week 14		
Class 40	M-H hysteresis loop, soft and hard magnetic materials	
Class 41	Superparamagentism, Maxwell equations	
Class 42	Course review	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO3	C1, C2
	Class Participation	5%	CO1, CO2	C1, C2
	Mid term	15%	CO1,CO2, CO3	C1, C2
Final Exam		60%	CO1,CO2, CO3	CO1, CO2, CO3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. **Fundamentals of Physics** : Halliday, Resnick and Walker
2. **Physics for Scientists and Engineers**: Serway and Jewett
3. **University Physics with Modern Physics**: Hugh D. Young and Roger A. Freedman
4. **Introduction to Solid State Physics**: Charles Kittle
5. **Solid State Physics**: S. O. Pillai
6. **Solid State Physics:** Ali Omar

COURSE INFORMATION

Course Code: MATH 101 **Credit Hours:** 3.00
Course Title: Differential and Integral Calculus **Contact Hours:** 3.00
Level and Term: Level 1 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Purpose of this course is to introduce basic knowledge of Differential and Integral Calculus and use it to engineering study.

OBJECTIVES

1. To impart basic knowledge on differential and integral Calculus to solve engineering problems and other applied problems.
2. Developing understanding some of the important aspects of rate of change, area, tangent, normal and volume.
3. To make proficient in imparting in depth knowledge of functional analysis such as increasing, decreasing, maximum and minimum values of a function

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Compute** different engineering calculations based on differential and integral calculus.
2. **Comprehend** basic ideas of rate of change, area, tangent, normal and volume.
3. **Prepare** necessary calculations based on differential and integral calculus.
4. **Perform** functional analysis calculations such as increasing, decreasing, maximum and minimum values of a function.

COURSE CONTENTS

a. **Differential Calculus:** Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability, Successive Differentiation, Leibnittz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions differentiation and integration, Indeterminate form, Cartesian differentiation, Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes, Partial differentiation.
b. **Integral Calculus:** Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its use, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, beta and gamma function, multiple integral and its application, Area, volume of solid revolution, Area under a plain curve, Area of the region enclosed by two

curves, Arc lengths of curves.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** the limit, continuity and differentiability of functions, **identify** the rate of change of a function with respect to independent variables and **describe** the different techniques of evaluating indefinite and definite integrals	√											
CO2	**Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	√											
CO3	**Calculate** the length, area, volume, center of gravity and average value related to engineering study	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the limit, continuity and differentiability of functions, **identify** the rate of change of a function with respect to independent variables and **describe** the different techniques of evaluating indefinite and definite integrals.	C1-C2	1		3	CT, F, ASG
CO2	**Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	C3	1		3	CT, MT, F
CO3	**Calculate** the length, area, volume, center of gravity and average value related to engineering study	C3	1		3	MT, F, ASG
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics, science and engineering sciences has to be applied to describe the complete concept of differential and integral calculus.

CO2-PO1	To apply proper and improper integral in the field of engineering study, the knowledge of mathematics, science and engineering sciences is required.
CO3-PO1	In order to calculate volume, average, center of gravity and area of any solid revolution object, the knowledge of mathematics and engineering sciences is needed.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1		CT 1, Final Exam
Class 1	Introduction to Differential Calculus for Engineering study, Limit of a function and its properties.	
Class 2	Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems.	
Class 3	Concept of Differentiation, definition, classification of discontinuity and solving problems	
Week 2		
Class 4	Basic concept of Differentiability, definition, derivative of a function, differentiable function.	
Class 5	Differentiability – one sided derivatives (R.H.D and L.H.D), solving problems	
Class 6	Successive differentiation – Concept and problem solving	
Week 3		
Class 7	Leibnitz’s theorem and its applications	
Class 8	Determination of $(y_n)_0$	
Class 9	Mean Value theorem, Taylor theorem	
Week 4		

Class 10	Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder.	CT 2, Final Exam
Class 11	Indeterminate forms – concept and problem solving	
Class 12	L'Hospital's rules with application	
Week 5		
Class 13	Partial differentiation - partial derivatives of a function of two variables and problems	
Class 14	Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems	
Class 15	Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving	
Week 6		
Class 16	Tangents and Normals – Tangents and Normals in Cartesian, equation of tangent at the origin, equation of normal of functions of explicit and implicit forms, Angle between two intersection of two curves; problem solving	
Class 17	Tangents and Normals – Tangents and Normals in polar, Angle between two intersection of two curves; problem solving	
Class 18	Tangents and Normals – Subtangent and subnormals in Cartesian and polar coordinate; problem solving.	
Week 7		Mid Term, Final Exam
Class 19	maxima and minima of functions of single variables – concept, Increasing and decreasing function, Concave up and down with problems	
Class 20	Curvature	
Class 21	Asymptotes	
Week 8		
Class 22	Introduction to integral calculus	
Class 23	Standard integrals – concept of definite and indefinite integrals, applications.	
Class 24	Indefinite integrals – Method of substitution, Techniques of integration	
Week 9		
Class 25	Indefinite integrals – Integration by parts, Special types of integration, integration by partial fraction	
Class 26	Integration by the method of successive reduction	
Class 27	Definite integrals – definite integrals with properties and problems	Mid Term, Final Exam
Week 10		
Class 28	Definite integrals – Reduction formula, Walli's formula	
Class 29	Definite integrals – definite integral as the limit of the sum	
Class 30	Beta function – concept and problem solving	
Week 11		
Class 31	Gamma function - concept and problem solving	
Class 32	Relation between beta and gamma function, Legendre duplication formula, problems and applications	
Class 33	Multiple integrals – double integrals	

Week 12		
Class 34	Multiple integrals – triple integrals	
Class 35	Multiple integrals – successive integration for two and three variables	
Class 36	Area in Cartesian	
Week13		CT 3, Final Exam
Class 37	Area in polar	
Class 38	Volume of solid revolution	
Class 39	Area under a plain curve in Cartesian and polar coordinates	
Week 14		
Class 40	Area of a region enclosed by two curves in Cartesian and polar coordinates	
Class 41	Arc lengths of curves in Cartesian coordinates	
Class 42	Arc lengths of curves in polar coordinates	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
			CO2	C3
	Class Participation	5%	CO3	C3
	Mid term	15%	CO2, CO3	C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Calculus (9th Edition) by Howard Anton (Author), Irl C. Bivens (Author), Stephen Davis.
2. Calculus: An Intuitive and Physical Approach by Morris Kline.

COURSE INFORMATION

Course Code: MATH 103 **Credit Hours:** 3.00
Course Title: Ordinary and Partial Differential Equations & Matrix **Contact Hours:** 3.00
Level and Term: Level 1 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Purpose of this course is to introduce basic knowledge of ordinary and partial differential equations and use it to engineering study.

OBJECTIVES

1. To impart basic knowledge on ordinary and partial differential equations to solve engineering problems and other applied problems.
2. To develop understanding of some of the important aspects of ordinary and partial differential equations.
3. To provide knowledge on using concept of differential equations in engineering problems and solve other applied problems.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Compute** different engineering calculations based on differential equations.
2. **Comprehend** basic ideas of differential equations and related theories.
3. **Prepare** necessary calculations based on ordinary and partial differential equations.
4. **Perform** differential equations calculations based on heat flow, fluid flow, temperature distribution etc.

COURSE CONTENTS

1. **Differential Equations:** Introduction & Formulation of DE in Eng, Degree and order of ODE, solution of first order but higher degree DE by various methods, solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs, Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial, linear first order PDE, Non-linear first order PDE, Standard form DEs of higher order and wave equation, particular solutions with boundary and initial condition, Non-linear PDE of order one, Charpit's method, Linear PDE with constant coefficients, Applications of DE.
2. **Matrix:** Definition of matrix, different types of matrices, algebra of matrices, transpose and adjoint of a matrix and inverse matrix, rank and elementary transformation, solution of linear equation or system of linear equation, matrix polynomials determination characteristic roots and vectors, characteristic subspace of matrix and Eigen values and Eigen vectors, Cayley Hamilton theorem.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** various types of differential equations, and **identify** the classifications of ordinary and partial differential equations.	√											
CO2	**Apply** the knowledge to identify and **solve** ordinary and partial differential equations.	√											
CO3	**Apply** the techniques to obtain solutions for problems based on heat flow, fluid flow, temperature distribution etc.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** various types of differential equations, and **identify** the classifications of ordinary and partial differential equations.	C1, C2	1		3	T, F, ASG
CO2	**Apply** the knowledge to identify and **solve** ordinary and partial differential equations.	C3	1		3	T, MT, F
CO3	**Apply** the technique to obtain the inverse matrix that solve the system of linear equations	C3	1		3	MT, F, ASG
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics, science and engineering sciences has to be applied to describe for the physical explanation of differential equations.
CO2-PO1	The application of differential equations need the knowledge of mathematics, science and engineering for describing exponential growth and decay, the population growth of species or change in investment return over time.
CO3-PO1	The solution of different real world phenomena like heat flow, fluid flow, temperature distribution, loading calculations etc require the concept of ordinary and partial differential equations.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week	**Contents**	**Assessment**
Week 1		CT 1, Final Exam
Class 1	Introduction & Formulation of DE in Eng, Degree and order of ODE	
Class 2	Introduction & Formulation of DE in Eng, Degree and order of ODE	
Class 3	Introduction & Formulation of DE in Eng, Degree and order of ODE	
Week 2		
Class 4	Solution of first order but higher degree DE by various methods	
Class 5	Solution of first order but higher degree DE by various methods	
Class 6	Solution of first order but higher degree DE by various methods	
Week 3		
Class 7	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Class 8	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Class 9	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Week 4		CT 2, Final Exam
Class 10	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Class 11	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Class 12	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Week 5		
Class 13	Linear first order PDE, Non linear first order PDE	
Class 14	Standard form DEs of higher order and wave equation	

Class 15	Standard form DEs of higher order and wave equation	
Week 6		
Class 16	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
Class 17	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
Class 18	Particular solutions with boundary and initial condition, Non-linear PDE of order one: Charpit's method	
Week 7		Mid Term, Final Exam
Class 19	Linear PDE with constant coefficients, Applications of DE	
Class 20	Linear PDE with constant coefficients, Applications of DE	
Class 21	Linear PDE with constant coefficients, Applications of DE	
Week 8		
Class 22	Wave equations	
Class 23	Particular solutions with boundary and initial conditions	
Class 24	Particular solutions with boundary and initial conditions	
Week 9		
Class 25	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables	
Class 26	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables	
Class 27	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables	Mid Term, Final Exam
Week 10		
Class 28	Application of OD and PDE in Eng study	
Class 29	Solving nonhomogeneous PDEs	
Class 30	Boundary conditions associated with the wave equation	
Week 11		
Class 31	The finite vibrating string (Standing waves)	
Class 32	The vibrating beam (Fourth order PDE)	
Class 33	First order equations (Method of characteristics)	
Week 12		
Class 34	Systems of PDEs	
Class 35	General nature of boundary value problems	
Class 36	The Dirichlet problem for a circle and annulus	
Week13		CT 3, Final Exam
Class 37	Explicit finite difference method	
Class 38	Monte Carlo methods	
Class 39	Monte Carlo Solutions of PDEs	
Week 14		
Class 40	Calculus of variations (Euler-Lagrange equations)	
Class 41	Duhamel’s Principle	
Class 42	Revision	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>COs</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td rowspan="2">Class Test/ Assignment 1-3</td><td rowspan="2">20%</td><td>CO1, CO2</td><td>C1, C2</td></tr>
<tr><td>CO2</td><td>C3</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO3</td><td>C3</td></tr>
<tr><td>Mid term</td><td>15%</td><td>CO2, CO3</td><td>C3</td></tr>
<tr><td colspan="2" rowspan="3">Final Exam</td><td rowspan="3">60%</td><td>CO1</td><td>C1, C2</td></tr>
<tr><td>CO2</td><td>C1, C2,C4</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. An Introduction to Ordinary Differential Equations (Author: Earl A. Coddington)
2. A Textbook on Ordinary Differential Equations (Author: Antonio Ambrosetti, Shair Ahmad)
3. Partial Differential Equations for Scientists and Engineers (Author: Stanley J. Farlow)
4. Ordinary and Partial Differential Equations By Dr. M.D. Raisinghania , S. Chand Publishing

COURSE INFORMATION

Course Code: MATH 201 **Credit Hours:** 3.00
Course Title: Vector Analysis, Laplace Transform & Co-ordinate Geometry **Contact Hours:** 3.00
Level and Term: Level 2 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

Purpose of this course is to introduce basic knowledge to identify and solve vector mathematical problems, to demonstrate practical applications of Laplace Transform and analyze co-ordinate geometry.

OBJECTIVES

1. To impart basic knowledge on the vector analysis, laplace transform and geometry.
2. To familiarize the students with straight lines, pair of straight lines, circles, conics in 2D and 3D co-ordinate systems.
3. To enable to find the length, volume and area of objects related to engineering study by using vector, application of Laplace transform to ordinary differential equations and also solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Compute** different engineering calculations based on Laplace transform, Vector analysis and Co-ordinate geometry.
2. **Comprehend** basic ideas of vector analysis, laplace transform and co-ordinate geometry.
3. **Prepare** necessary calculations based on vector analysis, laplace transform and co-ordinate geometry.
4. **Perform** real case studies calculations based on vector analysis, laplace transform and co-ordinate geometry.

COURSE CONTENTS

1. **Vector Analysis:** Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors, Gradient of scaler functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and its application, Stoke's theorem and its application, Gauss theorem and its application in Engineering.

2. **Laplace Transform:** Definition of LT and Application of LT for Engineering , LT of some

elementary functions and properties of LT, Sufficient condition for existence of LT, Inverse LT, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Partial fraction, Solution of DEs by LT, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Application of LT.

3. **Co-ordinate Geometry:** Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid straight lines, standard equation of coincides, sphere and ellipsoid.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Know** the physical explanation of different vector notation and **Define** Laplace transform, inverse Laplace transform, different types of matrices, and their properties.	√											
CO2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	√											
CO3	**Calculate** length, volume and area of objects related to engineering study by using vector, **Apply** Laplace transform to ODE and PDEs and the knowledge of geometry in engineering study. **Solve** the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Know** the physical explanation of different vector notation and **Define** Laplace transform, inverse Laplace transform, different types of matrices, and their properties.	C1, C2	1		3	CT, F, ASG

CO2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	C3	1		3	CT, Mid Term Exam, F
CO3	**Calculate** length, volume and area of objects related to engineering study by using vector, **Apply** Laplace transform to ODE and PDEs and the knowledge of geometry in engineering study. **Solve** the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.	C3	1		3	Mid Term Exam, F, ASG
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics, science and engineering has to be applied to describe the operation of being able to identify the physical explanation of different vector notation, explain the complete concept about Laplace transform, 2D and 3D geometry.
CO2-PO1	To explain the differentiation and integration of a vector valued functions in Cartesian, cylindrical and spherical geometry and to solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc. the concept of mathematics and engineering Is required.
CO3-PO1	In order to construct and calculate the area and volume of objects related to engineering study by using vector, solve the differential equations by Laplace transform is needed the concept of mathematics, physics and engineering.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21

Preparation for final examination	21
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	**120**

COURSE SCHEDULE

Week	Contents	Assessment
Week 1		CT 1, Final Exam
Class 1	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Class 2	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Class 3	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Week 2		
Class 4	Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors	
Class 5	Gradient of scaler functions, Divergence and curl of point functions	
Class 6	Physical significance of gradient, divergence and curl	
Week 3		
Class 7	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
Class 8	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
Class 9	Green’s theorem and it’s application	
Week 4		CT 2, Final Exam
Class 10	Gauss theorem and application in Engineering	
Class 11	Stoke's theorem and it’s application.	
Class 12	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates	
Week 5		
Class 13	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Class 14	Changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Class 15	Changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Week 6		
Class 16	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	

Class 17	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Class 18	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Week 7		Mid Term, Final Exam
Class 19	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Class 20	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Class 21	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Week 8		
Class 22	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Class 23	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Class 24	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Week 9		
Class 25	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
Class 26	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
Class 27	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	Mid Term, Final Exam
Week 10		
Class 28	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
Class 29	Definition of LT and Application of LT for Engineering, LT of some	

	elementary functions and properties of LT	
Class 30	Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT	
Week 11		
Class 31	Sufficient condition for existence of LT	
Class 32	LT of derivatives and it's application	
Class 33	LT of Integration with application, LT of sine and cosine integral	
Week 12		
Class 34	Unit step function and it's application	
Class 35	Periodic function with examples, LT of some special function.	
Class 36	Definition of inverse Laplace Transform and it's properties	
Week 13		CT 3, Final Exam
Class 37	Partial fraction and it's application in inverse Laplace Transform	
Class 38	Heaviside formula and it's application	
Class 39	Convolution theorem, Evaluation of improper integral, Application of LT	
Week 14		
Class 40	Solve ODE s by Laplace transform	
Class 41	Solve PDE s by Laplace transform	
Class 42	Application of LT in Eng study	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
			CO2	C3
	Class Participation	5%	CO3	C3
	Mid term	15%	CO2, CO3	C3
Final Exam		60%	CO1	C1, C2
			CO2	C1, C2,C4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Vector Analysis, 2nd Edition 2nd Edition by Murray Spiegel, Seymour Lipschutz, Dennis Spellman
2. Schaum's Outline of Laplace Transforms by Murray R. Spiegel.
3. Engineering Mathematics, Volume Two 2 II: Containing Coordinate Geometry of Two Dimensions, Co-ordinate Geometry of Three Dimensions, Matrices.
4. Theory of Equations and Vector Calculus by K. Kandasamy, P.; Thilagavathy, K.; Gunavathy
5. A Text Book on Co-ordinate Geometry with Vector Analysis - Rahman & Bhattacharjee.

COURSE INFORMATION

Course Code: MATH 219 **Credit Hours:** 3.00

Course Title: Statistics, Complex Variable and Fourier Analysis **Contact Hours:** 3.00

Level and Term: Level 2 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

To teach the students the concepts, principles and working field of Complex Variable, Statistics and Fourier analysis of different types of function. It is targeted to provide a basic foundation and applications of Fourier series, Fourier Integrals, orthogonal functions, and collection of numerical data systematically, complex analysis and observing data to give statistical assumption and probability. Finally, this course is designed to demonstrate practical applications of Complex Variable, Fourier analysis and Statistics and their methods of solution.

OBJECTIVE

1. To impart basic knowledge about Complex Variable, Statistics, Fourier analysis for different types of functions.
2. To familiarize the students with the characteristics of Complex Variable, Fourier series, Fourier Integrals and orthogonal functions.
3. To make proficient to familiarize with basic methods of statistics and their application.
4. To impart knowledge on Statistics, Complex Variable, Fourier analysis and thereby students able to solve engineering problems and to give physical interpretation.

COURSE OUTCOME

On successful completion of this course, students should be able to:

1. **Recall** the basic idea about Complex Variable and Statistics.
2. **Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.
3. **Apply** sampling theory and different tests in which giving concept about practical situation.
4. **Solve** complex engineering boundary value problems by Fourier analysis and probability distribution in engineering fields.

COURSE CONTENT

1. **Complex Variable:** Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Differentiation and the Cauchy-Riemann equations, Mapping by elementary functions, Line integral of a complex function, Cauchy's Integral formula, Complex function, Convergence and Uniform convergence, Liouville's theorem, Taylor's and Laurent's theorem, Singular residues,

Cauchy's residue theorem.

2. **Fourier Analysis**: Real and Complex form of Fourier Series, Definition and expansion of a function of x in a Fourier Series, Physical application of Fourier Series, Finite Fourier Transform, Fourier Integral Inverse Fourier transform, Fourier transform and their uses in solving boundary value problems, Diffusion, wave, Laplace Equation.
3. **Statistics:** Measures of central tendency, Frequency distribution, Graphical representation of data including stem, Leaf and Box Plot, Chebyshev's theorem, z-scores, standard deviation, moments, skewness and kurtosis, elementary probability theory, discontinuous probability distribution, Continuous probability distribution, Binomial, Multinomial, Negative binomial, Poisson, Exponential, Elementary sampling theory, Estimation, Sets and probability, Random variable and its probability distribution, Treatment of grouped sampled data, Normal distribution, Tests of hypothesis, regression and correlation, Analysis of variance, Chi-square distributions, Conditional probability, Bayes's Theorem.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recall** the basic idea about Complex Variable and Statistics.	√											
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	√											
CO3	**Apply** sampling theory and different tests in which giving concept about practical situation.	√											
CO4	**Solve** complex engineering boundary value problems by Fourier Analysis and probability distribution in engineering fields.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Recall** the basic idea about Complex Variable and Statistics.	C1	1		1	T, F
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	C2	1		2	T, MT, F
CO3	**Apply** sampling theory and different tests in which giving concept about practical situation.	C3	1,3		2	T, MT, F
CO4	**Solve** complex engineering boundary value problems by Fourier Analysis and probability distribution in engineering	C3	1		5	ASG

	fields.					
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Justifications
CO1-PO1	The knowledge of mathematics has to be applied to Statistics and Complex Variable in the field of engineering study.
CO2-PO1	In order to explain the characteristics of various components of NAME, the knowledge of mathematics regarding Complex Variable is needed
CO3-PO1	In order to identify and describe statistical phenomena and probability distribution, using the knowledge of mathematics and sciences is required.
CO4-PO1	The concept of Mathematics and sciences is required to calculate Fourier integral for various types of function and analysis probability distribution in engineering study.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	**120**

COURSE SCHEDULE

Week 1	**COMPLEX VARIABLE**	
Class-1	Complex number system	
Class-2	General functions of a complex variable	
Class-3	Limits and continuity of a function of complex variable and related theorems	
Week 2	**COMPLEX VARIABLE**	

Class-4	Differentiation and the Cauchy Riemann equations	**CT-1**
Class-5	Mapping by elementary functions	
Class-6	Line integral of a complex function	
Week 3	**COMPLEX VARIABLE**	
Class-7	Cauchy's Integral formula	
Class-8	Complex function	
Class-9	Convergence and Uniform convergence	
Week 4	**COMPLEX VARIABLE**	**CT-2**
Class-10	Liouville's theorem	
Class-11	Taylor's and Laurents theorem	
Class-12	Singular residues, Cauchy's residue theorem	
Week 5	**FOURIER ANALYSIS**	
Class-13	Real and Complex form of Fourier Series	
Class-14	Definition and expansion of a function of x in a Fourier Series	
Class-15	Physical application of Fourier Seires	
Week 6	**FOURIER ANALYSIS**	
Class-16	Finite Fourier Transform	
Class-17	Infinite Fourier Transform	
Class-18	Fourier Integral	
Week 7	**FOURIER ANALYSIS**	**Mid Term Exam**
Class-19	Inverse Fourier transform	
Class-20	Fourier transform	
Class-21	Solving boundary value problems, Diffusion, wave , Laplace Equation.	
Week 8	**STATISTICS**	
Class-22	Measures of central tendency	
Class-23	Frequency distribution, Graphical representation of data including stem	
Class-24	Leaf and Box Plot	
Week 9	**STATISTICS**	
Class-25	Chebyshev’s theorem, z-scores	
Class-26	Standard deviation, moments	
Class-27	Skewness and kurtosis	
Week 10	**STATISTICS**	
Class-28	Elementary probability theory	
Class-29	Discontinuous probability distribution, Continuous probability distribution	
Class-30	Binomial, Multinomial distribution	
Week 11	**STATISTICS**	
Class-31	Negative binomial, Poisson, Exponential distribution	
Class-32	Uniform, Gamma distribution	
Class-33	Elementary sampling theory, Estimation	
Week 12	**STATISTICS**	
Class-34	Sets and probability, Random variable and its probability distribution	
Class-35	Treatment of grouped sampled data	
Class-36	Normal distribution	

Week 13	**STATISTICS**	**CT-4**
Class-37	Tests of hypothesis	
Class-38	regression and correlation	
Class-39	Analysis of variance	
Week 14	**STATISTICS**	
Class-40	Chi-square distributions	
Class-41	Conditional probability, Bayes‟s Theorem	
Class-42	Counting techniques	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C3
			CO4	C3
	Class Participation	5%	CO4	C3
	Mid term	15%	CO2, CO3	C2,C3
Final Exam		60%	CO 1, CO 2	C1,C2
			CO3	C3
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Complex Variables by - Murray R. Spiegel, Schaum’s Outline Series.
2. Theory and functions of complex variables, Shanti Narayan.
3. Fourier series, Schaum’s outlines series, Murray R. Spiegel.
4. Statistics and probability - Spiegel (Schaum Series).
5. Probability and it’s Applications – H. C. Saxena.

COMMUNICATIVE LANGUAGE COURSES

Military Institute of Science and Technology

Department of Naval Architecture and Marine Engineering

COURSE INFORMATION

Course Code: LANG 102 **Credit Hours:** 1.50

Course Title: Communicative English I **Contact Hours:** 3.00

Level and Term: Level 1 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course has mainly been designed to improve speaking and oral communication skills of the students. The course includes instructions and experience in speech preparation and speech delivery within various real life situations, formal and informal. Emphasis will be given on various speeches, such as informative, persuasive and interactive. This course will help students progress in real life both personally and professionally. Students will be able to understand class lectures and can comfortably continue the Engineering course, and also to compete in the global job market and increase career skills.

OBJECTIVES

1. To develop the four basics skills of English language, i.e. listening, speaking, reading and writing.
2. To develop students' interpersonal skills engaging them in various group interactions and activities.
3. To improve students' pronunciation in order to improve their level of comprehensibility in both speaking and listening.
4. To give the students exposure to different types of texts in English in order to make them informed using different techniques of reading.
5. To gain an understanding of the underlying writing well-organized paragraphs and also to teach how to edit and revise their own as well as peer's writing.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Listen, understand**, and **learn** the techniques of note taking and answering questions
2. **Understand and** speak English quickly and smartly using the techniques learnt in the class.
3. **Communicate** effectively within the shortest possible time to present their ideas and opinions.
4. **Develop** competency in oral, written communication/presentation
5. **Understand** the techniques of academic reading and summarizing any book article/literature for review

COURSE CONTENTS

1. **Speaking:** Introduction to Language: Introducing basic skills of language, English for

Science and Technology, Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd, Name, family background, education, experience, any special quality/interest, likings/disliking, etc. Asking and answering questions, expressing likings and disliking; (food, fashion etc.) Asking and giving directions, Discussing everyday routines and habits, Making requests /offers /invitations/excuses /apologies/complaints, Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event, Practicing storytelling, Narrating personal experiences/Anecdotes, Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)

2. **Listening**: Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions, Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand, Listening to short conversations between two persons/more than two.
3. **Reading:** Reading techniques: scanning, skimming, predicting, inference; Reading Techniques: analysis, summarizing and interpretation of texts
4. **Writing**: Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event; Paragraph writing, Compare-contrast and cause- effect paragraph

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES:

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Listen, understand and speak** English quickly and smartly using the techniques learnt in the class.	√											
CO2	**Understand** the techniques of academic reading and academic writing	√											
CO3	**Communicate** effectively within the Shortest possible time to present ideas and opinions.										√		
CO4	**Develop** competency in oral, written communication/presentation										√		

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Listen, understand and speak** English quickly and smartly using the techniques learnt in the class.	C1, C2				ASG
CO2	**Understand** the techniques of academic reading and academic writing	C2				ASG, Pr

CO3	**Communicate** effectively within the shortest possible time to present ideas and opinions.	C2				Pr
CO 4	**Develop** competency in oral, written communication/presentation	C3				Q, ASG, Pr
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	14
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	75

COURSE SCHEDULE

Week	Class	Topic
Week 1	Class 1	Introduction to Language: Introducing basic skills of language. English for Science and Technology
	Class 2	Self-introduction and introducing others: How a speaker should introduce himself to any stranger/ unknown person/ a crowd. Name, family background, education, experience, any special quality/ interest, likings/ disliking etc.
	Class 3	Self-introduction and introducing others: How a speaker should introduce himself to any stranger/ unknown person/ a crowd. Name, family background, education, experience, any special quality/ interest, likings/ disliking etc.
Week 2	Class 4	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
	Class 5	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
	Class 6	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions

Week 3	Class 7	Discussing everyday routines and habits, Making requests /offers /invitations/excuses /apologies/complaints
	Class 8	Discussing everyday routines and habits, Making requests /offers /invitations/excuses /apologies/complaints
	Class 9	Discussing everyday routines and habits, Making requests /offers /invitations/excuses /apologies/complaints
Week 4	Class 10	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
	Class 11	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
	Class 12	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
Week 5	Class 13	Practicing storytelling, Narrating personal experiences/Anecdotes
	Class 14	Practicing storytelling, Narrating personal experiences/Anecdotes
	Class 15	Practicing storytelling, Narrating personal experiences/Anecdotes
Week 6	Class 16	Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
	Class 17	Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
	Class 18	Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
Week 7	Class 19	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
	Class 20	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
	Class 21	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
Week 8	Class 22	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
	Class 23	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
	Class 24	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
Week 9	Class 25	Listening to short conversations between two persons/more than two
	Class 26	Listening to short conversations between two persons/more than two
	Class 27	Listening to short conversations between two persons/more than two
Week 10	Class 28	Reading techniques: scanning, skimming, predicting, inference
	Class 29	Reading techniques: scanning, skimming, predicting, inference
	Class 30	Reading techniques: scanning, skimming, predicting, inference
Week 11	Class 31	Reading techniques: analysis, summarizing and interpretation of texts
	Class 32	Reading techniques: analysis, summarizing and interpretation of texts
	Class 33	Reading techniques: analysis, summarizing and interpretation of texts

Week 12	Class 34	Introductory discussion on writing, prewriting & drafting
	Class 35	Introductory discussion on writing, prewriting & drafting
	Class 36	Introductory discussion on writing, prewriting & drafting
Week 13	Class 37	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
	Class 38	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
	Class 39	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Week 14	Class 40	Paragraph writing, compare contrast and cause-effect paragraph
	Class 41	Paragraph writing, compare contrast and cause-effect paragraph
	Class 42	Paragraph writing, compare contrast and cause-effect paragraph

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Assessment Criteria		**CO**	**Blooms Taxonomy**
Components	**Grading**		
Assignment I	20%	CO1, CO2	C1, C2, C3
Assignment II	50%	CO1, CO2	C1, C2, C3
Continuous Assessment	30%	CO3, CO4	C1, C2, C3
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Langan, J. (2005). College Writing Skills with Readings (6^{th} Ed). McGraw-Hill Publication
2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
3. Jones, L.(1981). Functions of English. (Student's Book, 2^{nd} Ed.) Melbourne, Australia: Cambridge University Press.
4. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson
6. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
7. Speak like Churchill stand like Lincoln - James C. Humes
8. Cambridge IELTS Practice Book
9. Selected Sample Reports and Selected Research Articles

COURSE INFORMATION

Course Code: LANG 202
Course Title: Communicative English II
Level and Term: Level 2 Term 1
Credit Hours: 1.50
Contact Hours: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The English language course is designed for the students to develop their competence in communication skills for academic purposes especially in reading and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to different types of texts to develop efficient reading skill. Reading will also involve activities and discussions leading to effective writing. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Emphasis is particularly put on the various forms of essay writing such as descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, students are expected to be able to communicate at various situations, participate in group activities and prepare formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills. In addition, the course emphasizes on providing constructive feedback on students' oral performances.

OBJECTIVES

1. To develop English language skills to communicate effectively and professionally.
2. To strengthen students' presentation skills.
3. To develop competency in academic reading and writing.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Understand** the techniques of academic reading and become familiar with technical terms
2. **Develop** competency in academic reading, preparing report written communication/presentation
3. **Analyze** any problem critically, interpret data and synthesize information to provide valid conclusions
4. **Communicate effectively** within the shortest possible time to present their reports and academic writings
5. **Apply** the techniques to find out the main points of any long article within a very limited time as well as know the techniques of any effective writing. In short, with consistent practice they will be able to overcome the language barrier.

COURSE CONTENTS

1. **Reading:** Reading comprehension: Practice using different techniques; Academic reading: comprehension from department or subject related passages; Vocabulary for engineers (some common engineering terms for both general and department specific); Reading subject specific text to develop vocabulary
2. **Writing:** Writing semi-formal, formal/official letters, official Email; Applying for a job: writing cover letter and curriculum vitae; Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading; Narrative and descriptive writing: comparison-contrast and cause-effect, argumentative and opinion expression, assignment writing; Analyzing and describing graphs or charts; Practicing analytical and argumentative writing.
3. **Speaking**: Public speaking: Basic elements and qualities of a good public speaker; Set speech and extempore speech: how to get ready for any speech – set or extempore; Individual/Group presentation: how to be ready for presentation, prepare script for good speech, preparing power point slides etc., selected books/selected stories for presentation.
4. **Listening:** Listening to long lecture on some topics; Listening and understanding speeches/lectures of different accent.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the techniques of academic reading and become acquainted with technical vocabularies	√											
CO2	**Understand** the techniques of effective academic writing such as research article/ report writing	√											
CO3	**Communicate effectively** within the shortest possible time to present any report and research work										√		
CO4	**Analyze** any problem critically, analyse and interpret data and synthesize information to provide valid conclusions										√		

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the techniques of academic reading and become acquainted with technical vocabularies	C2				ASG
CO2	**Understand** the techniques of effective academic writing such as research article/ report writing	C2				ASG, Pr
CO3	**Communicate effectively** within the	C3				Pr

	shortest possible time to present any report and research work					
CO 4	**Analyze** any problem critically, analyze and interpret data and synthesize information to provide valid conclusions	C4				Q, ASG, Pr
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	14
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	75

COURSE SCHEDULE

Week	Class	Topic
Week 1	Class 1	Reading comprehension: Practice using different techniques
	Class 2	Reading comprehension: Practice using different techniques
	Class 3	Reading comprehension: Practice using different techniques
Week 2	Class 4	Academic reading: comprehension from department or subject related passages
	Class 5	Academic reading: comprehension from department or subject related passages
	Class 6	Academic reading: comprehension from department or subject related passages
Week 3	Class 7	Vocabulary for engineers (some common engineering terms for both general and department specific) Reading subject specific text to develop vocabulary
	Class 8	Vocabulary for engineers (some common engineering terms for both general and department specific) Reading subject specific text to develop vocabulary

	Class 9	Vocabulary for engineers (some common engineering terms for both general and department specific) Reading subject specific text to develop vocabulary
Week 4	Class 10	Writing semi-formal, formal/official letters, official Email
	Class 11	Writing semi-formal, formal/official letters, official Email
	Class 12	Writing semi-formal, formal/official letters, official Email
Week 5	Class 13	Applying for a job: writing cover letter and curriculum vitae
	Class 14	Applying for a job: writing cover letter and curriculum vitae
	Class 15	Applying for a job: writing cover letter and curriculum vitae
Week 6	Class 16	Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading
	Class 17	Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading
	Class 18	Essay writing: writing steps, principles and techniques, outlining, revising, editing, proofreading
Week 7	Class 19	Narrative and descriptive writing: comparison-contrast and cause-effect, argumentative and opinion expression, assignment writing
	Class 20	Narrative and descriptive writing: comparison-contrast and cause-effect, argumentative and opinion expression, assignment writing
	Class 21	Narrative and descriptive writing: comparison-contrast and cause-effect, argumentative and opinion expression, assignment writing
Week 8	Class 22	Analyzing and describing graphs or charts
	Class 23	Analyzing and describing graphs or charts
	Class 24	Analyzing and describing graphs or charts
Week 9	Class 25	Practicing analytical and argumentative writing.
	Class 26	Practicing analytical and argumentative writing.
	Class 27	Practicing analytical and argumentative writing.
Week 10	Class 28	Public speaking: Basic elements and qualities of a good public speaker
	Class 29	Public speaking: Basic elements and qualities of a good public speaker
	Class 30	Public speaking: Basic elements and qualities of a good public speaker
Week 11	Class 31	Set speech and extempore speech: how to get ready for any speech – set or extempore
	Class 32	Set speech and extempore speech: how to get ready for any speech – set or extempore
	Class 33	Set speech and extempore speech: how to get ready for any speech – set or extempore
Week 12	Class 34	Individual/Group presentation: how to be ready for presentation, prepare script for good speech, preparing power point slides etc., selected books/selected stories for presentation.
	Class 35	Individual/Group presentation: how to be ready for presentation, prepare script for good speech, preparing power point slides etc., selected books/selected stories for presentation.
	Class 36	Individual/Group presentation: how to be ready for presentation, prepare script for good speech, preparing power point slides etc., selected books/selected stories for presentation.
Week 13	Class 37	Listening to long lecture on some topics
	Class 38	Listening to long lecture on some topics
	Class 39	Listening to long lecture on some topics
Week 14	Class 40	Listening and understanding speeches/lectures of different accent
	Class 41	Listening and understanding speeches/lectures of different accent
	Class 42	Listening and understanding speeches/lectures of different accent

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Assessment Criteria		CO	Blooms Taxonomy
Components	**Grading**		
Assignment I	20%	CO1, CO2	C1, C2, C3
Assignment II	50%	CO1, CO2	C1, C2, C3
Continuous Assessment	30%	CO3, CO4	C1, C2, C3
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)
3. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication
4. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
5. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes
7. Cambridge IELTS Practice Book
8. Selected Sample Reports and Selected Research Articles

GENERAL EDUCATION COURSES

Military Institute of Science and Technology

Department of Naval Architecture and Marine Engineering

COURSE INFORMATION

Course Code: GEBS 101 **Credit Hours:** 2.00

Course Title: Bangladesh Studies **Contact Hours:** 2.00

Level and Term: Level 1Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course has been designed for undergraduate engineering students to help them learn the rich history of Bangladesh and to provide them with basic knowledge of historical events which eventually led to the formation of Bangladesh and constitution of Bangladesh, current trends in economic development and thereby to enhance their understanding of present phenomena in the light of history which will make them responsible citizen.

OBJECTIVES

1. To equip students with factual knowledge that will enable them to learn history of Bangladesh.
2. To trace the historical roots of Bangladesh as an independent state focusing on the social, cultural and economic developments that have taken place since its independence.
3. To promote an understanding of the development of Bangladesh and its culture.
4. To create an awareness among the students about the History, Geography, Economics, Politics and Culture of Bangladesh.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and critically analyze plurality of cultural identities of Bangladesh.
2. **Explain** the economy and patterns of economic changes through qualitative and quantitative analysis.

COURSE CONTENTS

1. **Bangladesh Geography:** Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones.
2. **History:** Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal; Bengal under the East India Company; religious and social reform movements; nationalist movements, division of the Indian sub-continent; language movement 1948-1952; education movement of 1962; six-point movement of 1966; mass uprising of 1969; war of independence and emergence of Bangladesh in 1971,

Constitution of Bangladesh, Political Development and Democratic Transition (1971-1990), Political Development (1991- Present), Bangladesh's contribution to world peace and its Security.

3. **<u>Environment, Economy and Culture:</u>** Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health, Education, Agriculture, Industries, NGOs, Population, Sociological and Cultural aspects of Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Art and Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No	Course Outcomes (CO) of the Course	Program Outcome											
		1	2	3	4	5	6	7	8	9	10	11	12
CO-1	**Identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and critically analyze plurality of cultural identities of Bangladesh.						√						
CO-2	**Explain** the economy and patterns of economic changes through qualitative and quantitative analysis.						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO-1	**Identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and critically analyze plurality of cultural identities of Bangladesh.	C1			7	CT, MT, F
CO-2	**Explain** the economy and patterns of economic changes through qualitative and quantitative analysis.	C3			7	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Teaching Strategies	Lecture, Tutorial, Assignments
Learning Strategies	Face to face, Guided learning, Independent learning, Assignments
Assessment Strategies	Class Test, Mid-Term Exam, Assignments, Final examination

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1 hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Week-1	**Topic**	**CT**
Class-1	Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course	CT-1
Class-2	Bangladesh Geography: Location, Area, Boundary, Physiography, River System, Forest and Climate, Demography of Bangladesh.	
Week-2		
Class-3	Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal	
Class-4	Bengal under the East India Company;	
Week-3		
Class-5	Religious and Social reform movements	
Class-6	Nationalist movements, division of the Indian sub- continent	
Week-4		
Class-7	Language movement 1948-1952, Education movement of 1962	Mid exam
Class-8	Language movement 1948-1952, Education movement of 1962	
Week-5		
Class-9	Six-point movement of 1966; Mass uprising of 1969;	
Class-10	War of Independence and Emergence of Bangladesh in 1971	
Week-6		
Class-11	Constitution of Bangladesh, Political Development and Democratic Transition (1971-1990)	
Class-12	Constitution of Bangladesh, Political Development and Democratic Transition (1971-1990)	
Week-7		
Class-13	Political Development (1991- Present), Bangladesh's contribution to world peace and security.	
Class-14	Political Development (1991- Present), Bangladesh's contribution to world peace and security.	
Week-8		
Class-15	Land, Characteristics of tropical Monsoon climate,	
Class-16	Forests and biomass, Fish	

Week-9		
Class-17	Minerals, Health and Education,	
Class-18	Agriculture, Industries	
Week-10		CT-2
Class-19	NGOs, Population, Sociological and Cultural aspects of Bangladesh	
Class-20	Economy and national development,	
Week-11		
Class-21	Development and Progress of the Millennium Development Goals (MDGs)	
Class-22	Public Administration in Bangladesh, State of Good Governance in Bangladesh	
Week-12		
Class-23	Art and Literature	
Class-24	Traditional cultural events	
Week-13		CT-3
Class-25	Vision-2021, Digitalization	
Class-26	Tourism and Natural Resources	
Week-14		
Class-27	Bangladesh and International Relations	
Class-28	Revision of the course	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
1	Class test (CT)	**20%**	
1	Class performance	**5%**	Assignment, quiz etc
	Exam		
1 & 2	Mid Term	**15%**	
1 & 2	Final	**60%**	

REFERENCE BOOKS

1. **Bangladesh Studies**: Md. Shamsul Kabir Khan and Daulatunnahar Khanam
2. **The Constitution of the People's Republic of Bangladesh**
3. **Discovery of Bangladesh**: Akbar Ali Khan
4. **History of Bangladesh, Vols, 1-3**: Sirajul Islam
5. **History of Modern Bengal, Vol, 1**: R C Majumdar
6. **Dynastic History of Bengal**: Dr. Abdul Mumin Chowdhury
7. **A History of Bangladesh**: William Van Schendel
8. **A History of Sufism in Bengal**: Dr. Enamul Huq
9. **Geography of Bangladesh**: Harun Er Rashid
10. **Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10**: Sirajul Islam
11. **History of Bengal: (Mughal Period 1526-1765)**: R. A. Chandra
12. **Land of Two Rivers:** Nitesh Sengupta

COURSE INFORMATION

Course Code: GELM 275 **Credit Hours:** 2.00
Course Title: Leadership and Management **Contact Hours:** 2.00
Level and Term: Level 2 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer.

OBJECTIVES

1. To introduce different management functions and approaches.
2. To expose students to different views and styles of leadership
3. To understand how an organization functions collaboratively with managers and engineers.
4. To understand various personality traits and its impact on leadership and management.
5. To solve real-world management problems as an engineer.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** with the fundamental concepts of leadership and management skills.
2. **Understand** the role and contribution of a leader in achieving organizational goals.
3. **Understand** the contribution of leadership traits and management skills in decision making and solving real life problems

COURSE CONTENTS

1. **Leadership:** Leadership styles, leadership theories, traits of a good leader, conflicts negotiation, engineer as a leader, manpower control, motivation and theories, group dynamics and participative management.
2. **Planning and Control:** Management functions, types, roles and responsibilities, management skills, management approaches, organization.
3. **Planning and Development:** Organizational planning, organizational development models, research process and diagnostic methods.
4. **Personnel planning and HR Management System:** Process of Human Resource Planning, performance management and appraisal.
5. **Cost and Financial Management:** Elements of costs of products, break-even analysis, investment analysis, net present value, payback period and benefit-cost ratio.
6. **Marketing Management:** Marketing concepts & organization, industrial and consumer selling, channel & advertising decisions and new product strategy.

7. **Operation management:** Project scheduling, demand and supply forecasting, inventory control and quality management.
8. **Information Technology and Management:** Management information system (MIS), enterprise resource planning (ERP).
9. **Case Studies:** Solving real-world management problems.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No	COURSE OUTCOMES (COs)	PROGRAM OUTCOME (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO-1	**Explain** with the fundamental concepts of leadership and management skills									√			
CO-2	**Understand** the role and contribution of a leader in achieving organizational goals									√			
CO-3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems										√		

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** with the fundamental concepts of leadership and management skills	C3			1	T, R, F
CO2	**Understand** the role and contribution of a leader in achieving organizational goals	C2			1	T, ASG, R, F
CO3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems	C2			1	T, ASG, R, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam	2

	Final examination	3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Week	Lecture	Topics	TEST
1	Lec 1	**Introduction to Leadership and Management:** Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.	**Class Test 1**
	Lec 2	**Management Fundamentals:** Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.	
2	Lec 3 Lec 4	**Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory	
3	Lec 5 Lec 6	**Leadership:** Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).	
4	Lec 7 Lec 8	**Case Study – I : Engineer as Great Leaders**	
5	Lec 9	**Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.	
	Lec 10	**Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.	
6	Lec 11	**Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.	
	Lec 12	**Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity vs innovation.	
7	Lec 13	**Case Study – II :** Planning and Goal Setting; A Managerial Approach: Engineer as Great Managers (Interactive Discussions in the Class)	

	Lec 14	**Attitude:** Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.	
8	Lec 15	**Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).	**Mid Term / Project**
	Lec 16	**Perception and Individual Decision Making:** Factors influencing perception; attribution theory; errors/biases in attribution	
9	**Lec 17**	**Perception and Individual Decision Making:** Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.	
	Lec 18	**Case Study – III :** A Case on Decision Making – Involves both leadership and managerial skills (Interactive Discussion in the Class)	
10	**Lec 19**	**Understanding Work Team:** Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.	**Class Test 2**
	Lec 20	**HR Management:** Process of Human Resource Planning; forecasting demand for labor; staffing.	
11	**Lec 21**	**HR Management:** Internal supply of labor; performance appraisal.	
	Lec 22	**Operations Management:** Project managing basics; goals and boundary of project; WBS; scheduling a project.	
12	**Lec 23**	**Operations Management:** Demand and supply forecasting; inventory control.	
	Lec 24	Exercise – Use of Microsoft Project (MSP) for scheduling a project at student level	
13	**Lec 25**	**Case Study – IV**: A case that covers all relevant theories taught throughout the course and involves both leadership and management issues, e.g., Columbia's Final Mission. (This may be given as group assignment followed by in class short presentations/discussions)	
	Lec 26		
14	**Lec 27**	**Information Technology and Management:** Management Information System (MIS); Enterprise Resource Planning (ERP) **-** For introductory knowledge.	
	Lec 28	Revision	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Assessment strategies		**CO**	**Bloom's Taxonomy**
Components	**Grading**		

Continuous Assessment (40%)	Class test 1-2	20%	CO 1	C1-C2, P1
			CO 2	C1-C2
	Class Participation	5%	CO 1	C1-C2, P1, A1
			CO 2	C1-2, P1-P2, A1
	Mid term	15%	CO 1	C1-C2, P1, A1
			CO 2	C1-C2, P1-P2, A1-A2
			CO 3	C1-C2, P1-P2, A1-A2
Final Exam		60%	CO 1	C1-C2, P1, A1
			CO 2	C1-C2, P1-P2, A1-A2
			CO 3	C1-C2, P1-P2, A1-A2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Students must be provided with SOLID reading material instead of referring text books. However, course teacher may select any text book as per his choice.
2. Engineering Management (Revised Edition) – A.K. Gupta
3. Industrial Engineering and Production Management - Martand T. Telsang
4. Leadership in Organizations – Gary Yukl
5. Developing Management Skills – David A. Whetten and Kim S. Camero

COURSE INFORMATION

Course Code: GEE 303
Course Title: Fundamentals of Economics
Level and Term: Level 3 Term I
Credit Hours: 2.00
Contact Hours: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is designed to present engineering students the major concepts and techniques of engineering economic analysis that are needed in the decision making process. This course provides an introduction to a broad range of economic concepts, theories and analytical techniques. The emphasis of this course is on the analytical analysis of money and its impact on decision making. The use of a market, supply and demand, model will be the fundamental model in which trade-offs and choices will be considered through comparison of costs and benefits of actions. The role of government policy to address microeconomic market failures and macroeconomic objectives will be examined.

OBJECTIVES

1. To enable students to demonstrate their knowledge of the fundamental and technical concepts of economics.
2. To work effectively in the organizations with honesty and integrity.
3. To impart knowledge to understand consumer behavior, elasticity and different market structure.
4. To enable identify the determinants of various macroeconomic aggregates such as national income, full employment, unemployment, consumption and savings function, inflation, productivity and the major challenges associated with the measurement of these aggregates.
5. To enable to apply the basic theories of economics in critical thinking and problem solving.
6. To make able to identify the basic features of economic development and regarding planning for the economy of the country.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Understand** the basic concepts and principles of Micro and Macro Economics.
2. **Identify and apply** the indifference curve theory and market equilibrium in real life situation
3. **Explain** time-value of money concept and **apply** the knowledge of inflation, investment and cost benefit analysis
4. **Understand** the Economic Development and Planning for the country. To get idea of international economy.

COURSE CONTENTS

Broad Topic	Details Topic
Fundamental of Economics	Definition
Production Possibility Frontier and Engineering Decision	1. PPF Curve. 2. Applying the PPF to Society's Choices by the Engineers.
Utility Theory	Law of diminishing marginal utility.
Demand	1. Definition. 2. Law of Demand. 3. Market Demand. 4. Reason for demand curve downward slopping. Mathematical Analysis
Supply	1. Definition. 2. Supply curve. 3. Market Equilibrium.
Elasticity of Demand	1. Different types of elasticity. 2. Different types of price elasticity. 3. Relation between AR, MR and elasticity 4. Mathematical Analysis
Indifference Curve Analysis and Consumers Equilibrium	Budget Line, MRS, Consumer Choice
Production Function from Engineering point of view	1. TP, AP, MP. 2. Law of Variable proportion. 3. Law of returns
Cost Analysis and Engineering Economics	1. TC, AC, MC. 2. Short run cost analysis
Analysis of Market Structure and Engineering Decision	1. Perfectly Competitive Market 2. Monopoly and Monopolistic Market
Key concept of Macroeconomics	Definition
National Income	GDP, GNP, NNP, NI
Circular Flow of National Income and Engineering Resources	Two, Three and Four sector Economy
Broad Topic	Details Topic
Savings	Savings Function, APS, MPS. Derive the savings function from consumption functions; Mathematically and Graphically.
Consumptions	Consumption functions, APC, MPC
Investment	Investment Theories, Investment Multiplier
Engineering Plan considering the Inflation Rate of the Country	Demand-Pull and Cost-Push Inflation
The Effect of Monetary policy on Engineering Plan	Impact and Use
The Effect of Fiscal Policy on Engineering Plan	Impact and Use
Theories of Developments	1 or 2 Theories of Economic Development.
Economic Problems in Developing Countries especially in Bangladesh.	

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No	COURSE OUTCOMES (COs)	PROGRAM OUTCOME											
		1	2	3	4	5	6	7	8	9	10	11	12
CO-1	**Understand** the basic concepts and principles of Micro and Macro Economics	√											
CO-2	**Identify and apply** the indifference curve theory and market equilibrium in real life situation	√											
CO-3	**Explain** time-value of money concept and **apply** the knowledge of inflation, investment and cost benefit analysis		√										
CO-4	**Understand** the Economic Development and Planning for the country. To get idea of international economy.	√											

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO-1	**Understand** the basic concepts and principles of Micro and Macro Economics	C2			1-4	CT, F
CO-2	**Identify and apply** the indifference curve theory and market equilibrium in real life situation	C3			1-4	CT, F
CO-3	**Explain** time-value of money concept and **apply** the knowledge of inflation, investment and cost benefit analysis	C2			1-4	CT, F MT
CO-4	**Understand** the Economic Development and Planning for the country. To get idea of international economy.	C4			1-4	CT, F MT

(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10

Independent Learning	Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Weeks	Lectures	Lecture/Tutorial/Assignment Topic	References/Teaching Materials/Equipment
1	1	Introduction to Engineering Economics Importance of Economics in Engineering.	Lecture notes, Reference texts/ video clips/etc.
	2	Definition of economics, Difference between micro and macroeconomics. Production possibility frontier (PPF) and Engineering choice.	
2	3	Demand and determinants of Demand	
	4	Demand curve related basic idea and Mathematical Application	
3	5	Supply and Determinants. Market Mechanism.	
	6	Consumer Choice (Indifference Curve and Budget Line)	
4	7	Indifference Curve, Properties of IC, MRS	
	8	Theory of production in the point of view of Engineers	
5	9	Theory of cost, Short run and long run cost curve	
	10	Firms Equilibrium (Concepts)	
6	11	Different types of Market.	
	12	How the Engineers will act in perfectly competitive market.	
7	13	How the Engineers will act in Monopoly Market	
	14	National Income analysis	
8	15	Aggregate Demand and Aggregate Supply	
	16	Determination of Level of Income and Employment	
9	17	Keynes Full Employment. Theory	
	18	Circular flow of Income and Expenditure (How engineers will utilize the resources and decision-making process of project plan)	
10	19	Consumption Function	
	20	Saving Function	
11	21	Inflation, Type of Inflation	
	22	Impact of Inflation	
12	23	Unemployment problem and its impact on society	
	24	Cost benefit analysis	
13	25	Theories of Economic Development	
	26	Economic Problems in Developing Countries	
14	27	Contribution of the Engineers in the Economic Development of Bangladesh.	

	28	How the Engineers compare their development projects in the context of World Economy.	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1, C2
			CO2	C1,C2
			CO3	C3, C4
	Class Participation	5%	CO4	
	Mid term	15%	CO2, CO3	C1, C2, C4
Final Exam		60%	CO1, CO2	C1, C2, , C4
			CO3, CO4	C1, C2,C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Economics by P. A. Samuelson and W. D. Nordhaus (7th Edition)
2. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Edition)
3. Macroeconomics by N. Gregory Mankiw (8th Edition)
4. Principle of Economics by N. Gregory Mankiw (8th Edition)
5. Engineering Economics by Niall M. Fraser and Elizabeth M. Jewkes. (5th Edition)

Military Institute of Science and Technology
Department of Naval Architecture and Marine Engineering

COURSE INFORMATION

Course Code: GES 305 **Credit Hours:** 2.00

Course Title: Fundamentals of Sociology **Contact Hours:** 2.00

Level and Term: Level 3 Term 1

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course has been designed to understand the human inter-personal relationship and human psychology in the society and to apply this knowledge in the practical field as an engineer through the study of varied societies and cultures.

OBJECTIVES

1. To learn basics, scopes and perspectives of sociology.
2. To understand societal and cultural issues in national, global and environmental context.
3. To synthesis between social problem and social satisfaction in real life.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. Understand the basic nature, scope and perspective of sociology and the criteria of social research process and methodologies.
2. Apply contextual knowledge to assess societal and cultural issues in national and global context and also environmental context for sustainable development.
3. Analyze social problem, social stratifications, socialism, capitalism and economic life and political issues.

COURSE CONTENTS

1. Nature and scope sociological imagination, perspectives of sociology.
2. Stages of social research and research method.
3. Culture and civilization, socialization and self –development
4. Globalization and social changes, media and individual
5. Social organizations and social problems, social stratification;
6. Industrial revolution, capitalism and socialism,
7. Work and economic life
8. Environment and human activities, climate change and global risk
9. Population and human society, urbanization and city development, social changes and technology

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	**Understand** the basic nature, scope and perspective of sociology and the criteria of social research process and methodologies.										√		
CO2	**Apply** contextual knowledge to assess societal and cultural issues in national and global context and also environmental context for sustainable development.						√						
CO3	**Analyze** Social problem, social stratifications, socialism, capitalism and economic life and political issues.						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the basic nature, scope and perspective of sociology and the criteria of social research process and methodologies.	C1		-	1	T, ASG, F
CO2	**Apply** contextual knowledge to assess societal and cultural issues in national and global context and also environmental context for sustainable development.	C2		-	1	Q, F
CO3	**Analyze** social problem, social stratifications, socialism, capitalism and economic life and political issues.	C2			2	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Justifications
CO1-PO10	In order to understand the basic nature, scope and perspective of sociology and the criteria of social research process and methodologies, it is required to communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
CO2-PO6	In order to apply contextual knowledge to assess societal and cultural issues in national and global context and also environmental context for sustainable development, application of reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems is required.
CO3-PO6	In order to analyze Social problem, social stratifications, socialism, capitalism and economic life and political issues, application of reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Weeks	Lectures	Lecture/Tutorial/Assignment Topic	Assessment Method
1	1.	Definition, nature and scope of sociology	Class test- 1, Final Exam
	2.	Sociological imagination	
2	3.	Perspectives of sociology	
	4.	Orientation of sociological theories	
3	5.	Social research and its process	
	6.	Research designs and techniques.	
4	7.	Introducing culture and its variations	
	8.	civilization	
5	9.	Defining family and its changes	
	10.	Socialization process and development of self	
6	11.	Introducing globalization and its impact on human life	Class test- 2 Mid Term Final Exam
	12.	Factors responsible to globalization	
7	13.	Media and its impact in modern society	
	14.	Addressing social problems of Bangladesh	
8	15.	Introducing social groups and organizations	
	16.	Introducing bureaucracy and good governance	
9	17.	Introducing social stratifications and social inequality	
	18.	Poverty and its types and dimensions	
10	19.	Industrial revolution and aftermath	
	20.	Urbanization and city development	
11	21.	Capitalism: features and influence	Class test- 3 Final Exam
	22.	Socialism: features and influence	
12	23.	Environment and human activities	
	24.	Climate change and global risk	
1	25.	Population of Bangladesh: problem or prospect	

3	26.	Crime and deviance: a brief analysis	
1 4	27.	Review 1	
	28.	Review 2	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		Grading	COs	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2
			CO4, CO5	C3, C4
	Class Participation	5%	CO6	
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1, CO2	C1, C2, , C4
			CO3, CO4	C1, C2,C4
			CO4, CO5	C5, C4
			CO6	C5, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
2. Sociology - Primary Principles: by CN Shankar Rao
3. Anthony Giddens- 5th edition
4. Relevant journal

COURSE INFORMATION

Course Code: GESL 311 **Credit Hours:** 2.00
Course Title: Environment, Sustainability and Industrial Law **Contact Hours:** 2.00
Level and Term: Level 3 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The development of the modern law of the sea and the growing concern for the condition of the oceans have given rise to a number of legal regimes addressing problems of the marine environment including pollution, loss of biodiversity, protection of endangered species, and marine mammals. The international law of the sea provides a foundation for continuing progress. This course introduces to the international legal framework on marine pollution, which covers global and regional legally binding and non-legally binding agreements addressing different sources of pollution.

OBJECTIVES

1. To familiarize with marine environment and with the types and sources of marine environment pollution.
2. To impart the knowledge of the importance of the protection the oceans from pollution.
3. To give brief idea on international law at sea.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Identify** the sources of marine pollution and **explain** the impacts of sectorial marine activities.
2. **Describe** importance of the protection the oceans from pollution and **outline** the regional approach to combat pollution of the marine environment
3. **Explain** general aspects of pollution management for sustainable shipping
4. **Apply** the international laws of maritime environmental conservation in ship design and shipbuilding.

COURSE CONTENTS

1. **Introduction to Marine Environment:** Definition of the Marine Environment, importance of the marine environment, Scope of the Marine Environment (Different Maritime Zones)
2. **Pollution of Marine Environment:** Pollution of marine environment, types and sources of marine pollution (pollution from ships, pollution by dumping wastes at sea, land-based sources, pollution resulting from seabed activities)
3. **Impacts of Sectoral Marine Activities:** Impact of fishing activities on marine life, shipping, offshore oil and gas production and transformation, exploitation offshore wind energy, dredging for navigation, for environmental cleanup and for sand, environmental risk of deep sea mining, impacts of land-based activities, Pollution from diffusive sources

4. **General Aspects on Marine Environmental Protection:** General aspects of management and governance of human activities on marine environmental protection; Social drivers, development and perspectives of increasing ocean uses.
5. **International Environmental law of the Sea:** Major Developments in the International Law of Marine Pollution and Marine Environmental Conservation, Marine Wildlife Conservation in Law and Policy.

COURSE OUTCOMES - PROGRAM OUTCOMES MAPPAING

No.	COURSE OUTCOMES (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** the sources of marine pollution and **explain** the impacts of sectorial marine activities.		√										
CO2	**Describe** importance of the protection the oceans from pollution and **outline** the regional approach to combat pollution of the marine environment							√					
CO3	**Explain** general aspects of pollution management for sustainable shipping							√					
CO4	**Apply** the international laws of maritime environmental conservation in ship design and shipbuilding						√						

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** the sources of marine pollution and **explain** the impacts of sectorial marine activities.	C3, C4			1,3, 4	CT, F
CO2	**Describe** importance of the protection the ocean environment from pollution and **outline** the regional approach to combat pollution of the marine environment	C2,C4	1		7	CT, MT, F
CO3	**Explain** general aspects of pollution management for sustainable shipping and other ocean operations.	C2,C5	3,6	4	7	CT/ASG, F
CO4	**Apply** the international laws of maritime environmental conservation in ship design and shipbuilding	C3			7	MT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO2	The knowledge of theory based fundamental knowledge of this course will help the students to define and distinguish the sources of marine pollution and explain the impacts of sectorial marine activities.
CO2-PO7	Students will be able to describe importance of the protection the ocean environment from pollution and able to find out sustainable solutions for various marine environmental issues.
CO3-PO7	Students get a better understanding of the pillars of sustainable shipping and other ocean operations through the marine environment pollution management which needed to be strengthened for sustainable development.
CO4-PO6	Students will gain knowledge on several international law of sea related to maritime environment which will make awareness of various environmental issues and it is needed to address while working as an engineer in a society.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1-hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Week	Contents	Assessment
Week 1	**Introduction to Marine Environment**	CT 1, Final Exam
Class 1	Definition of the marine environment, importance of the marine environment	
Class 2	Scope of the marine environment, different maritime zones	
Week 2	**Pollution of Marine Environment**	
Class 3	Definition of the pollution of marine environment and types of marine environment pollution	
Class 4	Sources of marine pollution	
Week 3	**Pollution of Marine Environment (Contd.)**	

Class 5	Sources of marine pollution	
Class 6	Review	
Week 4	**Impacts of Sectoral Marine Activities**	CT 2, Final Exam
Class 7	Assessment (CT-1)	
Class 8	Impact of fishing activities on marine life	
Week 5	**Impacts of Sectoral Marine Activities (Contd.)**	
Class 9	Shipping	
Class 10	Offshore oil and gas production and transformation, exploitation offshore wind energy	
Week 6	**Impacts of Sectoral Marine Activities (Contd.)**	
Class 11	Dredging for navigation, for environmental cleanup and for sand	
Class 12	Environmental risk of deep sea mining	
Week 7	**Impacts of Sectoral Marine Activities (Contd.)**	Mid Term, Final Exam
Class 13	Impacts of land-based activities, Pollution from diffusive sources	
Class 14	Assessment -2 (CT-2)	
Week 8	**General Aspects on Marine Environmental Protection**	
Class 15	Challenges and foundation of sustainable ocean governance	
Class 16	Institutional framework for marine environment governance	
Week 9	**General Aspects on Marine Environmental Protection (Contd.)**	
Class 17	Industrial principle of marine environment protection and future prospects of marine environmental governance	
Class 18	Marine Management on sustainable shipping and hazardous substance in the marine environment	
Week 10	**General Aspects on Marine Environmental Protection(Contd.)**	
Class 19	Social drivers, development and perspectives of increasing ocean uses	
Class 20	Assessment -3 (CT-2)	
Week 11	**International Environmental law of the Sea**	
Class 21	Major Developments in the International Law of Marine Pollution	
Class 22	Conservation Prospects at UNCLOS	
Week 12	**International Environmental law of the Sea (Contd.)**	
Class 23	MARPOL 1973	
Class 24	OPRC, Marine Environmental Hazard Control	
Week13	**International Environmental law of the Sea (Contd.)**	CT 3, Final Exam
Class 25	Wildlife Conservation in Law and Policy (Fisheries, climate change, Exotic species,)	
Class 26	Wildlife Conservation in Law and Policy (challenges of marine wildlife conservation, convention on international trade in endangered species of fauna and flora, convention biological diversity, migratory species)	
Week 14		
Class 27	Assessment -4 (CT-2)	
Class 28	Revision Class	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous	Class Test/	20%	CO1	C1, C2,

Assessment (40%)	Assignment 1-3		CO2	C1,C2
			CO3	C3, C4
	Class Participation	5%	CO4	
	Mid term	15%	CO2, CO4	C1, C2, C4
Final Exam		60%	CO1	C1, C2,C2
			CO2	C1, C2,C4
			CO3	C2,C3, C5
			CO4	C1, C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. 'The environmental law of the sea' edited by Douglas M. Johnston Published by (1981)
2. 'Handbook on Marine Environment Protection(Science, Impacts and Sustainable Management)' edited by Salomon, Markus, Markus**,** Till
3. 'Handbook on the Economics and Management of Sustainable Oceans' by Edited by Paulo A.L.D. Nunes (et. al)
4. 'Protection of the marine environment under international law' by Yousef H. Almutairi (2016)
5. 'International law and the protection of the marine environment' by Howard S. Schiffman

COURSE INFORMATION

Course Code: GERM 352 | **Credit Hours:** 2.0

Course Title: Fundamentals of Research Methodology | **Contact Hours:** 4.0

Level and Term: Level 4 Term I

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The Fundamentals of Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in Science and Engineering context. UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments.

OBJECTIVES

The primary objective of this course is to develop a research orientation among the UG students and to acquaint them with fundamentals of research methods. Some other objectives of the course are:

1. To evaluate/review related extant literature, form a variety of sources, pertinent to the research objectives/questions.
2. To expose students to various research methodologies (design), relevant to the research problem needing to be addressed.
3. To explain and justify how researchers will collect and analyze research data.
4. To educate students in the common mistakes, research misconduct, and ethical considerations in the field of research methodology.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.
2. **Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.
3. **Develop writing** and presentation skill, and **demonstrate** ethical considerations in conducting Research.

COURSE CONTENTS

1. **Foundations of Research:** Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good

Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.

2. **Problem Identification and Formulation:** Meaning and need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

3. **Research Design:** Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental/Computational Design: Concept of Independent & Dependent variables.

4. **Data Analysis:** Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

5. **Research Misconduct and Ethics:** Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

6. **Use of Tools / Techniques for Research:** Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No	COURSE OUTCOMES (COs)	PROGRAM OUTCOME (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO-1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.		√										
CO-2	**Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.												√
CO-3	**Develop writing** and presentation skill, and **demonstrate** ethical considerations in conducting Research.										√		

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOME (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.	C3			1	ASG/Q
CO2	**Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.	C3			1	R/Pr/ASG/Q

CO3	**Develop writing** and presentation skill, and **demonstrate** ethical considerations in conducting Research.	C2			1	R/Pr /ASG
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Lecture and Discussion, Mini-Seminars by Experts, Co-operative and Collaborative Method and Problem Based Method

TEACHING LEARING STRATEGY

Teaching and learning activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical / Tutorial / Studio	14
Student-Centred Learning	08
Self-directed learning	
Non face-to-face learning Revision	08
Report preparations	14
Formal Assessment	
Continuous Assessment	1.5
Report Submission (2)	-
Presentation (2)	0.5
Total	**60**

COURSE SCHEDULE

Week	Topics	
1	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.	**Continuous Assessment** (presentation/ quiz/other assignment)
2	Practice session on Foundations of Research	
3	Problem Identification & Formulation: Meaning & need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.	
4	Practice session on Problem Identification & Formulation	**Assignment 1** Assignment has to provide before, here students will
5	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs	

	– concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.	submit report and give PPT
6	Practice session on Research Design	
7	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	
8	Practice session on Data Analysis	
9	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.	
10	Practice session on Research misconduct and Ethics	**Continuous Assessment** (presentation/ quiz/other assignment)
11	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.	
12	Practice session on Use of tools / techniques for Research	
13	Review Session (Theory) – I /Final Presentation	**Assignment 2** Assignment has to provide before, here students will submit report and give PPT
14	Review Session (Practice) – II /Final Presentation	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Assessment Criteria		**CO**	**Blooms Taxonomy**
Components	**Grading**		
Assignment I	20%	CO1 and CO3	C2-C3
Assignment II	50%	CO2 and CO3	C2-C3
Continuous Assessment	30%	CO1 and CO2	C2-C3
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Engineering Research Methodology: A Practical Insight for Researchers. Springer, by Deb, Dipankar, Dey, Rajeeb, Balas, Valentina E.
2. Research Methods for Engineers, 1st Edition, by David V. Thiel.
3. Handbook of Research Methodology by Talati, J.K.
4. Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project by Uwe Flick
5. DRM, a Design Research Methodology by Lucienne T.M. Blessing and

Amaresh Chakrabarti

6. Research Methods: Information, Systems, and Contexts by Kirsty Williamson, Graeme Johanson
7. Zelkowitz, M. V. and Wallace, D. R. (1998), Experimental models for validating technology, *Computer*, vol. 31, no. 5, pp. 23-31.
8. Internet, mail, and mixed-mode surveys : the tailored design method (3rd ed.) by Dillman, D. A., Smyth, J. D., & Christian, L. M.
9. Improving survey questions: design and evaluation. Sage Publications, by Fowler, F. J.
10. Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, by Cohen, J., Cohen, P., West, S., & Aiken, L.
11. Experimental and Quasi-Experimental Design for Generalized Causal Inference. Boston, Mass: Houghton Mifflin, by Shadish W.R., Cook T.D. & Campbell P.T.
12. Computational handbook of statistics (4th ed.). New York: Longman, by Bruning, J. L. & Kintz, B. L.

COURSE INFORMATION

Course Code: GEA 407 **Credit Hours:** 2.00
Course Title: Principles of Accounting **Contact Hours:** 2.00
Level and Term: Level 4 Term I

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

The course provides students with a basic grounding in topics such as assets and liabilities, financial analysis, planning and budgeting and investment appraisal with specific reference to unique aspects of finance and accounting in the realm of engineering, all of which are important in understanding accounting and finance. It is comprised of a variety of different learning resources including case studies of financial decision making in business and examples of when things go wrong and how this can be avoided.

OBJECTIVES

1. To know the meaning, history and definition of accounting, the users and uses of accounting, importance of ethics in financial reporting.
2. To impart knowledge, the International Financial Reporting (IFRS), Generally Accepted Accounting Principles (GAAP), cost principle, monetary unit assumption and the economic entity assumption.
3. To familiarize with and enable to prepare and understand the worksheet, preparation of financial statements, cost benefits analysis of different projects with honesty and integrity.
4. To provide the students with an in-depth knowledge of Management Accounting to enable them to apply its methods and techniques for preparing and presenting information for management decision-making and control purposes.
5. To apply selected management accounting techniques and analyze the implications of the techniques with regards to cost-volume profit analysis, budgeting, standard costing and variance analysis.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Understand** the cost principle, monetary unit assumption and the economic entity assumption and ethics in financial reporting for each and every project.
2. **Understand** worksheet, preparation of financial statements, cost benefit analysis of different projects.
3. **Acquire** knowledge of Management Accounting and apply it for preparing and presenting information for management decision-making and control purposes.
4. **Apply** and **analyze** the cost-volume profit, budgeting, standard costing and variance analysis for any project.

COURSE CONTENTS

1. **Accounting in Action**
   a. History & Definition of Accounting,
   b. Objectives and Importance of Accounting
   c. Accounting & Engineering
   d. International Financial Reporting Standard (IFRS), Generally Accepted Accounting Principles (GAAP), Ethics in Accounting
   e. Accounting Equation (Math)

2. **Recording Process :** Journal, Ledger, T-account and Trial balance

3. **Adjusting the Accounts :** Adjusting Entries , Adjusted Trial Balance, Income Statement, Retained Earnings Statement and Statement of Financial Position (Balance Sheet) , Worksheet

4. **Financial Statement Analysis:** Horizontal Analysis, Vertical Analysis and Ratio Analysis.

5. **Computerized Accounting System:** Manual vs. Computerized Accounting system, Some Accounting Software: NetSuite ERP. Tipalti. Sage Business Cloud Accounting. Sage 50cloud. Plooto. Tradogram. Tally accounting software.

6. **Cost Concepts:**
   a. Explain The Distinguishing Features of Managerial Accounting
   b. Identify The Three Broad Functions of Management
   c. Classification of Costs on Various Bases
   d. Indicate How Cost of Goods Manufactured is Determined, Break Even Point (BEP) for Different Projects.

7. **<u>Absorption costing and Variable costing:</u>**
   a. Prepare Profit Statements Based on a Variable Costing and Absorption Costing System
   b. Cost Volume Profit (CVP) Analysis for different engineering projects
   c. Account for the difference in profits between variable and absorption costing profit calculations
   d. Explain the arguments for and against variable and absorption costing

8. **<u>Job Order Costing and Process Costing:</u>**
   a. Job Order Costing
   b. Process Costing

9. **<u>Short & Long-Term Decision-Making in Accounting:</u>**
   a. Relevant & Irrelevant Costs for Decision-Making
   b. How to Determine Costs & Make Decisions
   c. Contrast annual rate of return and cash Payback in Capital Budgeting, Budgeting for Various Engineering Projects.
   d. Distinguish between the Net Present Value And Internal Rate Of Return Method

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No	COURSE OUTCOMES (COs)	PROGRAM OUTCOME (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO-1	**Understand** the cost principle, monetary unit assumption and the economic entity assumption and ethics in financial reporting for each and every project.	√											
CO-2	**Understand** worksheet, preparation of financial statements, cost benefit analysis of different projects.	√											
CO-3	**Acquire** knowledge of Management Accounting and apply it for preparing and presenting information for management decision-making and control purposes.		√										
CO-4	**Apply** and **analyze** the cost-volume profit, budgeting, standard costing and variance analysis for any project.											√	

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO-1	**Understand** the cost principle, monetary unit assumption and the economic entity assumption and ethics in financial reporting for each and every project.	C2			1-4	Pop Quiz, F
CO-2	**Understand** worksheet, preparation of financial statements, cost benefit analysis of different projects.	C2			1-4	MT, F
CO-3	**Acquire** knowledge of Management Accounting and apply it for preparing and presenting information for management decision-making and control purposes.	C2			1-4	CT, F
CO-4	**Apply** and **analyze** the cost-volume profit, budgeting, standard costing and variance analysis for any project.	C4			1-4	CT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP-Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning

		Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1 hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Lectures	Lecture/Tutorial/Assignment Topic	CT
Week-1		
1	Meaning, history and definition of accounting	
2	The users and uses of accounting.	
Week-2		
3	Ethics in financial reporting	
4	The cost principle, monetary unit assumption and the economic entity assumption	
Week-3		
5	Accounting equation and its components	
6	The effects of business transactions on the accounting	
Week-4		**1**
7	Four financial statements and how they are prepared.	
8	Journal	
Week-5		
9	Journal	
10	T-account, Ledger, Trial balance	
Week-6		
11	Adjusting Accounts	
12	Worksheet.	
Week-7		**2**
13	Completion of the Accounting cycle.	
14	Financial Statement Analysis	
Week-8		
15	Managerial Accounting Basics	
16	Cost Concepts	
Week-9		
17	Job Order Cost Accounting	
18	Job Order Cost Accounting	
Week-10		
19	Process Cost Accounting	
20	Process Cost Accounting	

Week-11		
21	Cost-Volume-Profit Relationships	
22	Cost-Volume-Profit Relationships	
Week-12		
23	Performance Evaluation through Standard Costs	
24	Performance Evaluation through Standard Costs	**3**
Week-13		
25	Incremental Analysis	
26	Incremental Analysis	
Week-14		
27	Capital Budgeting	
28	Capital Budgeting	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1, C2
			CO2	C1,C2
			CO3	C3, C4
	Class Participation	5%	CO4	
	Mid term	15%	CO2, CO3	C1, C2, C4
Final Exam		60%	CO1, CO2	C1, C2, , C4
			CO3, CO4	C1, C2,C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Financial Accounting IFRS edition by Weygand, Kimmel & Kieso (3th)
2. Accounting Principles by Weygandt, Kieso& Kimmel (IFRS Latest edition)

COURSE INFORMATION

Course Code: GEEM 441 **Credit Hours:** 2.00
Course Title: Engineering Ethics and Moral Philosophy **Contact Hours:** 2.00
Level and Term: Level 4 Term 2

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course is an introduction to engineering ethics, which stresses analytical reasoning and emphasizes clear thinking regarding the application of professional ethical codes to specific cases. Theory includes ethics and moral philosophy of engineering which approaches to ethical issues include: analyzing the factual, conceptual, application, and moral aspects of an issue; evaluating the risks and responsibilities of a particular course of action; and using theories of ethics or codes of ethics developed by engineering societies as a basis for decision making. Ethics can be built into the education of engineering students and professionals, either as an aspect of courses already being taught or as a component of engineering projects to be examined along with research findings. This course will help students to conceptualize the dynamics of the ethical practice in the Naval Architecture and Marine Engineering domain.

OBJECTIVES

1. To develop student's ability in analyzing and interpreting the real life situation and to enhance the student's Moral/ Ethical integrity for the practice of Engineering Profession.
2. To develop attitudes required from engineers and values shared by engineers.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Explain** the basic perception of profession, professional code of ethics, various moral & social issues, industrial standards and role of professional ethics in engineering field.
2. **Identify** and **analyze** practical legal problems commonly encountered by engineers in their professional field/industry and **formulate** solutions to some of the legal problems
3. **Practice** professional responsibilities of an engineer for safety and risk benefit analysis.
4. **Assess** the codes of professional conduct and their implications in Naval Architecture and Marine Engineering field.

COURSE CONTENTS

1. Introduction to Engineering ethics and professionalism; History and development of engineering ethics and Ethical theories; Ethics and law, Nature of ethical problems, Analysis of Ethical Problems, Types of issues in ethical problem solving.
2. Applied ethics in engineering: Case Studies of ethics and Ethical Problem-Solving Techniques; Risk, Safety, and Accidents;
3. Engineer's Responsibilities and Rights; Human qualities of an engineer. Obligation of an

engineer to the clients.

4. Introduction to Philosophy of Engineering; Professional Engineering Codes, Moral Reasoning and Codes of Ethics, Codes of Ethics (IEB); Code of Ethics (BAERA & IAEA), Moral Frameworks for Engineering Ethics, Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession.
5. Ethical expectation: Employers and employees, inter-professional relationship, Professional Organization – maintaining a commitment of ethical standards. Desired characteristics of a professional code. Institutionalization of ethical conduct. Environmental Ethics.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (POs)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the basic perception of profession, professional code of ethics, various moral & social issues, industrial standards and role of professional ethics in engineering field.								√				
CO2	**Identify** and **analyze** practical legal problems commonly encountered by engineers in their professional field/industry and **formulate** solutions to some of the legal problems						√						
CO3	**Practice** professional responsibilities of an engineer for safety and risk benefit analysis.						√						
CO4	**Assess** the codes of professional conduct and their implications in Naval Architecture and Marine Engineering field.												√

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the basic perception of profession, professional code of ethics, various moral & social issues, industrial standards and role of professional ethics in engineering field.	C2,C3	-	-	1	T, Q, F
CO2	**Identify** and **analyze** practical legal problems commonly encountered by engineers in their professional field/industry and **formulate** solutions to some of the legal problems	C1, C2, C3	-	-	1	T, Q, F
CO3	**Practice** professional responsibilities of an engineer for	C4	-	-	1	MT, F

	safety and risk benefit analysis.					
CO 4	**Assess** the codes of professional conduct and their implications in Naval Architecture and Marine Engineering field.	C2	-	-	1	T, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)						

JUSTIFICATIONS OF CO-PO MAPPAING

Mapping	Justifications
CO1-PO8	In order to develop foundation knowledge of ethics to be applied in professional fields, application of ethical principles and commit to professional ethics and responsibilities and norms of engineering practice is required.
CO2-PO6	In order to be able to identify practical and legal problems commonly encountered by engineers in their professional field/industry application of reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems is required
CO3-PO6	In order to be able to Practice professional responsibilities of an engineer for safety and risk benefit analysis commonly encountered by engineers in their professional field/industry application of reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems is required
CO4-PO12	In order to engage in lifelong learning through acquiring knowledge on legal and ethical aspects of professions of Naval Architecture and Marine Engineering, it is required to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

TEACHING LEARING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	28
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	14
Revision of the previous lecture at home	14
Preparation for final examination	14
Formal Assessment	
Continuous Assessment	2
Final Examination	3

Total	**75**

COURSE SCHEDULE

<table>
<tr><th>Weeks</th><th>Topics</th><th>Remarks</th></tr>
<tr><td>Week-1</td><td>Introduction to ethics, history, evolution, need and importance of ethics in Naval Architecture and Marine Engineering technology, ethical terminology</td><td rowspan="3">Class Test 1,Final Exam</td></tr>
<tr><td>Week-2</td><td>Introduction to the Engineering Ethics: purpose, objectives, scope, methods etc.</td></tr>
<tr><td>Week-3</td><td>Introduction to Philosophy of Engineering</td></tr>
<tr><td>Week-4</td><td>Professional Engineering Codes, Codes of Ethics (IEB)</td><td rowspan="4">Class Test 2, Final Exam</td></tr>
<tr><td>Week-5</td><td>Code of Ethics (IAEA)</td></tr>
<tr><td>Week-6</td><td>Code of Ethics (BAERA)</td></tr>
<tr><td>Week-7</td><td>Ethical Problem Solving Techniques</td></tr>
<tr><td>Week-8</td><td>Whistle Blowing.</td><td rowspan="3">Mid Term, Final Exam</td></tr>
<tr><td>Week-9</td><td>Case study methodology, different case studies</td></tr>
<tr><td>Week-10</td><td>The Rights and Responsibilities of Engineers</td></tr>
<tr><td>Week-11</td><td>Ethical Issues in Engineering Practice</td><td rowspan="4">Class Test 3, Final Exam</td></tr>
<tr><td>Week-12</td><td>Ethics Issues in Naval Architecture and Marine Engineering Technology</td></tr>
<tr><td>Week-13</td><td>Safety, Risk and Liability</td></tr>
<tr><td>Week-14</td><td>Trust and reliability</td></tr>
</table>

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>COs</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td rowspan="2">Class Test/ Assignment 1-3</td><td rowspan="2">20%</td><td>CO1</td><td>C1,C2</td></tr>
<tr><td>CO3</td><td>C1,C2</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO2</td><td></td></tr>
<tr><td>Mid term</td><td>15%</td><td>CO2, CO3</td><td>C2,C3,C4</td></tr>
<tr><td colspan="2" rowspan="3">Final Exam</td><td rowspan="3">60%</td><td>CO1</td><td>C1-C3</td></tr>
<tr><td>CO2</td><td>C1-C3</td></tr>
<tr><td>CO3</td><td>C1-C3</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Charles E. Harris, et el. *Engineering Ethics: Concepts and Cases*, Cengage Learning Boston, USA: 4th Edition, 2009.
2. Charles B. Fleddermann, *Engineering Ethics*, 4th Edition, NewYork, USA: Mc-Grawhill: 2012.
3. Davis, M., ed. *Engineering Ethics*. Farnham, United Kingdom Ashgate Publishing Co, 2005.

COURSE INFORMATION

Course Code: GEPM 471
Course Title: Project Management and Finance
Level and Term: Level 4 Term 1

Credit Hours: 2.00
Contact Hours: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

RATIONALE

This course has been designed to understand the overlapping connection between engineering and management with financial matters in an organization through the study of varied management practices and finance as an engineer.

OBJECTIVES

1. To introduce some aspects of business management and business organization.
2. To identify the tools and techniques needed to lead any project to its intended conclusion.
3. To introduce sales fundamentals include understanding the customer and the competition, sales strategy, sales management, product positioning, product life cycle, sales structures, margins, and prospecting for new customers.

COURSE OUTCOMES (COs)

On successful completion of this course, students should be able to:

1. **Develop** in depth idea on ship design and building project management and organization to perform the Management Functions.
1. **Compare** between selected Theories of Management.
2. **Design** ship building project and to perform the functions in the Marketing Mix.
3. **Develop** knowledge of effective material management; management and resource allocation; Engineering economy and assessment on ethical issues in business situations.

COURSE CONTENTS

1. **Management Functions and Organization:** Evolution; Management functions: organization, theory and structure, span of control, authority delegation, manpower planning.
2. **Human Resource Management:** Importance, need hierarchy, motivation, leadership, wage incentives, performance appraisal and participative management.
3. **Production Control and Management Strategy:** Production planning and control (PPC) functions, quantitative methods applied in production, quality management, location and layout planning, safety and loss management, cost management elements of cost of products, cost centers and allocation of overhead costs.
4. **Management Accounting:** Marginal costing, standard costing, cost planning and control, budget and budgetary control, development and planning process, annual development plan and National budget.

5. **Investment Management:** Objectives, strategy, investing, performance analysis of enterprise, investment appraisal, criteria of investment, cost planning and control, budget and budgetary control.
6. **Retail and Technology Management:** Concepts, strategy, sales promotion, patent laws, technology management, management of innovation and changes, technology life cycle.
7. **Scheduling Management:** Resource schedule, project schedule management, time-phased costs, budget baseline management.

MAPPING OF COURSE OUTCOMES AND PROGRAM OUTCOMES

No.	COURSE OUTCOME (COs)	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Develop** in depth idea on ship design and building project management and organization to perform the Management Functions.	√											
CO2	**Compare** between selected Theories of Management.	√											
CO3	**Design** ship building project and to perform the functions in the Marketing Mix.		√										
CO4	**Develop** knowledge of effective material management, management and resource allocation; Engineering economy and assessment on ethical issues in business situations.											√	

COURSE OUTCOMES & GENERIC SKILLS

No.	COURSE OUTCOMES (COs)	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO-1	**Develop** in depth idea on ship design and building project management and organization to perform the Management Functions.	C3	1	-	1	CT, Q, F
CO-2	**Compare** between selected Theories of Management.	C4	2	1	1	ASG, F
CO-3	**Design** ship building project and to perform the functions in the Marketing Mix.	C5	2	-	1	MT, F
CO-4	**Develop** knowledge of effective material management, management and resource allocation; Engineering economy and assessment on ethical issues in business situations.	C6	3	1	2	CT, F
(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create;						

CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

JUSTIFICATION OF CO-PO MAPPINGS

Mapping	Justification
CO1-PO1	The knowledge of mathematics, science, and engineering fundamentals is required to develop in depth idea on ship building industrial management and organization to perform the Management Functions.
CO2-PO1	The knowledge of mathematics, science, Engineering fundamentals is required to compare between selected Theories of Management.
CO3-PO2	In order to develop a ship deesign project and to perform the functions in the Marketing Mix, identification, formulation, research literature and analysis of complex engineering problems are required to reach substantiated conclusion using first principles of mathematics, sciences and engineering fundamentals.
CO4-PO11	In order to develop knowledge of effective material management; Students will learn Management and resource allocation; Engineering economy and assessment on ethical issues in Business situations, it is required to demonstrate knowledge and understanding of engineering management principles and economic decision- making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam

TEACHING LEARING STRATEGY

Components	Teaching and Learning Activities	Student Learning Time (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1 hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL SLT	80
	CREDIT = SLT/40	2

COURSE SCHEDULE

Weeks	Topics	Remarks
Week-1	Management Functions and Organization: Evolution	

Week-2	Management functions: organization, theory and structure, span of control, authority delegation, manpower planning	**Class Test 1, Final Exam**
Week-3	Management functions: organization, theory and structure, span of control, authority delegation, manpower planning	
Week-4	Personnel Management: Importance, need hierarchy, motivation	
Week-5	leadership, wage incentives, performance appraisal, participative management	
Week-6	Operation Management : Production planning and control (PPC) functions, quantitative methods applied in production	**Mid Tem, Final Exam**
Week-7	Quality management, location and layout planning, safety and loss management	
Week-8	Cost management elements of cost of products, cost centres and allocation of overhead costs	
Week-9	Management accounting : marginal costing, standard costing, cost planning and control, budget and budgetary control	
Week-10	Development and planning process; annual development plan; National budget	**Class Test 2, Final Exam**
Week-11	Financial management : objectives, strategy, financing, performance analysis of enterprise, investment appraisal, criteria of investment	
Week-12	Management Accounting: Cost planning and control, budget and budgetary control	
Week-13	Marketing Management: Concepts, strategy, sales promotion, patent laws	
Week-14	Technology Management; Management of innovation and changes, technology life cycle	

LINKAGE OF CO WITH ASSESSMENT METHODS & THEIR WEIGHTS

Components		**Grading**	**CO**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment (1-3)	20%	CO1, CO2, CO4	C3, C4, C6
	Class Participation	5%	CO1, CO2	C3, C4
	Mid term	15%	CO3	C5
Final Examination		60%	CO1-CO4	C3, C4,C5, C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. P. Kotler, K. L. Keller, Marketing Management,15th ed., Pearson, 2016
2. D. H. Besterfield, G. Besterfield, Total Quality Management, 3rd ed,. Prentice Hall, 2002
3. J. Liker, The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, 1st ed., McGraw-Hill Education, 2004

ANNEX-A

CHAPTER 4. CRITERIA (BAETE MANUAL 2019 VERSION 2)

This section presents the criteria that a program must meet to become accredited. The following sub-sections sequentially outline the ten major criteria.

4.1 Organization and Governance

Major positions should be filled, and the statutory bodies/committees of the institution should be formed in accordance with the applicable rules and guidelines. These positions include Vice Chancellor, Pro-Vice Chancellor, Treasurer, Dean, and Chairperson and bodies/committees such as the Board of Trustees, Syndicate, Academic Council, Admission Committee, Finance Committee, Curriculum Committee and the Faculty Selection Committee. The position appointees and committee members should function effectively as per the roles defined in the relevant act/statute.

The institution should have published policies, including a mechanism for addressing grievances, regarding academic and administrative matters involving students, faculty members and non-teaching employees. These policies should be put into practice.

4.2 Financial and Physical Resources

The financial resources of the institution should be adequate to fulfill its mission and vision. The financial resources committed to the program should also be sufficient for the appropriate functioning of the program, including recruiting and retaining qualified faculty members, and procuring the necessary lab equipment and equipment and tools to support teaching and learning.

The institution should have a process for budget planning and allocate resources to the priority areas as required. The campus infrastructure, such as the extent of the land and built-up area, extra- and co-curricular facilities, and support facilities, including maintenance support for infrastructure and facilities, should be adequate for the total number of students and employees at the institution.

The possibility of any risk from manmade or natural hazards should be properly assessed and addressed in the Safety Plan. All labs shall have their own plans to prevent and manage incidents and accidents. Fire detection and firefighting facilities should be adequate. An action plan is required to address safety issues as the situation demands. Adequate measures should be in place to make the campus safe for students, employees and visitors.

4.3 Faculty

The department should have a sufficient number of full-time faculty members to ensure that the faculties are not overloaded with courses and that the program does not become overly dependent on part-time faculty members.

The faculty members should have adequate academic qualifications with specializations in areas closely related to the program(s) offered by the department. The proportion of senior faculty members and junior faculty members should be appropriate. Adequate interaction between students and faculty members both within and outside classes is essential. The teacher-student ratio, class size and teaching load should not compromise opportunities for interaction.

Faculty members should be motivated to improve their pedagogy and assist the students in achieving outcomes. They should be committed to the continuous quality improvement activities of the department. Faculty members should have the responsibility and authority to design and update the curriculum; establish course and program outcomes, and select and use appropriate assessment tools for evaluating student performance in classes and the achievement of outcomes.

Faculty members should be engaged in research, development and professional activities such as consulting. They should also be involved in relevant professional societies. The results of these activities should benefit the students. The institution or department should periodically arrange training for the faculty members on outcome- based education and assessment. All the faculty members should be adequately trained on how to establish course outcomes, conduct teaching-learning activities that are appropriate for the outcomes and assess the level of outcome achievement.

4.4 Students

There should be a published policy for the admission and transfer of students into the program. The admission or transfer requirements should be appropriate for the selection of students with the potential to achieve the program's outcomes. The policy should be implemented in practice. Transfer students must also show the attainment of program outcomes from courses in the institution.

Students' academic performance should be continuously monitored in terms of the achievement of outcomes, and feedback should be provided to the students. There should be provisions for remedial or corrective measures when necessary. Every student should be assigned an advisor. The advisor should counsel, guide and mentor the student on all academic and professional matters.

Students should have opportunities to participate in extra- and co-curricular activities and the activities of relevant professional societies. The institution should ensure the participation of a significant number of students.

4.5 Academic Facilities and Technical Support

The institution should have a well-stocked library. The books, e-books, journals and other resources available in the library should be adequate for the program and the faculty members. The number of classrooms available should be adequate to properly run the program. The classroom facilities and the environment should be conducive to learning.

The number of labs and equipment should be adequate for conducting the program's various laboratory courses. Every student should have the opportunity for hands-on activity in the laboratories. Each lab should have adequate safety and health measures.

Students and faculty members should have access to adequate computing and Internet facilities, including hardware, software tools and support.

4.6 Curriculum and Teaching-Learning Processes

The curriculum should satisfy the relevant program-specific criteria described in Section 6.

The breadth and depth of the curriculum and the teaching-learning activities should be appropriate for solving complex engineering problems in the relevant discipline. The curriculum should contain an adequate number of courses on mathematics, physical science, humanities and non-engineering subjects. The teaching-learning processes and activities selected for each course should be effective and appropriate for achieving the outcomes. Student participation and learning should be enhanced. Hands-on activities in the lab should be an integral part of teaching and learning. The program should include adequate activities in the lab.

The program should demonstrate the culmination of program outcomes (POs) at the level of solving complex engineering problems, preferably through a final-year design project or capstone project extending over a period of one year.

4.7 Program Educational Objectives

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. PEOs are assessable based on the attributes and accomplishments of graduates, preferably those who have worked for 3 to 5 years after graduation. Each engineering program should have published PEOs that are clear, concise, assessable and realistic within the context of the available resources. The PEOs should be consistent with the vision and mission of the department offering the program. They should be supported by a curriculum and teaching-learning processes that lead to the attainment of these objectives. Justifications should be provided for how the curriculum and the outcomes contribute to the attainment of the PEOs.

A process should be developed to assess the level of attainment of each PEO to evaluate the academic program's effectiveness. Adequate evidence and documentation on the assessment of PEO attainment should be provided. The assessment tools should be indicated, and the way in which these tools are used should be explained. PEO assessment should lead to the periodic review of PEOs. Feedback from the various program stakeholders, including employers, alumni, students and faculty, should be considered during the review.

4.8 Program Outcomes and Assessment

Program Outcomes (POs) or graduate attributes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These statements relate to the knowledge, skills and attitudes acquired by students while progressing through the program. The program must demonstrate that by the time of graduation, students have achieved an acceptable minimum level of certain knowledge, skills and behavioral traits. The BAETE specifically requires that students acquire the following graduate attributes:

- **(a) Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.

- **(b) Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)

(c) **Design/development of solutions**: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)

(d) **Investigation:** Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

(e) **Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)

(f) **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)

(g) **Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)

(h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)

(i) **Individual work and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

(j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(k) **Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

(l) **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

In addition to incorporating the above-listed POs (graduate attributes), the educational institution may include additional outcomes in its learning programs. An engineering program that aims to attain the abovementioned POs should ensure that its curriculum encompasses all the attributes of the Knowledge Profile (K1 – K8) as presented in Table 4.1 and as included in the PO statements. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are given in Tables 4.2 and 4.3, respectively.

Table 4.1: Knowledge Profile

	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

Table 4.2: Range of Complex Engineering Problem Solving

Attribute	**Complex Engineering Problems** have characteristic P1 and some or all of P2 to P7:
Depth of knowledge required	P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	P2: Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	P5: Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder	P6: Involve diverse groups of stakeholders with widely varying involvement and conflicting requirements needs
Interdependence	P7: Are high level problems including many component parts or sub-problems

Table 4.3: Range of Complex Engineering Activities

Attribute	**Complex activities** means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying Principles-based approaches

The program should describe the process involved in defining and refining the POs. The correlation between the course outcomes (COs) and POs should be demonstrated through the mapping of COs onto POs.
The way in which each attribute of the Knowledge Profile (K1 – K8) is addressed in the curriculum should be demonstrated through mapping. The program should also demonstrate how each attribute of the Range of Complex Engineering Problems (P1 – P7) and Complex Engineering Activities (A1 – A5) is incorporated in the teaching, learning and assessment.

For each course, a course file must be maintained. The course file should include the assessment of outcomes, curriculum, and examination questions and answer scripts, the results of other assessments, and a summary of performance and attainment of course outcomes with suggestions or feedback for future development.

POs should be assessed using direct methods. Direct methods of assessment are accomplished through the direct examination or observation of students' knowledge or skills against measurable performance indicators or rubrics. In addition, indirect methods may also be used for PO assessment. Indirect methods of assessment are based on opinions or self-report from different stakeholders. The way in which various assessment tools, including examinations and rubrics, contribute to the evaluation of attainment of each PO should be described. The results of the evaluation of PO attainment should be shown.

4.9 Continuous QualityImprovement

The program should have a continuous quality improvement mechanism. It should demonstrate an established system for periodically compiling the level of attainment in terms of PEO, including a mechanism for tracking and obtaining feedback from graduates and their employers. The outcomes of these exercises should be evaluated, and the identified shortcomings and limitations should be used to refine and improve the program.

POs should be assessed on a regular cycle. The program should prepare CQI file for each of the 12 POs to review. Each teaching module should have clear quality requirements and facilitate the achievement of COs through teaching and evaluation methods. Students should provide feedback in every course on the appropriateness of the COs, course content, delivery of content, assessment and the attainment of the COs. The concerned course instructor should prepare course review reports including CQI files for the courses he/she is teaching. The program should also evaluate the curriculum and teaching quality on a regular basis while considering feedback from faculty members and students. The program should demonstrate that the results of this periodic evaluation are used for continuous improvement.

4.10 Interactions with the Industry

A communication channel between the educational institution and the industry should be in place. The industry should be encouraged to provide feedback concerning the quality of the teaching-learning process. There must be industry participation in the development of the curriculum to ensure that it is relevant, regularly updated, and meets the needs of the industry, particularly in areas experiencing rapid changes. An engineering program should have an Industry Advisory Panel (IAP) and an alumni association (AA) for this purpose. The IAP or AA may meet at certain intervals with the department to provide feedback.

The program should provide students with the opportunity to obtain industrial experience through internships, industry visits or design projects conducted by practicing engineers and faculty members with industrial experience.