DEPARTMENT OF SHIP TECHNOLOGY

B.Tech And B.Tech (Honours) Degree Programme In

NAVAL ARCHITECTURE & SHIPBUILDING

(8 SEMESTER DURATION) WITH EFFECT FROM 2024 UNDER OBE SYSTEM

Regulations

Program Structure

&

Detailed Syllabus

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

Kalamassery, Cochin – 682022 Kerala, India

Phone: 0484 – 2577290

Fax: 084-2577550

Web: www.cusat.ac.in

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF SHIP TECHNOLOGY
COCHIN - 22

12.12.23
HEAD OF THE DEPARTMENT
SHIP TECHNOLOGY

REGULATIONS FOR B. Tech AND B. Tech (HONOURS) DEGREE PROGRAMME IN NAVAL ARCHITECTURE & SHIP BUILDING

1. **Programme of Study:**

1.1 The Programme for the B. Tech degree shall extend over a period of four academic years comprising eight semesters each of four months duration (approx.16 weeks).

1.2 The programme of study shall follow credit system and will be in accordance with the scheme, course content and syllabus prescribed. **The total credit for the entire course shall be 180.**

Additional credits to be earned by students opting for B.Tech (Honours) shall be 16 (total 196 credits)

1.3 The programme of instruction shall consist of the following:

1.3.1 Humanities and management courses, Basic science courses, basic engineering courses, professional core courses, professional electives and industrial electives related to Naval Architecture and Shipbuilding.

1.3.2 Workshop practice, laboratory works, Internship, Project work

1.3.3 Mandatory Non-Credit course in Environmental studies

1.3.4 At least one elective course with minimum 2 credits as MOOC courses, hosted in SWAYAM platform/ offered by CUSAT/ platforms in online mode by other post graduate institution in INDIA or abroad, be taken by students after approval from Department Council (DC).

1.3.5 Elective courses (In house electives /Industrial electives /Open electives) enable the students to opt for specialised courses related to the profession. The electives will be identified and approved by the DC before commencement of courses.

1.3.6 The industrial elective will be offered jointly with an industry. The evaluation will be done jointly with the industry in a method mutually agreed upon.

1.4 Training and regular visits to the industry will also form part of the programme. Every academic year, except in the final year, the students will undergo internship for a period of 4 - 6 weeks duration in shipyards, ship repair firms and related industries. Credits for the internship will be counted in the subsequent odd semesters (i.e., III, V or VII semesters).

2. Eligibility for the B.Tech Degree:

2.1 No candidate shall be eligible for the B. Tech Degree in Naval Architecture and Shipbuilding unless he / she has undergone the prescribed programme of study for a period not less than 4 academic years from the date of admission to the first semester and has passed the prescribed examinations in all the semesters.

2.2 A Student should complete the prescribed programme of study within eight academic years from date of first admission to the programme.

2.3 Each student shall secure 180 credits for the completion of the undergraduate program and award of BTech degree.

3 Rules regarding Attendance:

3.1 Every candidate is required to secure a minimum of 75% attendance overall considering all the subjects in the semester to be eligible for appearing for the University examinations.

3.2 The Vice Chancellor shall have the power to condone shortage of attendance up to 10 percent on medical grounds on the recommendation of the Head of Department. However, such condonation for shortage of attendance shall be given only twice during the entire programme.

4 Rules for Examination:

4.1 Internal Assessment: -

4.1.1 All sessional works shall be evaluated and marks shall be awarded on the basis of day-to day work, periodic tests and regular assignments based on the scheme of evaluation as decided by the Department Council.

4.1.2 The total sessional marks for theory and laboratory courses shall be made up of 50% for internal tests (minimum two tests), 40% for assignments / quizzes / seminars and 10% for attendance. However, the teachers, depending upon the specific requirements of the subjects, can make changes in the distribution with the permission of the Head of the Department. Marks for attendance shall be awarded as follows:

% of Attendance	Marks Awarded
96-100	10
91–95	8
86–90	6
81–85	4
75–80	2
below 75	0

4.1.3 There will be no continuous assessment mark for online courses. The total marks for the course will be assigned as end semester marks out of 100 against the course.

4.1.4 A candidate shall be allowed to improve internal assessment marks in theory/laboratory courses prior to or after the course completion, subject to the following conditions: -

- The candidate shall be allowed to improve the internal assessment marks in a particular course only once.
- The candidate shall not be allowed to improve the internal assessment marks of any course if the candidate has already passed the course.
- Moderation of marks given during the final pass board of any semester will not be applied to the internal assessment marks.

4.2 External Assessment: -

4.2.1 The University Examination shall be conducted at the end of every semester in the courses as prescribed under the course content.

4.2.2 To pass in a course, a candidate has to score not less than 45% of the marks in the University examination and not less than 50% aggregate marks in the University examination and sessional marks put together.

4.2.3 In courses where there are no University examinations, a candidate has to score not less than 50% sessional marks for a pass in that course.

4.2.4 A student should score a minimum of 50% marks to get a pass in the registered online course irrespective of the pass percentage specified by the host institution. Those who fail to get 50% marks will have to repeat the same online course or do another online course with the approval of department council. No internal exam /makeup exam / supplementary exam will be conducted by the department for online courses.

5 Rules for Promotion:

5.1 A student will be eligible to be promoted from one semester to the next semester only if the candidate has secured a minimum of 75% attendance overall

5.2 Each candidate shall register for the examination at the end of each semester.

5.3 A candidate shall not register for the n^{th} semester examination without registering for $(n-1)^{th}$ semester

5.4 To get promotion from the n^{th} semester to the $(n+1)^{th}$ semester, a candidate has to pass the $(n-3)^{th}$ semester in full. This rule shall be applicable for promotion from fourth semester (i.e., n = 4) onwards.

6 Rules for B.Tech (Honours):

6.1 Honours is an additional credential a student may earn if he/she acquires the extra 16 credits apart from the credits required for the B.Tech program. B.Tech students with a minimum CGPA of 8.0 and above obtained in the first attempt in the first and second years combined are eligible to register for B.Tech. (Honours).

6.2 The CGPA of the candidate at the end of eighth semester shall be 8.0 or higher to be eligible for the award of B. Tech. (Honours).

6.3 The B.Tech. (Honours) registration shall be along with the registration of the 5^{th} semester.

6.4 If a student fails in any course of the B.Tech. programme or the courses chosen for B.Tech. (Honours), he/she shall not be eligible to continue the B.Tech. (Honours).

6.5 The student shall earn a minimum of additional 16 credits from the courses chosen for B.Tech. (Honours), to be eligible for the award of B.Tech. (Honours) Degree.

6.6 For CGPA calculation of B.Tech. programme as per the provision of section 8, the credits earned by the student for his/her Honours programme will not be considered.

6.7 There shall be no transfer of credits from courses of Honours programme to regular B. Tech. programme and vice versa.

6.8 All additional 16 credits shall be earned through successfully completing the Courses/mini projects in the 5^{th}, 6^{th} , 7^{th} and 8^{th} semesters. The break up of credits and broad area for the projects shall be carried out as follows (details shall be specified in the syllabus for the respective semesters). Students are encouraged to carry out mini projects from Industries/ Research Institutions also.

Semester	Title	Credits	Description
V	**Course I (H)**	**3**	To be completed in core areas as MOOC courses, hosted in SWAYAM platform/ offered by CUSAT in offline/online mode after approval from Department Council (DC)
VI	**Course II (H)**	**3**	
VII	**Mini Project I (H)**	**5**	Broad Areas: Fluid Mechanics, Stability, Material Science, Applied Mechanics, Thermal Engineering, Ship Dynamics (Powering, Ship Motions, Controllability), Electrical/ Control Systems in Ships/ Shipyards, Marine Engineering
VIII	**Mini Project II (H)**	**5**	Broad Areas: Numerical Analysis (FEA or CFD), Marine Hydrodynamics, Ship Design, Green Technology, Ship Production, Heating Ventilating and Airconditioning (HVAC) system design.

6.9 Credits for the B.Tech.(Honours) courses are deemed to be earned only on getting a "C" grade or better as per the provisions of section 8.1.

6.10 The maximum number of additional credits a student can register (course registration) in a semester is limited to 6 credits in excess of the mandatory credits allotted in the curriculum for that semester.

6.11 The assessment of the mini projects for earning credits shall be carried out by a department committee consisting of at least three faculty members. Representative from industry/Research Institutions also to be included in the committee in the case of an external projects.

6.12 B.Tech. (Honours) Degree shall be awarded by the University to the students who fulfill all the academic eligibility requirements for the B.Tech. and B.Tech. (Honours) programme.

6.13 Students opting for B.Tech. (Honours) have to pay requisite fees for additional courses.

7 Rules for Readmission:

7.1 A Student who is unable to attend classes on medical or other genuine grounds may be readmitted to the respective semester along with the subsequent batch.

7.2 A student seeking readmission shall give a written application to the Head of the Department, sixty days prior to the commencement of the semester to which readmission is sought.

7.3 A Student who has been removed from the nominal rolls due to default in payment of the semester fees shall be readmitted subject to the following conditions:

- The Head of the Department can readmit the student within 10 days from the last date of payment of the semester fees.
- Thereafter the University may accord sanction for readmission.
- Readmission can be given only if the student can secure a minimum of 75% attendance in each course meeting the eligibility to register for the University examination of the respective semester.

8 Grading:

8.1 Grades shall be awarded to the candidates in each course based on the total marks obtained in the internal and external assessments as follows:

Marks obtained (Percentage)	**Grade**	**Grade Points**
90-100	S	10
80 to less than 90	A	9
70 to less than 80	B	8
60 to less than 70	C	7
50 to less than 60	D	6
Less than 50	F	0

8.2 A student is considered to have credited a course or earned credits in respect of the course if the student secures a grade other than F for that course.

8.3 Grade Point Average (GPA):

a.) The academic performance of a student in a semester is indicated by the Grade Point Average (GPA)

$$\text{GPA} = \frac{G1C1+G2C2+G3C3+\cdots\ldots\ldots GnCn}{C1+C2+C3+\cdots\ldots\ldots\ldots\ldots Cn}$$

where G refers to the grade point and C refers to the credit value of corresponding course undergone by the student.

b) The cumulative Grade Point Average (CGPA) will be calculated as

$$\textbf{CGPA} = \frac{S1T1+S2T2+S3T3+\cdots\ldots SnTn}{T1+T2+T3+\ldots\ldots\ldots\ldots Tn}$$

where 'S' refers to the Grade Point Average, 'T' refers to the total credits in that semester.

8.4 Grade Card:

The Grade Card issued at the end of the semester to each student by the Controller of Examinations, will contain the following: -

a. The code, title, number of credits of each course registered in the semester, marks (internal, external, total, month & year of passing the subject)
b. The letter grade obtained (grade number)
c. The total number of credits earned by the student upto the end of that semester
d. GPA & CGPA (CGPA for final semester only)
e. Details of Honours courses passed

9 Overall Classification:

9.1 ***B.Tech First Class with Distinction***: - Candidates who qualify for the Degree passing all the examinations within 4 academic years after the commencement of the programme of study and securing a CGPA of 8 and above. However, if a candidate has a CGPA of 8 and above, but is not able to complete within 4 years , such candidate is eligible to be classified as First class only.

9.2 ***B.Tech First Class: -*** Candidates who qualify for the Degree passing all the examinations within 8 academic years after their commencement of the programme of study and securing a CGPA of 6.5 and above.

9.3 ***B.Tech Second Class:*** Candidates who qualify for the Degree passing all the examinations within 8 academic years after the commencement of the programme of study and securing a CGPA of 6 and above but less than 6.5.

9.4 ***B.Tech (Honours):*** Candidate who qualify for B.Tech First Class with Distinction and satisfy all the conditions as per section 6.

10 Revision of Regulation and Curriculum:

The University may from time-to-time revise, amend or change the Regulations, Curriculum, Scheme of Examination and Syllabus.

MISSION AND VISION

VISION

To evolve into a globally recognized department in the frontier areas of Naval Architecture and Ship Building.

MISSION

As a department, we are committed to

- Achieve academic excellence in the field of Naval Architecture and Ship Building through innovative teaching and learning processes.
- To prepare the students to be professionally competent to face the challenges in academics, industry and research.
- Promote inter-disciplinary research among the faculty and the students to create state of art research facilities.
- To promote quality and ethics among the students.
- Motivate the students to acquire entrepreneurial skills to become global leaders.

Program Educational Objectives (PEOs)

It is expected that students of B.Tech Naval Architecture & Ship Building will have acquired certain characteristics which will enable them utilize it in their careers. They are:

PEO 1	Utilizing strong technical aptitude and domain knowledge **to develop smart solutions for design and construction** of marine vehicle and structure and consequently **contribute to the economic progress** and general the upliftment of society.
PEO 2	Applying **research and entrepreneurial skills** augmented with a rich set of communication, teamwork and leadership skills to excel in their profession.
PEO 3	Showing **continuous improvement** in their professional career through life-long learning, appreciating human values and ethics.

Program Outcomes

Engineering Graduates will be able to:

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, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and 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 the public health and safety, and the cultural, societal, and environmental considerations.

PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the 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 modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**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.
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 and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**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.

Program Specific Objectives (PSOs)

On completion of Naval Architecture and Shipbuilding Programme, the NA & SB graduates are expected to:

PSO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in the solution of complex Naval Architecture and shipbuilding problems.
PSO 2	**Problem analysis**: Identify, formulate, review research literature, and analyse complex Naval Architecture and shipbuilding problems to reach substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO 3	**Design/development of solutions**: Design solutions for complex Naval Architecture and shipbuilding problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental factors
PSO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

Bloom's Category Assessment for Course Outcome

Level	Description	Sample
Remember	Recognizes students 'ability to use rote memorization and recall certain facts	Define, cite, name, recall, list, state, write
Understand	Involves students 'ability to read course content, understand and interpret important information and put other 's ideas into their own words	Describe, explain, identify, summarise, discuss, outline
Apply	Students take new concepts and apply them to another situation	Demonstrate, illustrate, interpret, solve, use, examine
Analyze	Students have the ability to take new information and break it down into parts to differentiate between them	Compare, contrast, distinguish, examine, identify, categorise, investigate
Evaluate	Involves students 'ability to look at someone else's ideas or principles and see the worth of the work and the value of the conclusions	Appraise, defend, support, value, justify, assess, inspect, recommend
Create	Students are able to take various pieces of information and form a whole creating a pattern where one did not previously exist	Assemble, construct, design, develop, create, plan, invent, synthesise

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

Total credits for completing B.Tech in Naval Architecture and Ship Building: 180.

Additional Credit requirement for BTech Honors in Naval Architecture and Ship Building:16

The structure of B. Tech programme in Naval Architecture and Ship Building shall have the following **Course Categories**:

Sl. No.	Course Category	Number of Courses	Credits
1	Basic Science Courses **(BSC)**	**6**	**18**
2	Engineering Science Courses **(ESC)**	**19**	**52**
3	Humanities & Management Courses **(HMC)**	**3**	**4**
4	Professional Core Course **(PCC)**	**26**	**90**
5	Professional Elective Course **(PEC)**	**4**	**16**

COURSE REQUIREMENTS

The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of one-hour duration)

T: Tutorial (One unit is of one-hour duration)

P: Practical (One unit is of one-hour duration)

PROGRAMME STRUCTURE

SEMESTER I

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0101	Technical Communication	HMC	2	1	1	4	2	100	100	200
24-215-0102	Mathematics I	BSC	3	1		4	3	100	100	200
24-215-0103	Engineering Physics	BSC	3	1		4	3	100	100	200
24-215-0104	Introduction to Naval Architecture	PCC	3	1	1	5	3	100	100	200
24-215-0105	Engineering Mechanics	ESC	3	1		4	3	100	100	200
24-215-0106	Programming in Engineering	ESC	2	1	2	5	3	100	100	200
24-215-0107	Workshop Practice I	ESC			4	4	2		50	50
Total			**16**	**6**	**8**	**30**	**19**	**600**	**650**	**1250**

SEMESTER II

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0201	Mathematics II	BSC	3	1		4	3	100	100	200
24-215-0202	Basic Ship Theory	PCC	3	1	1	5	3	100	100	200
24-215-0203	Electrical Engineering	ESC	3	1		4	3	100	100	200
24-215-0204	Mechanics of Solids	ESC	3	1		4	3	100	100	200
24-215-0205	Engineering Graphics	ESC	2	2	1	5	3	100	100	200
24-215-0206	Engineering Chemistry	BSC	3	1		4	3	100	100	200
24-215-0207	Workshop Practice II	ESC			4	4	2		50	50
Total			**17**	**7**	**6**	**30**	**20**	**600**	**650**	**1250**

SEMESTER III

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0301	Mathematics III	BSC	3	1		4	3	100	100	200
24-215-0302	Fluid Mechanics I	ESC	3	1		4	3	100	100	200
24-215-0303	Professional Ethics and Universal Human Values	HMC	2	1		3	2	100	100	200
24-215-0304	Instrumentation	ESC	3	1		4	3	100	100	200
24-215-0305	Analysis of Structures	ESC	3	1		4	3	100	100	200
24-215-0306	Machine Drawing	ESC	1	3		4	3	100	100	200
24-215-0307	Stability of Ships	PCC	3	1		4	3	100	100	200
24-215-0308	Electrical Engineering Lab	ESC			3	3	2		50	50
24-215-0309	Internship	PCC					2		50	50
Total			**18**	**9**	**3**	**30**	**24**	**700**	**800**	**1500**

SEMESTER IV

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0401	Mathematics IV(Numerical Methods in Engineering)	BSC	3	1		4	3	100	100	200
24-215-0402	Resistance of Ships	PCC	3	1		4	3	100	100	200
24-215-0403	Fluid Mechanics II	ESC	3	1		4	3	100	100	200
24-215-0404	Design of Machine Elements	ESC	2	2		4	3	100	100	200
24-215-0405	Applied Thermodynamics	ESC	3	1		4	3	100	100	200
24-215-0406	Materials Science	ESC	3	1		4	3	100	100	200
24-215-0407	Fluid Mechanics Lab	ESC	1		2	3	2		50	50
24-215-0408	Model Making Techniques Lab	PCC			3	3	2		50	50
Total			**18**	**7**	**5**	**30**	**22**	**600**	**700**	**1300**

SEMESTER V

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0501	Propulsion of Ships	PCC	3	1		4	3	100	100	200
24-215-0502	Ship Motions in Seaway	PCC	3	1		4	3	100	100	200
24-215-0503	Marine Engineering	PCC	3	1		4	3	100	100	200
24-215-0504	Ship Structural Analysis I	PCC	3	1		4	4	100	100	200
24-215-0505	Structural Design of Ships	PCC	3	1		4	4	100	100	200
24-215-0506	Marine Hydrostatics & Hydrodynamics Lab	PCC			4	4	2		50	50
24-215-0507	Material Testing Lab	ESC			4	4	2		50	50
24-215-0508	Environmental Studies	HMC	1	1		2	0		50	50
24-215-0509	Internship	PCC					2		50	50
Total			**16**	**6**	**8**	**30**	**23**	**500**	**700**	**1200**
24-215-0510	Course I (H)	PCC					3	100		100

SEMESTER VI

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0601	Joining Techniques in Ship building Technology	PCC	3	1		4	3	100	100	200
24-215-0602	Controllability of Ships	PCC	3	1	1	5	3	100	100	200
24-215-0603	Ship Production Technology	PCC	3		1	4	4	100	100	200
24-215-0604	Ship Design	PCC	3	1	1	5	3	100	100	200
24-215-0605	Electrical Systems on Ships and Shipyards	ESC	3	1		4	3	100	100	200
24-215-0606	Ship Structural Analysis II	PCC	3	1		4	4	100	100	200
24-215-0607	Marine Engineering Lab	PCC	1		3	4	2		50	50
Total			**19**	**5**	**6**	**30**	**22**	**600**	**650**	**1250**
24-215-0608	Course II (H)	PCC					3	100		100

SEMESTER VII

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0701	Ship Production Management	PCC	3	1		4	4	100	100	200
24-215-0702	Practical Ship Design	PCC	3	1		4	3	100	100	200
24-215-0703	Computational Hydrodynamics and Structural Engineering	PCC	3	1		4	3	100	100	200
24-215-0704	Project Work Phase I	PCC	2	2	6	10	6		400	400
24-215-0705	Internship	PCC				0	2		50	50
	Elective I	PEC	3	1		4	4	100	100	200
	Elective II	PEC	3	1		4	4	100	100	200
Total			**17**	**7**	**6**	**30**	**26**	**500**	**950**	**1450**
24-215-0714	Mini Project I **(H)**	PCC			5	5	5		100	100

List of Electives Semester VII

24-215-0706 Marine Corrosion and Prevention

24-215-0707 Design of Fishing Vessels

24-215-0708 Refrigeration and Airconditioning of Ships

24-215-0709 Offshore Structure Design

24-215-0710 Ship Recycling

24-215-0711 Maritime Engineering Contracts and Commercial Management

24-215-0712 Composite Boat Design

24-215-0713 Computer Aided Design & Drafting

SEMESTER VIII

Subject Code	Subject	Category	Hrs / Week				Credit	Marks		
			L	T	P	Total		University	Internal	Total
24-215-0801	Special Problem & Seminar	PCC		2		2	2		50	50
24-215-0802	Project Work Phase II & Viva	PCC	8	2	10	20	14	300	500	800
	Elective III	PEC	3	1		4	4	100	100	200
	Elective IV	PEC	3	1		4	4	100	100	200
Total			**14**	**6**	**10**	**30**	**24**	**500**	**750**	**1250**
24-215-0810	Mini Project II **(H)**	PCC			5	5	5		100	100

List Of Electives Sem VIII

24-215-0803 Experimental Techniques on ships and models

24-215-0804 Finite Element Methods and Applications

24-215-0805 Ship Repairing and Surveying

24-215-0806 Marine Pollution Prevention and Management

24-215-0807 Inland water Transport

24-215-0808 Artificial intelligence in marine Technology

24-215-0809 Advanced Computational Fluid Dynamics in Marine Technology

Total Credits:	**180**
Total Internal Exam mark:	**5850**
Total university Exam Mark:	**4600**
Grand Total marks:	**10450**
Additional credit for Honors:	**16**

SYLLABUS

SEMESTER I

24-215-0101 TECHNICAL COMMUNICATION

Course Description: To provide an overview on the importance of communication and to improve soft skills of students.

24-215-0101	Technical Communication	Category	L	T	P	Credit	Year of Induction
		HMC	2	1	1	2	2024

Pre-requisites: Nil

Course Objectives: To provide knowledge on effective technical communication methods and to provide a platform for improving soft skills

Course outcome: After the completion of the course the students will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyse, interpret and effectively summarize a variety of textual content
CO 3	Students will able to know how to read a journal paper
CO 4	Students will able to write a scientific paper
CO 5	Students will able to effectively communicate with scientific and professional society

Mapping of course outcomes with PO: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1								3			3
CO 2	1								2			3
CO 3	2											
CO 4	2	1										1
CO 5	1							2				2

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	20
Understand	10	10	50
Apply	25	25	30
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content

Module I

Fundamentals of Technical Communication: Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication

Module II

Forms of Technical Communication:

Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Key-Note Speech: Introduction & Summarization; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Module III

Technical Presentation, Strategies & Techniques: Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module IV

Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non-verbal means.

Module V

Kinesics: Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation; Pronunciation; Articulation; stress & accent; Linguistic features of voice control: Vowel & Consonant Sounds.

LIST OF PRACTICALS TO BE CONDUCTED WITH THE RESPECTIVE MODULES.

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics/Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.

References:

1. Clifford Whilcomb & Leslie E, Effective inter-personal and team communication skills for engineers, Whilcomb Woley -IEEE press, 2013.
2. Johnson Eilola & Stuart, A Selber: Solving Problems in Technical Communication, University of Chicago Press, 2012.
3. Meenakshi Reman & Sangeetha Sharma: Technical Communication: Principles and Practice, Third Edition - Principles and Practice, OUP India,2015
4. Paul. J.Silvia, How to Write a Lot: A Practical Guide to Productive Academic Writing, American Psychological Association, 2007
5. Gustavii Bjorn,How to Write and Illustrate a Scientific Paper, Cambridge University Press
6. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
7. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
8. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
9. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.

24-215-0102 MATHEMATICS I

Course Description: Mathematics 1 subject gives the knowledge regarding trace standard curves in engineering practice and their properties and to learn about hyperbolic functions, series expansion of function and concept and application of partial differentiation.

24-215-0102	Mathematics I	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	0	3	2024

Pre-requisites: Knowledge of trigonometric functions and trigonometric identities, Differentiation, Curve tracing.

Course objectives: This course introduces the concepts and applications of Partial differentiation, Hyperbolic functions and Standard curves in engineering practice. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include Differentiation of nth order, Taylor and Mac Lauren ‘s Series, Euler ‘s Theorem on homogeneous function, Error approximation which are invaluable for any engineer ‘s mathematical tool box. The topics treated in this course have applications in all branches of engineering

Course outcome: After the completion of the course the students will be able to

CO 1	Learn the properties of hyperbolic functions
CO 2	Compute Taylor and Mac Lauren Series of different functions and learning Leibnitz Rule of Differentiation
CO 3	Co-ordinate systems – Polar coordinates in plane, Cylindrical and Spherical polar coordinates in space. Familiarize with important curves in engineering practice
CO 4	Learn about curvature. Method of finding Envelopes and evolutes of curves
CO 5	Compute Partial Derivatives of functions of two variables and applications.

Mapping of course outcomes with PO: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1				2	1					2
CO 2	3	1										
CO 3	2	2		2	1							2
CO 4	2	2	1	1	2							1
CO 5	3	2	2	1		2	2					1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Hyperbolic functions: Definitions, Relation between Hyperbolic and Circular functions Formulae for Hyperbolic functions, Inverses expressed as logarithms. Derivatives and Integrals of Hyperbolic functions, Series for Sinh x and Cosh x

Module II

Leibnitz 's rule for finding nth derivative, Standard forms, Taylor 's and Mac Lauren 's series

Module III

Introducing Polar coordinates, Cylindrical and Spherical polar coordinates. Standard curves in engineering practice such as conics, cycloids, hypocycloids, catenaries. Lemniscates, cardioids. Tangents & normals.

Module IV

Envelopes, Curvature, Centre of Curvature, Radius of Curvature. Evolutes viewed both as locus of Centre of curvature and envelope of normal.

Module V

Partial derivatives. Euler 's theorem on homogeneous functions. Total derivative, Jacobians Errors and approximations, Maximum and Minimum of functions of two variables

References:

1. Kreyzig, E.; Advanced Engineering Mathematics, Wiley, New York, 2011.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, New Delhi, 201
3. John Bird, Higher Engineering Mathematics, Rowlledge, 2010.
4. Calculus and Analytical Geometry, George B.Thomas, Ross L. Finny (Pearsson, ninth Edition)
5. R.K.Jain, S.R.K Iyengar, Advanced engineering mathematics, Narosa, 2011

24-215-0103 ENGINEERING PHYSICS

Course Description: The aim of the Engineering Physics is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

24-215-0103	Engineering Physics	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	-	3	2024

Pre-requisites: Higher Secondary Level physics and Mathematics at the plus two levels in schools.

Course Objectives: This is an introductory course, designed to provide the fundamental concepts of physics. To describe fundamental aspects of physics and its and applications to engineering field.

Course outcome: After the completion of the course the students will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment.
CO 3	Apply the comprehended knowledge about laser and holography, Ultrasound waves into possible applications in engineering fields.
CO 4	Understand the concepts of fibre optic communication system
CO 5	Understand the behavior of matter in the atomic and subatomic level to perceive the microscopic processes in electronic devices i.e., dielectric and superconducting applications.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2										1
CO 2	2	2				1						1
CO 3	2	1				1						1
CO 4	2	1				1						1
CO 5	2	1				1						1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Oscillations and Waves: Harmonic oscillations, damped harmonic motion-Derivation of differential equation and its solution, over damped, critically damped and Under damped Cases, Quality Factor-Expression, Forced Oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators.

Wave motion- Derivation of one-dimensional wave equation and its solution, Three-dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration.

Module II

Acoustics & Ultrasonics: Acoustics, Classification of sound-Musical Sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies.

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid, Applications of ultrasonic waves -SONAR, NDT and Medical.

Module III

Coherence and Lasers: Spatial and temporal coherence-coherence length-spontaneous emission-stimulated emission- population inversion- CW & pulsed Laser, typical laser systems like Helium-Neon, Nd, YAG,

Ruby, Semi-conductor lasers. Applications of lasers, Principle of holography-reflection and transmission type, Recording and reconstruction, Applications of holography-white light holograms.

properties and application, Recording and reproduction of sound- Magnetic tape recording-sound recording on cine films

Module IV

Fibre optics and its applications: General ideas of optical fibre- NA of fibre-step index and graded index of fibres, multimode and single mode fibres, applications of optical fibres, fibre optic communication, optical fibre sensors, general ideas of integrated optics.

Module V

Crystallography and lattice planes: Crystallography-space lattice, unit cell-crystal systems-simple cubic-body centred and face centred cubes. Lattice planes and Miller indices, spacing between lattice planes, powder method for crystal study. Dielectrics: Types and applications. Superconductivity: Transition temperature, Meissner Effect-Isotope effect, Type I and type II-superconductors- B.C.S. theory (qualitative study), High temperature super conductivity (General idea), Josephson effect, SQUIDS.

Introduction to Quantum mechanics, wave nature of particles, Uncertainty principle, Introduction to nanoscience and technology, properties of nanomaterials, Applications of nanotechnology (Qualitative ideas).

References:

1. Theraja, Modern physics, S Chand, 2013.

2. Charles Kittel, Solid State Physics, Wiley, 2012.

3. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015.

4. Ajoy Ghatak, Optics, McGraw Hill, 2012.

5. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.

6. Steve Cook, Interference, Double dare Publishers, 2014

7. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017.

8. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016.

9. Bhavikatti, S.S. Solid State Physics, 7,PB 499, New age Publication,2019.

10. Sharma, S.S. Engineering Physics: Theory and Experiments, 3, PB 360 New age Publication, 2018.

24-215-0104 INTRODUCTION TO NAVAL ARCHITECTURE

Course Description: The objective of the course is to provide the learners with a broad appreciation of the science and art of Naval Architecture. Emphasis is given to define the subject in physical rather than mathematical terms. The learners would be able to have a clear understanding of the basic concept of a ship, underlying principles involved, definition of its geometry and various elements that constitute the ship as a whole, thus laying the foundation for more in depth studies in future.

24-215-0104	Introduction To Naval Architecture	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	1	3	2024

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the basic terms, datums, dimensions, features and motions associated with ships and naval architecture
CO 2	Explain physical fundamentals of Naval Architecture, basic properties of ship and hull form, such as buoyancy, displacement and form co-efficients, and solve problems related to that
CO 3	Draw a faired Lines plan from an Offset table, and visualize the 3-D form of a ship from a Lines Plan
CO 4	Explain the evolution of ships - types of hull material, types of propulsion gear and power sources, types of ships, and types of hull forms.
CO 5	Explain the different Elements of a ship related to Structure, Spaces, Systems Equipment. Machinery, the Role of a Naval Architect in the Maritime Industry and the various organisations in the Maritime domain.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	3	2	2	1	1							
CO3	3	3	2	1	3							
CO4	2	1	1									
CO5	2	2	1	1	1	3	3					3

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content

1. Module I

Naval Architecture Terminology: Ship Terms – Centreline, Port, Starboard, Midships, Fwd, Aft, Inboard, Outboard, Bow, Beam, Quarter, Stern, Astern, Ahead, Knots, Nautical Mile, Port of Call, Port of Registry ; **Datums**-Reference Directions (Longitudinal, Transverse), Reference Planes (Buttock Plane, Waterplane, Section Plane), Reference Lines (Centreline, Baseline, Waterline(LWL), FP, AP, Midships), **Dimensions** (Moulded, Extreme, Length {L_{OA}, L_{BP}, L_{WL}}, Breadth, Depth, Draft, Freeboard), Draft Marks, Plimsoll Marks, **Features** (Camber, Sheer, Flare, Tumble home, Rise of Keel, Rise of Floor), **Types of Motion** (Translational { Surge, Sway, Heave}, Rotational (Roll, Pitch, Yaw}), **Aspect** (Heel, List, Trim)

Module II

Physical Fundamentals-Definition and Concept: Archimedes Principle, Law of Flotation, Volume, Buoyancy, CoB (LCB,VCB,TCB), Density, Weight, CoG(LCG,VCG,TCG), Displacement, Tonnage (GRT, NRT), Reserve of Buoyancy, Co-efficients of Form (C_B , C_M , C_W , C_P , C_{VP}), Stability (Stable, Unstable, Neutral), Shift of CoG (due to Removal, Addition and Shift of weight, Effect of suspended weight), TPC, LCF, MCT, Effect of density on draft and displacement(Box shaped and ship shaped vessels), Fresh Water Allowance, Maintaining draft when density changes.

Practical: Numerical Problems

3. Module III

Lines Plan: Importance of Ship Geometry, 3D Geometry -Representing 3D objects in 2D views-Orthographic Projection-Orthogonal Planes, Lines Plan: Purpose, Three views -Body Plan, Half Breadth Plan, Sheer Plan or Profile, Three Curves - Stations, Waterlines, Buttocks, Types of Stem and Stern profiles, Offset Table, Drawing tools , Drawing of Border/ Grids and Labelling of Grids, How to Draw Body Plan using Offset Table, How to end stations using Keel Offsets, How to draw Half breadth Plan using Body Plan (using paper strip), How to end waterlines in Half Breadth Plan using Stem and Stern Offsets, How to draw Sheer Plan using Body Plan and Half Breadth Plan, How to draw diagonal, Fairing -Concept, importance and procedure, Title Box, Main Particulars box.

Practical: Lines plan drawing (On Paper and any Drawing Software) from a given offset table and generation of final offset table after fairing.

3. Module IV

Evolution of Vessels : **General** – logs, canoe, rafts, boats, and ships; **Types of Hull Material** - wood, iron, steel, aluminium, GRP/FRP ; **Types of Propulsion Gear and Power sources** – Manual (Oars, poles), Wind (sails), Steam-Fossil fuels-Solar-Nuclear-Electric (paddle wheel, propeller) **Types of Ships**: Passenger(boats, ferry, ocean liner), Fishing Vessels (Trawlers, Seiners, Longliners, Factory Ship), Cargo Vessels (General Cargo, Tanker{Oil, Chemical, Gas}, Bulk Carrier(Ore, Grain, etc), Container, Reefer, RO-RO/Vehicle Carrier, Cattle Carrier, MPGC, SSDCetc.), Warships(Destroyer, Frigate, Aircraft Carrier, Submarine etc), Research/Scientific (Oceanographic, Hydrographic, Seismic, Polar etc.) Pleasure / Adventure (Speed boats, Yacht, Cruise ships etc.), Specialised Vessels(Dredger, Cable /Pipe laying, FPSO, Icebreaker,) Support Vessels (Tugs, AHTS, PSV, DSV, Crane Vessel, FF Vessel, Salvage Vessel etc.) **Types of Hull Form**: Displacement (Monohull, Multihulls{catamaran, SWATH,SWASH etc.}), Dynamic Lift (Planing Hulls{single/multiple chine}, Foil Lift{fully submerged, surface piercing), Air Lift{Air Cushion Vehicle, Wing in Ground Effect Crafts}), Combination Hull forms (Surface Effect Ships etc.)

5. Module V

Elements of Ships and Role of a Naval Architect : Ship Structure and Spaces : Hull- Shell, Deck (Inner Bottom/ Tank top, Main deck,), Bulkhead (Longitudinal, Transverse, Watertight, Non watertight), Single/Double Hull, Stiffeners (Longitudinals{Girders}, Transverses{Beams, Floors}); Superstructure (Bridge, Funnel, Mast etc.); Accommodation spaces (cabins, galley, wash spaces, messes, stores, Doors, Hatches, Porthole, Cargo hold, Engine Room, Tanks(Fuel,FW, LO, Ballast etc.), Underwater fittings (Rudder, Propeller, Stabiliser), **Systems, Equipment and Machinery:** Ventilation, Firefighting (Portable and Fixed), Anchoring Mooring and Towing, Life Saving, Cargo Handling, Propulsion and Auxillary Machinery, Power Generation and Distribution , Piping (Fuel, SW, FW, CW etc.), Insulation(Thermal{hot and cold), Acoustic), Cabling, Communication and Navigation (Lights etc), **Role of a Naval Architect:** Art or Science, Design-Stages of Design(Geometry, Stability, Resistance, Powering, Structure, GA, Seakeeping, Design Spiral), Construction (Time lines, Methods) , Maintenance (Frequency and types) ; -Origin and Purpose of Classification Societies, IMO, MMD and DG Shipping

Reference: -

1. Basic Ship Theory- K.J. Rawson and E.C. Tupper
2. Introduction to Naval Architecture- E.C. Tupper
3. Ship Stability for Masters and Mates- Capt D.R. Derret
4. Ship Stability: Notes and Examples – Kemp & Young
5. Naval Architecture for Marine Engineers - W. Muckle
6. Reed's Naval Architecture for Marine Engineers -EA Stokoe
7. Ships and Naval Architecture – R Munro Smith
8. Ship Design and Construction - SNAME Publication
9. Geometry for Naval Architects - Adrian Biran
10. Ship Hydrostatics and Stability – Adrian Biran
11. Principles of Naval Architecture-Vol 1 Stability and Strength, SNAME Publication
12. The Principles of Naval Architecture Series-The Geometry of Ships, SNAME Publication
13. Ship Construction- DJ Eyres
14. Introduction to Naval Architecture -Thomas C. Gillmer and Bruce Johnson

24-215-0105 ENGINEERING MECHANICS

Course Description: The goal of this course is to expose the students to the fundamental concepts of mechanics and enhances their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

24-215-0105	Engineering Mechanics	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Prerequisite: Nil

Course Objectives: This is an introductory course, designed to provide the fundamental concepts of Engineering Mechanics.

Course Outcomes: After completion of the course, the student will be able to:

CO1	Identify and describe the components of system of forces acting on a given system and determine the equilibrium of a particle using laws of mechanics.
CO2	Comprehend the principles of Coloumb friction and analyze systems that include frictional forces
CO3	Determine the moment of inertia of composite areas.
CO4	Understand the concept of motion of particles and rigid bodies.
CO5	Solve problems involving rigid bodies in general plane motion.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										1
CO2	3	3					1					1
CO3	3	3	2									1
CO4	3	3					1					1
CO5	3	3	2				1					1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test2	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

1. Module1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of super position and transmissibility, law of action and reaction(review), free body diagrams.

2. Module 2

Friction–sliding friction-Coulomb 's laws of friction–analysis of single bodies–wedges, ladder analysis of connected bodies.

Parallel coplanar forces–couple – resultant of parallel forces– centre of parallel forces–equilibrium of parallel forces–Simple beam subject to concentrated vertical loads. General coplanar force system-resultant and equilibrium equations.

3. Module 3

Centroid of composite areas—moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia, radius of gyration, mass moment of inertia-ring, cylinder and disc.

Theorem of Pappus Guldinus (demonstration only), Forces in space-vectorial representation of forces, moments and couples–resultant and equilibrium equations–concurrent forces in space (simple problems only)

4. Module 4

Dynamics–rectilinear translation-equations of kinematics (review)Kinetics– equation of motion– D'Alembert's principle –motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation-equations of kinematics–projectile motion (review), kinetics–equation of motion. Moment of momentum and work energy equation (concepts only).

5. Module 5

Rotation–kinematics of rotation-equation of motion for rigid body rotating about a fixed axis– rotation under a constant moment. Plane motion of rigid body–instantaneous center of rotation (concept only). Simple harmonic motion–free vibration–degree of freedom undamped free vibration of spring mass system-effect of damping (concept only)

References:

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I.H.,Engineering Mechanics-Statics and Dynamics, Prentice Hall of India.
3. C. Hibbeler and Ashok Gupta,Engineering Mechanics,Vol.I Statics, Vol.II Dynamics, Pearson Education.
4. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
5. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
6. Beer,F.P. &Johnston,E.R., "Vector Mechanics for Engineers-Statics and Dynamics", 11/e, McGraw Hill International Book Co., 2017
7. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics-Statics and Dynamics, Vikas Publishing HousePvtLtd.
8. Arthur P. Boresi, Richard A. Schmidt, Engineering Mechanics Statics and Dynamics, Thomson Brooks/Cole Publications, 2004.

24-215-0106 PROGRAMMING IN ENGINEERING

Course Description: This course introduces students to the field of computer science and giving foundation to programming and basic concepts in software development. Beginning from the first principles of computer organization and history of computing, students will receive a foundation in programming through coding in a programming language. Fundamental programming concepts such as Data types, Operators, Flow control statements, Functions, Arrays and pointers will be covered through relevant programming assignments.

24-215-0106	Programming in Engineering	Category	L	T	P	Credit	Year of Induction
		ESC	2	1	2	3	2024

Pre-requisites: Nil

Course Objectives: This course provides problem solving and computer programming skills for students with no prior experience in the area of programming. Students will be using any one of the fundamental programming languages, to learn the fundamentals of computer programming including how to write, compile, execute programs especially for solving engineering problems.

Course Outcome: After the completion of the course the students will be able to

CO 1	Demonstrate the basic knowledge of computer hardware, software and algorithms
CO 2	Formulate computer programs for problem solving by adopting modular programming approach
CO 3	Write computer programs using conditional and iterative statements
CO 4	Analyse and select appropriate basic data structure and access methods for problem solving using programming language.
CO 5	Apply object-oriented programming for problem solving

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3											
CO 2	1	3	2	1								
CO 3	2	3	2	2	1							
CO 4	2	3	2	1	1							
CO 5	2	3	2	1	1							1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	10	10	20
Understand	15	15	30
Apply	25	25	50
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

History of Computing, Generations of Computers, Basic computer organization, representation of information, memory allocation, storage devices, software, operating system, Algorithm, Pseudo code and Flow chart, compilation, debugging, executable code

Module II

Identifiers, Data Types, Variables, Constants, Input / Output, Operators, Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Declarations, Initializations, preprocessor commands.

Module III

Control flow Statements- Decision making, branching, looping, Simple Programming examples.

Introduction to Structured Programming – Functions, user defined functions, parameter passing, Storage classes, scope rules, recursive functions.

Module IV

Arrays, structures and unions, Pointers - Pointer Applications, Arrays and Pointers, Pointer Arithmetic, memory allocation functions, array of pointers, self-referential structures, linked lists.

Module V

Strings, File handling, Introduction to Object Oriented Programming, Classes and objects, Advanced programming languages

References:

1. Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Programming in C. P. Dey and M Ghosh , Oxford University Press.
3. Stephen G.Kochan, Programming in Objective- C, Adison Wiley, 2013.
4. Anita Goel, Computer Fundamentals, Pearson, 2010
5. ReemaTareja: Introduction to C programming, Oxford University Press, 2015.
6. Rama N. Reddy and Carol Ziegler, C Programming for Scientists and Engineers with applications, Jones & Bartlett learning, 2009.
7. Kernighan, B.W.K. &Ritchi, D.M.; The C Programming Language (Ansi C Version), Prentice Hall of India, 1990.
8. Richard Johnson-Baugh & Martin Kalin, Applications Programming in Ansi C; Macmillan International Edition, 1996
9. Schildt, H.; C Made Easy; McGraw Hill Book Company, 1985.
10. D S Yadav, Programing for problem solving using C, 1,PB,425,2020,New Age Punlication.
11. Programming with C, B.Gottfried, 3rd edition, Schaum's outlines, TMH.
12. Object-Oriented Programming in C++, Robert Lafor
13. Problem Solving and Programming in C , Y. Daniel Liang

24-215-0107 WORKSHOP PRACTICE I

Course Description: This training mainly focuses on to develop a platform where the students can enhance their engineering knowledge in the practical working environment by applying the theoretical knowledge they acquired.

24-215-0107	Workshop Practice I	Category	L	T	P	Credit	Year of Induction
		ESC	0	0	4	2	2024

Prerequisite: Nil

Course Objectives: The objective of this lab is to provide practical experience on various basic mechanical workshop operations.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Machine the given specimen to required dimension.
CO 2	Demonstrate the principle of mechanical process and operations.
CO 3	Describe specific operations carried out.
CO 4	Apply the theoretical knowledge gained in the class room with the physical world.
CO 5	Carry out scientific experiments as well as accurately record and analyse the results of such experiments.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2		1									
CO 2	3											
CO 3	2											1
CO 4	3	2										1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	-
Understand	10	10	-
Apply	10	10	-
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 5 marks

Continuous Assessment: 20 marks

Internal Test /Evaluation :25marks

Total Marks: 50 marks

List of Experiments

1. Fitting Shop
2. Carpentry Shop
3. Sheet Metal Shop
4. Lathe
5. Shaping m/c, Planning m/c, milling m/c, Drilling and Boring m/c

SEMESTER II

24-215-0201 MATHEMATICS II

Course Description: This course equips students with concepts of Fourier Series, Vector Calculus and convergence and divergence of series which has many applications in Engineering and to understand basic theory of Ordinary Differential Equations and Multiple integrals

24-215-0201	Mathematics II	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	0	3	2024

Pre-requisites: Calculus of single and multi-variable calculus

Course objectives: This course introduces the concepts and applications of Integral calculus. The objective of this course is to familiarize concepts of Fourier series, Different Kinds of co-ordinate systems and behaviour of series which are invaluable for any engineer ‘s mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Course outcome: After the completion of the course the students will be able to

CO 1	Evaluate surface and volume integrals and learn their inter-relations and applications
CO 2	Learn concept of Curl, Divergence and Gradient and its applications
CO 3	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients
CO 4	Fourier series, Introduction, Euler’s formulae, Expansion of functions
CO 5	Make a study on important tests of convergence of infinite series

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO 1	3	1				1						2
CO 2	2	1										
CO 3	2	2		2	2							
CO 4	3	1	1	1	2							1
CO 5	2	1	1	2		2	1					1

Assessment Pattern:

Bloom 's Category			End Semester
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analvse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Applied Integral Calculus. Areas, arc-lengths, volumes and surface areas of solids of revolution. Multiple Integrals; Jacobians.

Module II

Vector calculus, Expression for Gradient, divergence, curl in different coordinate systems systems. Gauss thermoscope's theorem. (Proof is not required)

Module III

Ordinary Differential Equations of the second order with constant coefficients, Euler-Cauchy type. Simultaneous Linear Equations.

Module IV

Fourier series. Even and Odd functions Full range and half-range series.

Module V

Sequences and infinite series: Convergence and divergence. Radius of convergence, comparison tests, Raabe's test. Solution of first order and second order differential equations at regular points (Singular points not included)

References:

1. Kreyzig, E.; Advanced Engineering Mathematics, Wiley, New York, 2011.

2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, New Delhi, 2011.

3. Calculus and Coordinate Geometry George B. Thomas, Ross L Finny (Pearson Ninth Edition)

4. John Bird, Higher Engineering Mathematics, Rowlledge, 2010.

5. R.K.jain, S.R.K Iyengar, Advanced engineering mathematics, Narosa, 2012

24-215-0202 BASIC SHIP THEORY

Course Description: The course is an introduction to the basic mathematical concepts like Numerical Integration and its application to a Lines Plan to obtain Bonjean and Hydrostatic parameters. The course will provide the learners with an introduction to basic naval architecture concepts and exposure to numerical problems, which will form a foundation for understanding of complex subjects like stability, resistance , powering, sea keeping etc.

24-215-0202	Basic Ship Theory	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	1	3	2024

Pre-requisites: Nil

Course outcome: After the completion of the course the students will be able to

CO 1	Explain the concept of Numerical Integration
CO 2	Apply Numerical Integration techniques to obtain parameters related to hull geometry
CO 3	Calculate Bonjeans Areas and Moment values and draw the curves and Hydrostatic Curves from a given Lines Plan.
CO 4	Calculate Hydrostatics values and draw the curves from a given Lines Plan and Explain the concept of each Hydrostatic parameter of a ship.
CO 5	Solve numerical problems to estimate change in drafts due to list, trim and parallel sinkage / rise.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2		2							3
CO 2	3	2	1		2							3
CO 3	3	2	1									3
CO 4	3	2	3									2
CO 5	3	2	3		1							2

Assessment Pattern:

Bloom 's Category	**Continuous Assessment Tests**		End Semester Examination
	1	**2**	
Remember	10	10	20
Understand	10	10	20
Apply	30	30	60
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE** Duration
200	100	100	3 hours

Course Content:

Module I

Numerical Integration Introduction-Analytical Integration vs Numerical Integration, Need for Numerical Integration for estimating ship form parameters; Integration Rules-Trapezoidal rule, Simpson 's rules (1-4-1, 1-3-3-1 and 5, 8,-1 rules), 6 ordinate rule, Tchebycheff's rule, Modification for Subdivided Intervals, 3,10,-1 Rule; 7,36,-3 Rule;

Practical: Numerical Problems

Module II

Application of Numerical Integration Application to ship geometry to find parameters (Cross sectional areas- Water plane area, Transverse section area; First Moment of areas about transverse axis (M_y) and about centreline (M_x) ; Centroids of Area and Volume, LCF, LCB, VCB; Second Moment of Areas about transverse axis(I_L, I_F) and about centreline(I_T))

Module III

Bonjeans Purpose and Concept; Calculation of Bonjean Areas and Moments using numerical integration - Procedure for Drawing of Bonjean Area and Moment curves; How to calculate volume for an inclined waterplane using Bonjeans curves; Sectional area curve – Significance, Parameters obtained from it.

Practical: -Bonjeans Calculation (by hand / Excel) and Drawing.

Module IV

Hydrostatics : Purpose and Concept; Concept of Metacentre, Introduction of transverse and longitudinal Stability- Parameters (GM, GZ); Shift of CoB due to external force; Shift of CoG due to internal weight shift; Definition of Hydrostatic Parameters - Volume, Displacement, KB, BM_T, BM_L, KM_T, KM_L, TPC, MCT, LCF, LCB, Form Co-efficients (C_B, C_M, C_P, $C_{VP,}$ C_W), Wetted Surface Area; Derivation of formula for BM, TPC, MCT and GZ; Calculation of Hydrostatic Parameters; Procedure for drawing Hydrostatic Curves; Features of Hydrostatic Curves

Practical: -Hydrostatics Calculation (by hand / Excel) and Drawing, Calculation in Ship Design Software

Module V

Estimating Change in Draft Calculating Parallel Sinkage/Rise, Trim and List due to addition, removal and shift of weight and change of density; Ship Squat, Using Trim to find CoF, loading weight to keep aft draft constant, Loading weight to produce required draft, Using Change of Trim to find $GM_{L,}$ Increase in Draft due to list (Box Shaped Vessels and Vessels with rise of floor), Combined List and Trim

Reference: -

1. Basic Ship Theory- K.J. Rawson and E.C. Tupper
2. Introduction to Naval Architecture- E.C. Tupper
3. Ship Stability for Masters and Mates- Capt D.R. Derret
4. Ship Stability: Notes and Examples – Kemp & Young
5. Naval Architecture for Marine Engineers - W. Muckle
6. Reed's Naval Architecture for Marine Engineers -EA Stokoe
7. Ships and Naval Architecture – R Munro Smith
8. Geometry for Naval Architects - Adrian Biran
9. Ship Hydrostatics and Stability – Adrian Biran
10. Principles of Naval Architecture-Vol 1 Stability and Strength, SNAME Publication
11. The Principles of Naval Architecture Series-The Geometry of Ships, SNAME Publication
12. Introduction to Naval Architecture -Thomas C. Gillmer and Bruce Johnson

24-215-0203 ELECTRICAL ENGINEERING

Course Description: This course on Electrical Engineering aims to equip learners with a comprehensive understanding of electromagnetism, circuit analysis, machines and electronic communication, preparing them for further study and practical applications in the field of electrical engineering. The aim of the course is to lay a solid base to electrical technology in view of understanding the electrical systems in ship and shipyard. The subject pitches gradually from the basic concepts of electromagnetism and analysis of ac circuits to principles of various electrical machines.

24-215-0203	Electrical Engineering	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Pre-requisites: Nil

Course Objectives: The objective of this course is i) To provide the learners a proper understanding of electromagnetism and circuit analysis as a base to study various electrical systems and equipment. ii)To impart understanding of the construction, characteristics and applications of DC and AC machines. iii) To introduce the basics of electronic communication, including modulation, transmission and reception of signals

Course outcome: After the completion of the course the students will be able to

CO 1	Discern the principles of electromagnetism and explore the laws governing electromagnetic induction and the behavior of magnetic and electric fields.
CO 2	Analyze the behavior of single phase and three phase ac circuits and explore voltage, current, power relationships, and impedance in both the systems.
CO 3	Analyze constructional details, principle of operation, testing and applications of dc generators and motors
CO 4	Analyze constructional details, principle of operation testing and applications of transformers.
CO 5	Learn the basic analog communications system, waveforms, modulation index and features of Amplitude modulation and Frequency modulation

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2										
CO 2	3	2									1	
CO 3	3	2									1	
CO 4	3	2	1	1							1	
CO 5	3	2	1			1						

Assessment Pattern:

Bloom 's Category	**Continuous Assessment Tests**		End Semester Examination
	1	**2**	
Remember	10	5	20
Understand	10	10	40
Apply	5	10	40
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE** Duration
200	100	100	3 hours

Course Content:

Module I

Magnetic Circuits- MMF, Magnetic Flux, Reluctance, Inductance - Inductances in Series and Parallel, Mutual Flux and Leakage Flux, Coefficient of Coupling, Dot Convention, Electromagnetic Induction: Faraday's laws of Electromagnetic induction, Induced E.M.F., Capacitance – Electrostatics, Capacitance, Parallel Plate Capacitor, Capacitors in series and parallel, Energy stored in Electrostatic Field

Single-phase AC Circuits - Average Value, Effective Value, Form and Peak factors for square, triangle and sinusoidal waveforms. Polyphase AC circuits: Generation of polyphase voltage-phase difference--comparison between single phase and three phase systems-star and delta connection-current, voltage and power in three phase systems-balanced and unbalanced three phase circuits-power measurements in three phase circuits using single wattmeter and three wattmeter methods. Introduction to power management systems.

Module II

DC Machines- D.C. generators-construction details-principle of operation-emf equation-methods of excitation characteristics- applications. D.C. motors-principle of operation-back e.m.f.-speed and torque equations-characteristics-losses-efficiency-applications of shunt, series and compound wound motors.

Module III

Transformers: principle and theory of an ideal transformer-Constructional features of single-phase transformer-core type-shell-type-emf equation-turns ratio-no load vector diagram-transformer on load-equivalent circuit-impedance transformation-transformer losses-, efficiency-open circuit and short circuit tests-estimation of equivalent circuit parameters. Auto transformer –working principle -basics of current transformer, potential transformer and three phase transformers.

Module IV

Rotating AC Machines: Alternators-construction details-principle of operation-types-emf equation(winding factor need not be derived)-synchronous speed-Synchronous motors- principle of operation and method of starting- Three Phase Induction Motor: Working principle, construction, types; slip, performance characteristics and efficiency, Single Phase Induction Motor -working, Types-split phase and capacitor start.

Module V

Basics of Electronic communication: Basic model of a communication system: transmitter, receiver and channel. Need for modulation and types - classification of communication based on modulation. Basic analog communications system -Amplitude modulation, Frequency modulation –modulation index, features of AM and FM—Super heterodyne receiver for AM and FM. Introduction to satellite communication systems in ships.

References:

1. Fundamentals of Electrical Engineering, Ashfaq Husain &Harroon Ashfaq, Fourth edition, 2016, Dhanpai Rai & Co
2. Basic Electrical Engineering, J.B Gupta, 2013 Published by S.K. Kataria& Sons
3. J. A. Edminister, Electric Circuit Theory, Schaum's Outline series: 6th ed., McGraw Hill, 2014
4. A. Desoer and E. S. Kuh, Basic Circuit Theory, McGraw Hill, 2009
5. Fitzgerald and Kingsley's Electric Machinery by Stephen Umans, seventh edition, 2013
6. Electrical Machinary – P S Bimbra, Khanna Publishing, 2021
7. Reed 's Vol.6: Basic Electro technology for Engineers- Chirstopher Lavers, Edmund G.R. Kraal & Stanley Buyers, Ed.4, 2013
8. Kennedy 's Electronic Communication Systems – George Kennedy, Bernard Davis McGraw-Hill, 5th ed., 2011

24-215-0204 MECHANICS OF SOLIDS

Course Description: This course on Mechanics of Solids throws light on the behaviour of different types of solids made of different materials and having different cross-sections under various loading conditions. The various principles and numerical calculations developed in structural designs are applied here. The subject pitches gradually from the basic concepts of stress and strain to problems on thin-walled pressure vessels and columns.

24-215-0204	Mechanics of Solids	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Prerequisite: Knowledge in basic engineering courses like engineering mathematics and engineering mechanics.

Course Objectives: This is an introductory course, designed to provide the fundamental concepts of behaviour of different types of solids under various loading conditions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Assimilate the concepts on stress, strain, modulus of elasticity and the relationship between different elastic constants.
CO 2	Able to draw the bending moment diagram and shear force diagram for various types of beams under different boundary conditions and loading.
CO 3	Understand the theory of pure bending of beams, section modulus, bending stresses, moment of resistance and calculate the shear stress distribution in various cross sections.
CO 4	Determine principal stresses and maximum shear stress with the aid of equations and Mohr‘s circle.
CO 5	Conceive the concept on torsion and its applications.
CO 6	Solve problems related to buckling of columns and critical buckling.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	1									1
CO 2	3	3										
CO 3	3	2										1
CO 4	3	3										
CO 5	3	2					1					

Assessment Pattern:

Bloom's Category	**Continuous Assessment Tests**		End Semester Examination
	1	**2**	
Remember	**10**	**10**	**10**
Understand	**20**	**20**	**20**
Apply	**20**	**20**	**70**
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE** Duration
200	100	100	3 hours

Course Content:

1. Module I

Basics in Mechanics of Solids:

Types of Loads and Uni-axial, Biaxial stresses and; Tri-axial State of Stresses.

Stress-Strain Concepts: Tension, Compression and Shear; Uni-axial stresses; Elastic Limit; Stress-Strain relationship for mild steel; Hooke's Law; Yield point; Bars of varying sections; Bars of composite sections; Temperature Stresses; Poisson's Ratio; Stress-Strain Diagram; Working Stress; Factor of safety; Volumetric strain; Modulus of elasticity; Modulus of rigidity; Bulk Modulus- Relationship between the elastic constants.

2. Module II

Bending Moment and Shear Force: Definitions and introduction to different types of supports; Concept of shear force and bending moment; Beams and Loads; Sign conventions; Shear force and Bending Moment Diagrams for Cantilever, simply supported and Overhanging beams with various types of loading (Point load, Distributed load, Couples).

3. Module III

Stresses in Beams: Simple bending; Theory of Simple Bending; Assumptions in Simple Bending; Neutral axis; Section Modulus; Flexural rigidity; Stresses in symmetrical sections; Bending Stress Distribution.

Shear Stress: Shear stress distribution in beams; Assumptions; Shear stress distribution for rectangular, circular, triangular, I and T sections.

4. Module IV

Principal Stresses and Strains: Introduction; Principal Stresses and Principal Strain; Mohr's Circle; Representation of Stress in 2D problems.

Beam Deflection: Differential Equation of the Elastic curve; Slope and deflection of beams by method of successive integration; Moment Area Theorem.

Columns and Struts: Euler's Theory; Rankine's Formula

5. Module V

Thin-Walled Pressure Vessels: Introduction; Biaxial Tension and Compression in Thin-Walled Pressure Vessels such as cylindrical and spherical.

Torsion: Introduction to torsion; Theory of pure torsion; Torsion of Circular Shafts; Shear stresses; Shear deformation.

References:

1. S. Timoshenko; Strength Of Materials; CBS Publishers and Distributors Pvt. Ltd., 3rd edition 2021.
2. R C Hibbeler; Mechanics of Materials; Pearson Education, 10th edition, 2022
3. Popov; Mechanics of Materials; Pearson Education, 2nd edition, 2015
4. Ferdinand P. Beer, E. Russell Johnston; Mechanics of Materials; Mc Graw Hill, 8th edition, 2020
5. Bansal R. K; Strength of Materials; Lakshmi Publications; New Delhi, 4th edition, 2007
6. Timoshenko S. P.; Strength of Materials Part 1; 3rd edition, D. Van Nostrand Company Inc .New York, 2002
7. S. Ramamrutham ; Strength of Materials; Dhanpat Rai Publishing Company, 16th edition,2008.
8. S. S Bavikatti; Strength of Materials; Vikas Publishing House Pvt Ltd., 4th edition, 2014.
9. Shames I. H., James M. Pitarresi; Introduction to Solid Mechanics; Pearson Education India. 3rd edition, 2015
10. V.N. Vazirani, M.M.Ratwani, analysis of structures . Vol 1, Khanna Publishers, 2015
11. T. D. Gunneswara Rao, Mudimby Andal; Strength of Materials: Fundamentals and Applications; Cambridge University Press; 1st edition, 2018
12. Punmia B. C. and A. K. Jain, Mechanics of Materials, Laxmi Publications (P) Ltd, 2017

24-215-0205 ENGINEERING GRAPHICS

Course Description: To enable the students to effectively perform technical communication through graphical representation as per global standards.

24-215-0205	Engineering Graphics	Category	L	T	P	Credit	Year of Induction
		ESC	2	2	1	3	2024

Prerequisite: Nil

Course Objectives: This is an introductory course, designed to provide the fundamental concepts of Engineering Graphics.

Course Outcomes: After the completion of the course the student will be able to

CO1	Draw the projection of points and lines located in different quadrants
CO2	Prepare Multiview orthographic projections of objects by visualizing them in different positions
CO3	Draw sectional views and develop surfaces of a given object
CO4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three-dimensions
CO5	Convert 3D views to orthographic views and vice versa
CO6	Obtain multi-view projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3									1		
CO3	3	1								1		
CO4	3									1		
CO5	3	1	1		2					2		
CO6	3	1	1		3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Continuous Internal Evaluation Pattern:

CIA for section A carries 50marks (30marks for1st test and Classwork 20marks) CIA for section B carries 50marks (30marks for 1st test and Class work 20marks)

End Semester Examination Pattern

ESE will be of 3-hour duration on A4 size answer booklet and will be for100marks. ESE question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20marks.

Course Content:

General Instructions:

First angle projection to be followed

Section A practice problems to be performed on A4size sheets

Section B classes to be conducted on CAD lab

CIA for section A carries 25marks (15marks for 1 test and Class work 10marks) - CIA for section B carries 15marks (10 marks for 1 test and Class work 5marks)

SECTION -A

Module I

Introduction: Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module II

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module III

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module IV

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module V

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane. Conversion of Pictorial Views: Conversion of pictorial views into orthographic views and vice versa

SECTION -B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two-dimensional drawing with dimensions using suitable software. Conversion of pictorial views into orthographic views. (Minimum 2 exercises mandatory). Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

References

1. Bhatt, N.D.,Engineering Drawing, Charotar Publishing HousePvt.Ltd.
2. John, K.C.Engineering Graphics, Prentice Hall India Publishers
3. Venugopal, K. Engineering Graphics (As Per Anna University),15,PB,475, New age Publication,2018,
4. Agrawal,B.and Agrawal,C.M., Engineering Drawing, TataMcGrawHill Publishers. 2.Duff,J.M.and Ross,W.A., Engineering Design and Visualisation, Cengage Learning
5. Kulkarni, D.M.,Rastogi,A.P.and Sarkar,A.K.,Engineering Graphics with AutoCAD, PHI
6. .Luzaddff,W.J. and Duff,J.M.,Fundamentals of Engineering Drawing, PHI.

24-215-0206 ENGINEERING CHEMISTRY

Course Description: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application-oriented topics like, Engineering materials, electrochemistry, Fuels, lubricants, pollution etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

24-215-0206	Engineering Chemistry	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	-	3	2024

Pre-requisites: Concepts of chemistry introduced at the plus two levels in schools.

Course Objectives: This is an introductory course, designed to provide the fundamental concepts of chemistry. To describe fundamental aspects of chemistry and its and applications to engineering field

Course outcome: After the completion of the course the students will be able to

CO 1	Recognize/recall the various types of materials with their application.
CO 2	Understand the basic concepts of electrochemistry and corrosion to explore its possible applications in engineering fields.
CO 3	Identify chemical characteristics of fuels.
CO 4	Apply the information learned to differentiate the lubricants
CO 5	Analyze various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	2					1					2
CO 2	2	1										
CO 3	3	1										
CO 4	2	1										1
CO 5	1	1					3					1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Production of engineering materials – Production of steel – Bessemer converter process, open hearth process, electric furnaces, oxygen process, chemical additions to steels. Production of non-ferrous alloys – Production of aluminium and its alloys, Production of other non-ferrous alloys – bronze, brass, and special reference to the requirements of shipbuilding (ships propellers etc). Plastics - formation of high polymers, thermoplastic

and thermosetting resins, methods of fabrication of plastics, production of GRP-materials.

Module II

Electrochemistry – classification of conductors, electrolytes, conductance of electrolytes, specific and equivalent conductance, application of conductance measurements, Debye Huckel model of electrolytic conductance and Onsager equation. Galvanic cells, EMF measurements, classification of electrodes, Nernst equation, electrode potentials, cell reactions. Relationship between cell potential and thermodynamic quantities. Electrochemical energy sources, lead acid battery, nickel cadmium battery. Fuel cells (H2/O2). Electrochemical corrosion and its application.

Module III

Fuels and Combustion – Solid, liquid and gaseous fuels, calorific value of fuels, properties and adverse effects, calorific intensity, flue gas analysis. Coal – analysis of coal, carbonisation of coal, metallurgical coke and its manufacture, hydrogenation of coal. Petroleum – Origin and refining of petroleum, cracking and polymerisation, requisites of good petrol. Diesel oil, Petrochemicals, Gaseous fuels – natural gas, LNG, Hydrogen, Ammonia, Methanol, LPG, Producer gas, combustion zone, reduction zone, water gas, coal gas, oil gas. Combustion calculations, explosives. Propellants, Nuclear fuels – nuclear fission and fusion. Types of lithium batteries used in marine field.

Module IV

Lubricants – Mechanisms of lubrication, boundary lubrication, extreme pressure lubrication. Classification of lubricants: synthetic lubricants & properties of lubricant.

Module V

Water and its Treatment – Source of water, hard and soft water, determination of hardness, softening water– lime soda process, ion exchange. Boiler feed water – removal of oil, blow down operation, caustic embrittlement, internal conditioning. Water for domestic purposes – sedimentation, coagulation, filtration and sterilisation, chlorination and its advantages and disadvantages. Disinfection with Ozone. Desalination. Pollution – chemical characteristics, sewage treatment – biological oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC). Solid wastes, Water pollution, Air pollution, their control.

References:

1. Balasubramanian M.R., Krishnamoorthy S. & Murugesan V., Engineering Chemistry, Allied Publishers Ltd., 2011.
2. Soney C. George,RinoLaly Jose, “Text Book of Engineering Chemistry”, S. Chand & Company Pvt Ltd, 2019.
3. M.N. Maulik, Water Supply, Waste Water Treatment & Sewage Disposal, Standard Book House, 2011.
4. Raman Sivakumar, R.Jayaprakasham, N.Sivakumar, Engineering Chemistry, McGraw Hill Education India, 2011
5. MuhammedArif, Annette Fernandez, Kavitha P. Nair “Engineering Chemistry”, Owl Books, 2019
6. S.P.Srivastava, Advances in Lubricant Additives and Tribology, CRC press, 2009.
7. K.S.Venkateswarlu, Water Chemistry-Industrial and power station water treatment, New Age Publishers, 2005.
8. O.G. Palanna, Engineering Chemistry, Tata McGraw Hill, 2017.
9. S.L. Kakani,Engineering Materials, 1,pb 299 New age Publication,2020.
10. Telang, Tulika Engineering Chemistry, 2, PB 325 2018, ew age Publication,2020

24-215-0207 WORKSHOP PRACTICE II

Course Description: This training mainly focuses on to develop a platform where the students can enhance their engineering knowledge in the practical working environment by applying the theoretical knowledge they acquired. This lab provides practical experience on various welding equipment.

24-215-0207	Workshop Practice II	Category	L	T	P	Credit	Year of Induction
		ESC	-	-	4	2	2024

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Describe welding operation carried out.
CO 2	Demonstrate the principle of operation of MMAW, TIG and MIG
CO 3	Prepare specified type of joint using various welding processes.
CO 4	Apply the theoretical knowledge gained in the class room with the physical world.
CO 5	Carry out scientific experiments as well as accurately record and analyse the results of such experiments.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2		1									
CO 2	3											
CO 3	2											1
CO 4	3	2										1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	5	5	-
Understand	10	10	-
Apply	10	10	-
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 5 marks

Continuous Assessment: 20 marks

Internal Test /Evaluation: 25marks

Total Marks: 50 marks

List of Experiments

1. Introduction to Welding Technology (Theory) – Historical review, classification of welding process, Gas welding, Manual metal arc welding, Submerged arc welding, Electro slag welding, Inert gas welding, Plasma arc welding, **Resistance welding and Gas cutting.**
2. Welding Practice – Arc welding, Gas welding, Gas cutting. **TIG, MIG and Spot welding**

SEMESTER III

24-215-0301 MATHEMATICS III

Course Description: This course equips students with concepts of Eigen values and diagonalization of matrix which has many applications on Engineering and to learn basic theory of functions complex variable and conformal transformation

24-215-0301	Mathematics III	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	0	3	2024

Pre-requisites: Knowledge of matrices, determinants, complex variable, statistics Course objectives: This course introduces the concepts and applications of diagonalization of matrices, Eigen values, Laplace transform and important distributions in statistics and moment generating functions. The objective of this course is to familiarize concepts of functions complex variable and conformal transformation and solution of Partial Differential Equations which are invaluable for any engineer‘s mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Course outcome: After the completion of the course the students will be able to

CO 1	Compute Eigen values of matrix and diagonalise
CO 2	Determine Laplace transforms of important functions
CO 3	Identify Analytic function, Harmonic function and Conformal Mapping
CO 4	Familiarize with moments, moment generating function and important statistical distributions
CO 5	Solve Partial Differential Equations

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1				1	1					1
CO 2	1	1										
CO 3	2	2		2	1							
CO 4	2	1	1	1	2							2
CO 5	1	2	2	2		2	1					1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Eigen values and Eigen vectors of a square matrix. Diagonalisation. Finding the nth power of a square matrix, Orthogonal, Hermitian and Skew Hermitian matrices. Theorems on the eigenvalues of these. Cayley Hamilton theorem

Module II

Laplace Transforms. Unit step function- Dirac Delta functions. Periodic functions. Inverse transforms. Convolution theorem. Solution of Ordinary Differential Equation, using Laplace transforms

Module III

Analytic functions of a complex variable. Cauchy-Riemann equations, Harmonic functions. Application to fiow problems Euler's formula and its uses in summation of series (C+i S method)

Module IV

Expectation, Variance and n th moments of the Binomial, Geometric, Poisson, Exponential and Normal variates. Moment generating functions

Module V

Partial Differential Equations of the form F (x, y, z, p, q) = 0. Formation Complete, Singular and General Integrals. Linear equation of first order- LaGrange's equation, Non-linear equations of first order. Charpit's Method

References:

1. Kreyzig, E.; Advanced Engineering Mathematics, Wiley, New York, 2011
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, New Delhi, 2011
3. William E. Boycee, Richard C. Diprima, Elementary differential equations and Boundary value problems. WILEY-INDIA EDITION Ninth edition
4. John Bird, Higher Engineering Mathematics,Rowlledge, 20
5. R.K.jain, S.R.K Iyengar, Advanced engineering mathematics, Narosa, 2012
6. N.W.McLachlan, Laplace transforms and their applications to differential equations, Dover publications, 2014

24-215-0302 FLUID MECHANICS I

Course Description: This course covers the fundamentals of fluid mechanics: the properties and behaviour of fluid, hydrostatics, buoyancy, rigid body accelerations, inviscid flow, applications of Bernoulli's theorems, control volume analysis for more complex fluid flow problems, dynamical similarity and dimensional analysis.

24-215-0302	Fluid Mechanics I	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Pre-requisites: Knowledge in basic engineering courses like engineering physics, engineering mathematics: calculus and differential equations, elementary vector and tensor algebra, and engineering mechanics.

Course Objectives: The objective of the course is to provide a solid base to study the underlying concepts of fluid properties and behaviour, thereby imparting basic ideas about how an object will behave when it moves through a fluid medium, and the concept of dynamical similarity with application of dimensional analysis to engineering problems.

Course outcome: After the completion of the course the students will be able to

CO1	Characterize the basic fluid properties and terms associated with the fundamentals of fluid mechanics
CO2	Estimate hydrostatic forces and stability of the floating and submerged bodies
CO3	Analyze characteristics of fluids in motion
CO4	Apply the governing equations for mass, momentum, and energy in practical flow problems
CO5	Apply dimensional analysis for fluid flow problems for applications in model testing.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										1
CO2	3	1	2									1
CO3	3	3	2	1	2		1					1
CO4	3	3	2	2	1		1					1
CO5	3	3	2	3	1		1					1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	15	10	20
Understand	20	20	40
Apply	15	20	40
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

Module I

Properties of Fluids Basic fluid properties – Density, specific weight, specific gravity; Viscosity, Newton's law of viscosity, Classification of fluids (Newtonian and non-Newtonian fluids), Kinematic viscosity, pressure, and temperature effects on viscosity; Ideal fluids and real fluids, Vapour pressure, Surface tension and capillarity

Module II

Fluid Statics Pressure due to gravity – Pascal's Law, Absolute and Gage pressure, Static pressure variation, Pressure variation for incompressible and compressible fluids; Measurement of static pressure– anometers:Piezometer, U-tube manometer, Differential manometer; Hydrostatic forces on plane and curved surfaces, walls of containers, center of pressure; Buoyancy and Stability of simple floating shapes – Hydrostatic forces acting on bodies immersed or floating in liquids, Stability of floating bodies; "Solid-Body" Acceleration of liquids – Constant linear acceleration of liquid, steady rotation of liquid.

Module III

Fluids in Motion Classification of fluid flow, One Dimensional Flows: Types of fluid flow – Graphical description of fluid flow – Streamlines, Path lines, Streak lines, Stream tubes; Equation of continuity; Euler's equation of motion – Bernoulli's Equation, Stagnation and total pressure, Applications of Bernoulli equation; Energy equation for unsteady flow; applications of momentum equation, Bernoulli's equation applied to pipe flow, losses in pipes, Impulse and momentum of fluids, Impact of jet on vanes.

Module IV

Flow Measurement Application of Bernoulli's Equation, Flow measuring devices, measurement of internal flow, measurement of discharge - venturimeter, orifice plate, rotameter, measurement of velocity - pitot tube, measurement of external flow - triangular and rectangular notches, coefficient of discharge, calibration of flow measuring devices.

Module V

Dimensional Analysis Dimensionless numbers in fluid mechanics, Reynold's Number, Froude Number, Euler Number, Weber Number, Buckingham Pi Theorem, Law of similitude, significance of non imensionalisation of equations of fluid flow.

References:

1. Frank M White; Fluid Mechanics Seventh Edition Tata McGraw-Hill Publishing Co, Ltd
2. Yunus A Cengel and John M Cimbala; Fluid Mechanics – Fundamentals and Applications, Mc Graw Hill 2021
3. Meihard Schobeiri, Applied fluid mechanics for Engineers, McGraw Hill professional, 2014. 2) Douglas, Gasiorek, and Swaffield; Fluid Mechanics, PHI, 2011.
4. Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd., 1963.
5. G.S Sawhney, Fundamentals of fluid mechanics, I.K. International, 2013.
6. Bruce R Munson & others, Fundamentals of fluid mechanics, Wiley, 2012.
7. Daugherty & Franzini; Fluid mechanics with engg. Applications, International Students Edition McGraw Hill., 1997.
8. Jagdish Lal; Hydraulic machines, Metropolitan book Co., Delhi-, 2000
9. Vallentine; Applied hydrodynamics, Butter Worths, London1970.
10. Bernard S.Massey , revised by John Ward-Smith; Mechanics of Fluids, CRC, 2019.
11. K.L.Kumar; Engineering fluid mechanics, S. Chand, New Delhi, 2016.
12. A.K Jain: Fluid Mechanics including hydraulic machines, Khanna Publishers, 1998.
13. N.S.Govind Rao; Fluid flow machines, Tata Mc Graw Hill., 2002

24-215-0303 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Description: The aim of the course is to expose the students to professional ethics and Human Values and also to provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics and Industrial Standards.

24-215-0303	Professional Ethics and Universal Human Values	Category	L	T	P	Credit	Year of Induction
		HMC	2	1	-	2	2024

Pre-requisites: Nil

Course Objectives: This course is designed to create awareness on professional ethics and Human Values and inculcate knowledge and exposure on Safety and Risk, Risk Benefit Analysis, Also to provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards.

Course outcome: After the completion of the course the students will be able to

CO 1	Recall various aspects of ethics and human values.
CO 2	Understand the importance of ethics and human values.
CO 3	Understand the problems faced by engineers and rectify them by applying the ethics and human values.
CO 4	Understand significance of Safety and Risk assessment in industries
CO 5	Understand other types of ethics and role of employees in ethics

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2							3				1
CO2	2							3				1
CO3	3	2	2					2				1
CO4	3	1	1					1				1
CO5	3	2	2		1			2				2

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content

Module I
Morals, values and Ethics –Integrity–Work ethic –Service learning–Civic virtue–Living peacefully–Caring–Sharing–Honesty–Courage–Time management –Integrity –Empathy–Self-Confidence-Courage– introduction to Yoga- Yoga as an effective tool for stress management.

Module II
Value education-Introduction to Universal Human values (UHV) – Harmony in four levels - self, family, society and nature

Module III
Case study on 4 levels of Harmony- value education and skill education - Significance of happiness and prosperity in human life.

Module IV
SafetyandRisk–AssessmentofSafetyandRisk–RiskBenefitAnalysis–ReducingRisk– Disasters of all time - Chernobyl and Bhopal Gas tragedy

Module V
Intellectual Property Rights (IPR), Copy right, Patent filing methods. Business Ethics-Environmental Ethics–Cyber security –Engineers as Managers– Conflict of interest in professional life

References:

1. A foundation Course in Human Values & Professional Ethics-r R Gaur, R Sangal,G P Bagaria, Excel books, 2010
2. Jayasree Suresh and B. S. Raghavan, Human Values and Professional Ethics, 3rd Edition, S. Chand Publications .2003
3. The 100 Greatest distasters of all time-Stephen J Spignesi,Citadel Press, 2002
4. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999.
5. David Ermann and Michele S Shauf, Computers, Ethics and Society, Oxford University Press, 2003
6. Govindarajan M, Natarajan S, Senthil Kumar V S., Engineering Ethics, Prentice Hall of India, New Delhi 2004.

24-215-0304 INSTRUMENTATION

Course Description: This course covers the basics of measurements, classification of instrument and transducers for various measurements. Instruments which are commonly used for measuring displacement, temperature, pressure, flow, level etc are covered.

24-215-0304	Instrumentation	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Prerequisite: Nil

Course Objectives: The objective of the course is to provide the learners a proper understanding of the basic working principles, construction and features of various measuring instruments. And to impart understanding of the intelligent instrumentation.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the basics of instrumentation, standards, calibration and errors in measurement.
CO 2	Discern the basic working principle and classification of transducers for measurement of displacement, strain, force and pressure
CO 3	Describe the working principle, construction and features of various temperature measuring instruments
CO 4	Explain the working principle, construction and features of various pressure, flow and humidity measuring instruments.
CO 5	Describe various sensors for measurement of nonelectrical quantities in process industries and explore the recent developments in intelligent instrumentation

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1								
CO2	3	2	1	1								1
CO3	3	2	1									1
CO4	3	2	2	1		1						1
CO5	3	2	1	1		1						2

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content

Module I

Introduction: Classification of instruments-Standards and calibration-Errors in instruments and measurements-gross errors-causes and corrective measures-systematic errors- static performance parameters -Dynamic errors –Random errors - Statistical analysis of data and errors- probable error- selection of the instrument.

Module II

Transducers-classification of transducers- Passive Transducers – resistive, Inductive and capacitive Transducers, Active Transducers – Thermoelectric, piezoelectric, magnetostrictive, Hall Effect- Strain gauges- gauge factor-unbounded and bonded resistance strain gauges-resistance strain gauge bridges. Capacitive gauges - L.V.D.T. (Linear variable differential transformer).

Module III

Temperature measurement: Electrical methods - Electrical resistance thermometer-Semiconductor resistance sensors (thermistors) Characteristics –-thermo-electric sensors (thermocouples) -Law of intermediate temperature-Law of intermediate metals Construction-Compensating circuits. Radiation methods - Total radiation pyrometer selective radiation pyrometer- optical pyrometer.

Module IV

Measurement of Pressure: Manometers- elastic transducers-electro mechanical instruments. High pressure measurement. Vacuum gauges-MC Leod gauge-Pirani gauge. Dynamic pressure measurement.

Flow measurement and draft measurement sensors- Electromagnetic flow meters- Laser Doppler anemometer. Measurement of Liquid level-using Gamma rays, float, ultrasonic methods radar type and hydrostatic head type sensor. Hygrometers-dew point methods-Industrial Psychrometer

Module V

Introduction to intelligent Instrumentation -intelligent transducer — comparison with conventional transducers — self-diagnosis and remote calibration features. **Sensors**– Semiconductor Sensors-Classification -Recent trends in sensor technology- Smart Sensors- Micro sensors –Radiation Sensors – Ultrasonic Sensors –Fiber Optic Sensors –Chemical Sensors – Biosensors -Introduction to Programmable Logic controllers Programming-Distributed Control Systems and Computer Based Systems.

References:

1. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGraw-Hill, 2017.
2. D. Patranabis , Instrumentation and control, PHI Learning, 2011
3. 3. D. Patranabis , Sensors And Tranducers , PHI Learning, 2011
4. B.C. Nakra, K.K.Chaudhary; Instrumentation measurement and Analysis, Tata Mc Graw Hill, 2016.
5. A.K. Sawhney, PuneetSawhney, A Course in Electrical And Electronic Measurements And Instrumentation, Dhanpat Rai Publications, 2015.
6. Joseph J Carr, Elements of Microcomputer Interfacing, Brady (Robert J.) Co, U.S., 1984.
7. Alan S Morris, Reza Langari, Measurement and Instrumentation-Theory and Practice, Butterworth Heinmann, 2011.
8. Oliver B. M. and Cage J. M., "Electronic Measurement and Instrumentation", McGraw-Hill International

24-215-0305 ANALYSIS OF STRUCTURES

Course Description: The course Analysis of Structures deals with the principles of elastic structural analysis and the various methods involved in the analysis of structures. This course also introduces the student to vibration analysis of discrete and continues bodies, and matrix method for structural analysis.

24-215-0305	Analysis of Structures	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Pre-requisites: Engineering Mechanics, Mechanics of Solids.

Course Objectives: This course is designed to impart knowledge on the principles of elastic structural analysis and behaviour of various structures to dynamic loads. It also provides knowledge of different methods for analyzing structures and an introduction to matrix method of structural analysis.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the concepts of elasticity and plasticity, analysis of fixed end beams, and effects of boundary conditions on beam responses.
CO 2	Apply the methods of moment distribution and three moment equation for the analysis of contiuous beams.
CO 3	Understand the behaviour of beam columns.
CO 4	Apply the concepts of vibration of discrete systems to determine the natural frequencies and vibration response of discrete systems, and understanding vibration of continuous structures with practical applications
CO 5	Analyse one dimensional and two-dimensional structures using matrix methods of structural analysis

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	2	1	1				2
CO2	2	2	2	2	1	2		1				2
CO3	2	2	2	2	1	2		1				2
CO4	3	3	2	3	1	2	3	1				3
CO5	3	3	2	3	1	2	2	1				3

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	10	10	20
Understand	20	20	30
Apply	10	10	30
Analyze	10	10	20
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

Module I

Revision of method of successive integration, Introduction to elasticity and plasticity, Analysis of fixed end beams, free bending moment, fixed end bending moment, superposition, critical comparison of bending moment and deflections of beams with various end conditions, effect of boundary condition on beam response.

Module II

Continuous beams, continuous beam indealisation in ship structures, Analysis of continuous beams using three moment equation and moment distribution method.

Module III

Stability of beams, (Revision of Euler buckling of columns), Introduction to beam column, differential equation of beam-columns, Energy and Equilibrium criteria for beam columns.

Module IV

Introduction to vibrations of discrete systems, undamped free vibrations of single degree of freedom systems, damped free vibrations, forced vibrations, effects of damping, dynamic stiffness, foundation impedance, concepts of shock and vibration mounting, Introduction to vibrations of continuous systems- Vibration of strings, rods, beams and shafts

Module V

Introduction to Matrix methods in structural analysis, stiffness and flexibility matrices, relations between stiffness and flexibility - Stiffness and flexibility methods for continuous beams and rigidly joined frames

References:

1. Timoshenko & Young; Theory of Structures, McGraw Hill Publications, 1965
2. Reddy, C.S.; Basic Structural Analysis, Tata-McGraw Hill Publications, 2017.
3. W.T.Thomson, M D Dahleh& C Padmanabhan; Theory of vibrations with applications: Person Education, 2008
4. Krishna Raju &Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications, 1997.
5. Russell. C. Hibbeler; Structural analysis. Ed. 10, Pearson, 2017
6. Aslam Kassimali ; Structural analysis . Cengage Learning, Ed.5, 2015.
7. Przemieniecki, J.S. ; Theory of matrix structural analysis, Dover Publication, 2012
8. Devdas Menon: Structural Analysis: Alpha Science International Limited, 2017
9. Manickasalvam V K: Elements Of Matrix And Stability Analysis Of Structures, Khanna 1999
10. S SBhavikatti: Structural Analysis Vol I &II, Vikas publishing house Ltd,2013
11. L S Srinath: Advanced mechanics of solids, McGraw hill Education,2017.

24-215-0306 MACHINE DRAWING

Course Description: Drawing is the language of Engineers and is the basic medium of communication between them. The course is intended to give basic knowledge in preparing, reading and interpreting production drawing. The rules and codes used for preparing drawings as per international standard, conversion of isometric view to orthographic projections, preparing sectional views from isometric and orthographic projection, drawing machine parts & assembly views.

24-215-0306	Machine Drawing	Category	L	T	P	Credit	Year of Induction
		ESC	1	3	-	3	2024

Pre-requisites: Basic knowledge of engineering drawing.

Course Objectives: This is a practical oriented course which enable students to prepare production drawings as per Indian standard and prepare drawings using various projection methods

Course outcome: After the completion of the course the students will be able to

CO 1	Acquaint with BIS codes, standards and conventions for preparing machine drawings.
CO 2	Convert pictorial views in to orthographic view.
CO 3	Draw sectional views of objects.
CO 4	Prepare drawings of various machine elements.
CO 5	Prepare part drawing and assembly drawing with all information for production like tolerance, surface finish, material, fits etc

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3									2		
CO2	3	2								2		
CO3	3	2								2		
CO4	3	2			2					2		2
CO5	3	2			2					2		2

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	10		10
Understand	15	20	30
Apply	25	30	60
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Test: 40 marks

Internal Tests: 50 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 5 questions of 4 marks each from each module and students should answer all questions. Part B contains 2 questions of 20 marks each from isometric to orthographic conversion, Drawing section from isometric and orthographic projections, machine parts and joints and one question of 40 marks for assembly drawing

Course Content:

Module I

Introduction to the rules of dimensioning, Types, size, location, functional and datum dimensions, principles for dimensioning (IS), dimension figures, notation of dimensioning. Lines, symbols, figures, notes, arrow heads, etc., placing the dimensions, dimensioning angles, arrangement of dimensions, machining symbols and surface finish. Simplifications and conventions-recommended abbreviations, use of symbols and abbreviations, conventions on machine drawing, conventional representation of threads, conventional lines.

Module II

Sectional views, section plane, section lining, full section, half section, partial or broken out section, offset section, removed or rolled section, auxiliary section, aligned section, disposition of successive sections, 20 partial views, developed view, part located in front of a cutting plane, assembly sectioning, sectioning conventions. Conversion of pictorial views into orthographic views, orthographic reading or interpretation of views Sketching

Module III

Drawing of machine elements: - keys, cotters & pin joints, rivets & riveted joints welded joints, screw threads and screw fastening, bearing, brackets and hangers, pipes and pipe joints, gearing springs.

Module IV

Production drawing (types and uses): - Final lay out drawings, general arrangement, assembly drawings, sub-assembly drawings, detail process drawings.

Module V

Information in drawings: material list, modifications, jigs and fixtures, weight, general tolerances, order number, material specifications, heat treatment, surface finish, general comments. Limits and tolerances

References:

1. Basudev Bhattacharya, Machine drawing, OUP, India, 2011.
2. Ajeet Singh, Machine Drawing, Tata McGraw Hill Education, 2017.
3. K.L. Narayanan, Machine Drawing, New age International, 2016.
4. Sadhu singh and P.L.Sah, Fundamentals of Machine drawing, PHI, 2013.
5. David Allen Low, A manual of machine Drawing and design, Longmann Green & Company, 2014.
6. N.D Bhat: Machine Drawing, Charotar Publishing House, Anand., 2014.
7. K.C John: Machine Drawing, PHI, 2009.
8. Narayana, K.L. Machine Drawing 6 PB 450 2019 New Age Publication.

24-215-0307 STABILITY OF SHIPS

Course Description: Fundamental concepts of the stability of ships including transverse stability, longitudinal stability, damaged stability, dynamic stability, and second-generation intact ship stability criteria.

24-215-0307	Stability of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Nil

Course Objectives: Enable students to appreciate stability theory and use it to calculate intact and damage stability of ships and to equip them with practical knowledge for conducting inclining experiments and preparing stability booklets.

Course Outcomes: After the completion of the course the students will be able to:

CO 1	Understand the concept of static equilibrium of floating bodies, the importance of various centers of a ship, and the effects of small changes in the ship, its attitude, and the density of water on the centers.
CO 2	Appreciate factors that affect the transverse stability of ships at small heel angles.
CO 3	Compute the various centers and stability of a ship when there are large changes in its attitude. Appreciate the intricacies of an inclining experiment and conduct one.
CO 4	Compute the cross curves of stability for a specified loading condition, perform trim and stability calculation for that loading condition, and check for compliance with the IMO intact stability criteria.
CO 5	Estimate trim of a ship resulting from addition, removal, and shifting of weights and due to change in density of water. Compute flooded attitude, floodable length curves, and design the positions of bulkheads.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1									
CO2	3	2	1	1								
CO3	3	3	1	1	1							1
CO4	3	3	1	1	1							
CO5	3	3	1	1	1							

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	10	10	15
Understand	20	20	35
Apply	20	20	50
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Contents:

Module I

Equilibrium of ships: Conditions for static equilibrium of a floating body, Archimedes Principle, Hydrostatic pressure distribution on floating cuboids and bodies of arbitrary shape, Stevin's Law. Small changes from equilibrium position, Three types of equilibrium, Small vertical change in the position, small inclination. Bouguer's Metacentre. Euler's Theorem and the axis of inclination, Centre of flotation. Change in the density, Fresh water allowance, Dock water allowance, Plimsoll line. Change in the centre of gravity, Movement of a mass on-board, Addition or removal of a mass. Change in the centre of buoyancy, Addition or removal of a small, medium, and large masses. Small and large changes in the attitude, Curve of centres of buoyancy. Change in the metacentre, Metacentric radius. BM = I/V, Metacentric Evolute, Metacentric height.

Module II

Initial Transverse Stability of ships: Righting lever arm, GZ, Lever arm of stability of weight. $\boldsymbol{GZ = GM \sin \phi}$, Lever arm of stability of form. Heeling of wall-sided ships, Change in the CoB, metacentre, and Atwood's formula for GZ. Finding M using curves of CoB and BM. Adverse effects on the righting lever arm due to vertical and horizontal movement of mass, Addition of mass, Suspended or hanging load, and Free-surface effect. Inclining experiment. Stability of grounded or docked ships. Rolling of ships, Stiff and tender ships

Module III

Stability of Ships at Large angles: Curve of statical stability. GZ(ϕ), Heeling to either side (positive and negative angles of heel), Critical angles. Angle of loll. Cross-curves of stability, Effect of ship dimensions, load distribution and attitude, and environment on the GZ. Intact stability regulations. Large change in the attitude of a ship. Prohaska and Krylov methods for calculating the GZ curve. CoB as a function of BM. Dynamic stability, Different Characteristic curves of dynamic stability, Dynamic stability criteria, Roll or heel test

Practical: Krylov method applied to a barge with a uniform trapezoidal cross-section

Module IV

Longitudinal Stability: Longitudinal metacentre, Trim and MCT1cm, Longitudinal centre of flotation. Change of trim and draft due to addition, removal, and movement of load. Effect of density on trim and draft. Rules on draft and trim and freeboard. Triam and stability booklet. Stability in waves. Second-generation intact ship stability criteria.

Module V

Damaged Stability: Bilging, Surface and volume permeability. Effect of bilging of midship, end, and side compartments. Floodable length curve.

Practical: Floodable length calculation and subdivision of ship. Stability in waves,

References

1. Adrian Biran, Ship Hydrostatics and Stability. 2nd Ed. Elsevier. 2013.
2. V. Semyonov-Tyan-Shansky. Statics and Dynamics of the Ship. Peace publishers, Moscow, 2004.
3. Colin S. Moore, Principles of Naval Architecture Series: Intact stability, SNAME, New Jersey, 2010.
4. E. C. Tupper and KJ Rawson. Basic Ship Theory. Combined Volume. 5th Edition. 2001.
5. Philip A. Wilson. Basic Naval Architecture. Ship Stability. Springer. 2018.
6. A. R. Lester, Merchant Ship Stability. Butterworths, 1985.
7. H. Subramanian, Ship Stability, Nutshell series Book 4, Parts 1, 2, and 3. Vijaya Publications, Mumbai.
8. C. B. Barrass and D. R. Derrett, Ship Stability for Masters and Mates. 7th Ed. Butterworth-Heinemann. 2012.

24-215-0308 ELECTRICAL ENGINEERING LAB

Course Description: This lab mainly focuses on to develop a platform where the students can enhance their engineering knowledge in basic electrical engineering and to apply theoretical knowledge they acquired. This lab provides practical experience on various electrical equipments.

24-215-0308	Electrical Engineering Lab	Category	L	T	P	Credit	Year of Induction
		ESC			3	2	2024

Prerequisite: Basic electrical engineering knowledge on circuits and machines

Course Outcomes: After the completion of the course the student will be able to

CO 1	Perform basic electrical wiring, select fuse for a given electrical circuit and perform electrical measurements using different meters and instruments
CO 2	Measure power and power factor in single-phase and three-phase ac circuits
CO 3	Acquire hands on experience of conducting various tests on induction machines and obtaining their performance indices
CO 4	Acquire hands on experience of conducting various tests on machines and obtaining their performance characteristics.
CO 5	Acquire hands on experience of conducting various tests on transformers and obtaining their performance characteristics.
CO 6	Function as a member of a team and prepare laboratory reports that clearly communicate experimental information in a logical and scientific manner.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1			1						
CO2	3											
CO3	2											1
CO4	3	2										1
CO5	2	1								1		1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	5	5	-
Understand	10	10	-
Apply	10	10	-
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	-

Continuous Internal Evaluation Pattern:

Attendance: 5 marks

Continuous Assessment: 20 marks

Internal Test /Evaluation: 25marks

Total Marks: 50 marks

List of Experiments

1. a) Familiarization of wiring tools, lighting and wiring accessories, various types of wiring systems. Study of Electric shock phenomenon, precautions, preventions, Earthing. Study of Fuse, MCB, ELCB – Selection of Fuse rating for circuits.
   b) Wiring of one lamp controlled by one switch.
   c) Wiring of one lamp controlled by two SPDT Switches and one 3 pin plug socket independently.
2. Three phase power measurement. a) Two wattmeter method b) Three wattmeter method
3. Load test on a dc shunt generator, determination of internal/ external characteristics and analysis
4. Load test on DC series and Shunt motors to plot performance characteristics
5. OC and SC tests on a single-phase transformer and predetermination of efficiency/ regulation
6. Load test on a single-phase induction motor, to plot performance characteristics

References:

1. H Cotton, Advanced Electrical Technology, Reem Publications, 2011.
2. EW. Golding, Electrical Measurements and Measuring Instruments, 5th ed. Reem Publications,2011.
3. Clayton A E & Hancock N N, Performance and Design of DC Machines, ELBS,1971.
4. Nagarath I J & Kothari D P, Electric Machines, Tata McGraw Hill, 1999.
5. Say M G, The Performance and Design of AC Machines, CBS, 1983.

.

24-215-0309 INTERNSHIP

Course Description: Impart students the application of theoretical knowledge on practical work related to Naval Architecture. Work experience is cooperatively planned by the department and employer to fulfill the student's objectives.

24-215-0309	Internship		Category	L	T	P	Credit	Year of Induction
			PCC	-	-	-	2	2024

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply classroom and laboratory concepts and principles in a Shipping industry related working environment.
CO 2	Establish goals by working with supervision to define work objectives for the internship experience.
CO 3	Demonstrate time and project management skills by completing the work objectives within the specified time limits.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Demonstrate the ability to work as a team member to successfully complete the assigned work objectives in an assigned company work group.
CO 6	Demonstrate and promote a proper work ethic.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2		2					3
CO2	3	2	1			3	3					
CO3	3	3			2	3	1				3	
CO4	3	1	1		3					3		
CO5	3	3				2		2	3	3	3	
CO6	3	3				1		3			1	

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	5	5	-
Understand	10	10	-
Apply	10	10	-
Analyze			
Evaluate			
Create			

Assessment Pattern:

Each student will work with their supervisor from the concerned company/organization to jointly develop projects / activities, which will be accomplished during the internship program. The projects/activities should be unique and must be related to the knowledge and/or skills attained during their degree program in Naval Architecture and related areas. The projects must be approved by the instructor/supervisor from the concerned industry/company and/or lead faculty member from the Department of Ship Technology, CUSAT.

Assessment Method:

Each student is required to maintain a comprehensive daily work log detailing their activities. This log should be generated using a word processing software such as Word or a database program like Excel. Emphasis should be placed on maintaining a professional and well-organized format. It is essential to record major activities undertaken on each day of work, ensuring that adequate detail is provided to sufficiently describe the performed tasks. While the following format is suggested, it is imperative to ensure that the log captures a thorough depiction of the work conducted:

Cochin University of Science and Technology Department of Ship Technology Daily Log (Template)
Course and Semester:
Name of the student:
Name of the Employer:
Supervisor's Name:
Date:
Activities for the particular date:

Furthermore, students are required to maintain precise documentation of their internship projects in an engineering notebook. **The notebook must be securely bound and should have page numbers**. Its primary purpose is to serve as a repository for key meetings, ideas, outcomes, observations, references, and all pertinent information associated with the internship. Entries into the notebook should be made directly in ink. This meticulous documentation ensures a thorough and replicable record of the internship's activities and outcomes.

Mark distribution:

Total Marks	CIE	ESE	ESE Duration
50	50	-	-

The assessment will remain exclusively internal. The allocation of marks for the training program adheres to a scale of 50, categorized as follows: 20 marks attributed to the internship workbook, endorsed by the supervisor; 20 marks assigned to the viva voce examination; and 10 marks designated for the final report submitted during the viva voce session.

SEMESTER IV

24-215-0401 MATHEMATICS IV (NUMERICAL METHODS IN ENGINEERING)

Course Description: To equip students with concepts of Solution of problems using Numerical Methods which has wide applications in Engineering problems.

24-215-0401	Mathematics IV (Numerical Methods in Engineering)	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	0	3	2024

Pre-requisites: Nil

Course objectives: This course introduces the concepts and applications of Numerical Methods of solution of problems which have applications in all branches of engineering.

Course outcome: After the completion of the course the students will be able to

CO 1	To solve Linear Algebraic Equations using numerical methods
CO 2	To solve Non-Linear Algebraic Equations using numerical methods
CO 3	Working of Difference operators and their inter relations
CO 4	To familiarize with Numerical Methods for Ordinary Differential Equation
CO 5	To solve Partial Differential Equations using Numerical Methods

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1				2	1					2
CO2	1	1										
CO3	2	2		2	2							
CO4	3	2	1	1	2							1
CO5	3	2	2	2		2	2					1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Solution of Linear Algebraic Equations by the methods of Gauss and Gauss-Jordan. Iteration methods of Jacobi and Gauss-Seidal. Relaxation methods

Module II

Regula-Falsi method and Newton-Raphson Method for non-linear equation in one variable. Horner's Method and Graeffe's Root squaring Method for polynomial equation.

Module III

Difference operators and their inter-relations. Newton 's forward and backward interpolation formulae. Lagrange Interpolation; Numerical differentiation, centre difference operators, central difference formula

Module IV

Numerical Methods for Ordinary Differential Equations. Taylor Series Method. Picard's Method. Runge-Kutta Method of the fourth order. Orders of errors to be mentioned, Milne 's predictor corrector method.

Module V

Harmonic Analysis. Estimation of Fourier coefficients given values of a function at specific values in its domain. Difference formulae for partial derivatives (only two dimensions need to be considered). Numerical methods for solving parabolic and elliptic partial differential equations in Cartesian co-ordinates only as in conduction of heat in infinitely long plates and steady state temperature distribution in finite rectangular plates.

References:

1) Kreyzig, E.; Advanced Engineering Mathematics, Wiley, New York, 2011.

2) B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, New Delhi, 2

3) N P Bali, Manish Goyal,ATextbook of Engineering Mathematics, Ninth Edition, Laxmi Publications

4) John Bird, Higher Engineering Mathematics, Rowlledge, 2010.

5) R.K.jain, S.R.K Iyengar, Advanced engineering mathematics, Narosa, 2012

24-215-0402 RESISTANCE OF SHIPS

Course Description: The goal of this course is to introduce the students to the fundamental concepts in ship resistance, its prediction and estimation of power required to achieve a specified speed. It is also intended to impart knowledge on the developments in hull forms and their design using modern day engineering tools and techniques.

24-215-0402	Resistance of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Basic Fluid Mechanics and Engineering Mathematics.

Course Objectives: This is an introductory course, designed to provide the fundamental concepts of ship resistance and modern scientific approach in powering calculations. It exposes the students to the connection between basic fluid mechanics and the application of hydrodynamics in daily ship design practice.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the various components of ship resistance; application of dimensional analysis and similarity laws in determination of resistance.
CO 2	Understand the components of viscous resistance and pressure resistance in detail that contribute to the total resistance of a surface ship.
CO 3	Understand the principles of various model testing facilities and methods of predicting full-scale resistance from model tests applying similarity laws and accounting for scale effects.
CO 4	Estimate resistance of ships and effective power using statistical / methodical series. Apply standard series data for estimating ship propulsive power for various ship types and size, particularly at the preliminary design stages.
CO 5	Understand the effect of restricted water ways on the resistance of conventional displacement hulls.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											2
CO2	3	2	2	2	1							1
CO3	2	2	2	2	1							1
CO4	2	2	2	2	1		1					2
CO5	2	1	1	1			1					1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test1	Test 2	
Remember	10	10	20
Understand	20	20	50
Apply	20	20	30
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Course Content:

Module I

Components of ship resistance, Dimensional analysis.

Laws of comparison – geometrical, kinematical and dynamical similarity, Froude 's and Reynold 's law, model-ship correlation.

Module II

Viscous resistance – turbulent plate friction and plate resistance, viscous pressure resistance, separation and resistance due to separation, influence of curvature of the ship 's hull, form factor, hull roughness and its influence on frictional resistance. Wave making resistance – pressure resistance, ship wave system, interference effects, theoretical calculation of wave-making resistance, wave breaking resistance, bulbous bows and their effects.

Module III

Model testing – tank testing facilities, testing, prediction of resistance from model tests, extrapolation, Froude 's concept, laminar influence and tank wall effect, comparison of resistance prediction with results of full-scale trials.

Module IV

Determination of resistance from series test results – residuary resistance, effect of hull form on resistance, Taylor series, Series 60, B S R A series, S S P A series, etc.; statistical analysis of resistance data, Guldhammer-Harvald 's and Danckwardt 's method.

Module V

Air and wind resistance, Resistance of appendages, Added resistance in waves; Resistance in restricted waterways – resistance in shallow water, resistance in canals.

Practical: - Resistance calculation using Guldhammer and Harvald series, shallow water resistance calculation, model – ship correlation; modelling and analysis of standard hull forms using modern engineering tools – software packages.

References:

1. Lothar Birk (2019). Fundamentals of Ship Hydrodynamics: Fluid Mechanics, Ship Resistance and Propulsion, First Edition, Wiley, 2019.
2. William Froude and Robert Edmund Froude; Resistance of Ships, primary source edition, Nabu Press, 2014.
3. Jonathan Ridley and Christopher Patterson: Ship Stability, Powering and Resistance, Vol. 13, Ed. 13, Thomas Reed Publications, 2014.
4. William Frederick Durand: Resistance and Propulsion of Ships, Nabu Press, 2013.
5. D. W. Taylor: Resistance of Ships and Screw Propulsion, Unikum, 2012.
6. G. S. Baker: Ship form, resistance and screw propulsion, 2010.
7. John Letcher, Randolph Paulling: Principles of Naval Architecture series – Ship Resistance and flow, SNAME, New Jersey, U.S.A., 2009.
8. Harvald S. A.: Resistance and Propulsion of Ships, John Wiley & Sons, 1983.
9. Antony F. Moland, Stephen R. Turnock: Ship Resistance and Propulsion – Practical Estimation of Propulsive Power, Cambridge University Press, 2011.

24-215-0403 FLUID MECHANICS II

Course Description: This course covers basics of potential flow analysis for inviscid flows, fundamental concepts of vortex motion, connections between circulation and lift, generation of drag in the boundary layer and Navier-Stokes equations for viscous flows: including pipe flows

24-215-0403	Fluid Mechanics II	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Pre-requisites: Knowledge in the fundamentals of fluid mechanics and basic engineering courses like engineering physics, engineering mathematics: calculus and differential equations, elementary vector and tensor algebra, and engineering mechanics.

Course Objectives: The objective of the course is to understand the fundamental concepts of potential flow, ideal flow, vortex motion, boundary layer formation and development of forces on streamlined bodies, flow in pipes, connections between circulation and lift, generation of drag in the boundary layer, thereby laying a solid background to comprehend the core subjects of the programme.

Course outcome: After the completion of the course the students will be able to

CO1	Recall the basic properties of ideal flow and develop an understanding of fundamental concepts of flow with circulation, potential flow and vortex motion
CO2	Understand the fundamental concepts of fluid flow and apply the boundary layer concepts to analyse the behaviour of an object as it moves through a fluid medium.
CO3	Analyse the behaviour of viscous flow in pipes or ducts and ability to solve for internal flow through simple solutions of the Navier-Stokes equations, Moody chart and head-loss equations.
CO4	Describe and analyse turbulent flow, and turbulence
CO5	Evaluate lift and drag for external flows and understand the fundamental concepts of computational methods

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									1
CO2	3	2	3	2			1					2
CO3	3	3	2	2	1	2	2					2
CO4	2	3	2	3	2		1					2
CO5	2	3	3	2	2	2	1					2

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	15	10	20
Understand	20	20	40
Apply	15	20	40
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

Module I

General theory of two and three-dimensional flow: -Continuity equation, Euler 's equation of motion (review). Circulation, Stoke 's integral theorem. Generalised Bernoulli 's equation, sources, sinks, dipole, Flow with circulation, potential flow with rotational symmetry, hydrodynamical lift, Kutta-Joukowski theorem. Vortex motion-Fundamental concepts, vortex analogy to Biot-Savart 's law, straight parallel vortex filaments, vortex sheets.

Module II

Differential Analysis of Fluid Flow- Conservation of mass – Continuity equation, Stream function. Viscous flow-Navier-Stoke 's equations – exact solutions. Approximate Solutions of Navier Stokes equation – Creeping flow approximation. Boundary Layer Approximation- Boundary layer theory-The Boundary Layer Equations, The Flat-Plate Boundary Layer Prandtl 's boundary layer equations, criterion for separation, Blasius solution, Skin friction, displacement thickness, momentum thickness, Turbulent boundary layer, Integral and differential equations of boundary layer, Order of magnitude analysis of boundary layer, Boundary Layers with Pressure Gradient

Module III

Internal Flow - Laminar Flow in Pipes – Pressure drops and head loss, effect of gravity and velocity on flow rate in laminar flow - Hagen-Poiseuille equation - Couette Flow. Turbulent flow in Pipes – turbulent shear stress, turbulent velocity profile, Moody chart and its associated equations.

Minor losses - Minor or Local Losses in Pipe Systems, Multiple-Pipe Systems, Pipes in Parallel, Pipe Networks

Module IV

Turbulent flow- Turbulence Modelling: Reynolds' Time-Averaging Concept, The Logarithmic Overlap Law, Equations of turbulent flow, turbulence closure problem, turbulent models, Reynolds Averaged Navier Stokes Equation

Module V

Drag and Lift, Friction and pressure drag, Drag coefficients of common geometries, Flow over flat plates, cylinders, spheres.

Lift – Finite span wings and induced drag, circulation, pressure distribution-theory of thin air foils, circulation distribution, Cavitation.

Introduction to Computational Methods in Fluid Dynamics, Application of CFD in fluid mechanics.

References:

1. Frank M White; Fluid Mechanics Seventh Edition Tata McGraw-Hill Publishing Co, Ltd.
2. Yunus A Cengel and John M Cimbala; Fluid Mechanics – Fundamentals and Applications, Mc Graw Hill 2021
3. Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd., 1963.
4. Schlichting; Boundary Layer Theory, Springer Verlag, 2001.
5. Vallentine; Applied Hydrodynamics, ELBS, 1967.
6. Joseph H Spurk, Fluid Mechanics, Springer, 2008.
7. Meihard Schobeiri, Applied fluid mechanics for Engineers, McGraw Hill professional, 2014.
8. Douglas, Gasiorek, and Swaffield; Fluid Mechanics, PHI, 2011.
9. G.S Sawhney, Fundamentals of fluid mechanics, I.K.International, 2013.
10. Bruce R Munson & others, Fundamentals of fluid mechanics, Wiley, 2016.
11. Hibbeler, R.C., Fluid Mechanics, Pearson, 2017
12. A.K Jain; Fluid Mechanics including hydraulic machines, Khanna Publishers, 1998.
13. Pijush K. Kundu, Ira M.Cohen and David R. Dowling; Fluid Mechanics, AcademicPress,2014.
14. John D Anderson, Computational Fluid Dynamics the Basics with Applications, Mc Graw Hill 2017.

24-215-0404 DESIGN OF MACHINE ELEMENTS

Course Description: Design engineer needs to design various elements of machines considering safety, durability, economical and ergonomical aspects, environmental impact etc. To accomplish this, he has the capability of identifying the load, material properties, safety requirements, failure mode etc under the given working condition. This course is intended to develop such a design skill.

24-215-0404	Design Of Machine Elements	Category	L	T	P	Credit	Year of Induction
		ESC	2	2	-	3	2024

Pre-requisites: Basic knowledge of Engineering mechanics, Mathematics and mechanical properties of materials.

Course Objectives: This is a practical oriented course which enable students to design machine parts as per BIS standards and codes.

Course outcome: After the completion of the course the students will be able to

CO 1	Identify machine elements subjected to steady load, variable load and shock load.
CO 2	Apply the concept of factor of safety, stress concentration factor, standardization, theories of failure in design problems.
CO 3	Evaluate the stress induced in the elements due to various loading conditions.
CO 4	Select suitable materials for the design
CO 5	Design various mechanical elements considering strength, safety, durability, economy, ergonomics and its environmental impact

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									
CO2	3	3	2									
CO3	3	3	2									
CO4	3	3	2									
CO5	3	3	2		2		2		2			2

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	10	10	10
Understand	15	15	30
Apply	25	25	60
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

1. Module I

Fundamentals of machine design: -, design process and principles; Stresses in machine parts-working stress, safe stress, factor of safety, endurance limits in fatigue loading

Elastic springs-classification and uses of springs-allowable stresses and deflections-design for static and fluctuating loads.

2. Module II

Joints: -Detachable joints: Knuckle and cotter Joints, Non detachable joints: welded joints, riveted joints, strength of welded and riveted joints.

3. Module III

Shafts for power transmission - torsion and bending of shafts, design of shafts based on strength and torsional rigidity .

4. Module IV

Keys: - Types of keys, Significance and application of keys in power transmission.

Shaft couplings: -Design of Rigid coupling and flexible couplings.

5. Module V

Bearings: - Slide bearings-introduction to lubrication, hydrodynamic bearings, bearing materials, design of slide bearings. Roller bearings- types, static & dynamic load, capacity, bearing life and selection of Bearings.

Gears: - Types (spur and parallel helical gears) and function of gears, strength of gear teeth, stresses and stress concentration in gears-design of gears.

References:

1. J.E.Shigley: Mechanical Engineering Design, McGraw-Hill., 2003.
2. R.K.Jain; Machine Design, Khanna Publications, New Delhi, 2017.
3. Bhandari.V; Design of machine elements, McGraw Hill education, 2017.
4. P.C.Sharma, D.K.Aggarwal: A text book of machine design, S.K.Kataria& sons, 2013.
5. K. Mahadevan and Dr. K. Balaveera Reddy, Design data hand book,CBS Publishers , 2014
6. U.C. Jindal, Machine design, Pearson education, 2010.

24-215-0405 APPLIED THERMODYNAMICS

Course Description: Covers principles of classical thermodynamics. Develops understanding of mass, energy, heat, work, efficiency, ideal and real thermodynamic cycles, thermodynamics processes, internal combustion engines, properties of steam, principles and modes of heat transfer, refrigeration and air-conditioning. Covers first and second laws of thermodynamics, perfect gas law, properties of real gases, and the general energy equation for closed and open systems.

24-215-0405	Applied Thermodynamics	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Pre-requisites: Nil

Course Objectives: is to impart knowledge on fundamental concepts and laws of thermodynamics and to introduce the various thermodynamic processes & cycles and to impart knowledge on the properties of pure substances and modes of heat transfer. Also, to introduce the principle of operation of steam nozzles, turbines, internal combustion engines, refrigeration systems and air-conditioning systems.

Course outcome: After the completion of the course the students will be able to

CO 1	Apply thermodynamics laws for practical engineering applications
CO 2	Demonstrate understanding of the working of internal combustion engines
CO 3	Able to solve heat transfer problems involving conduction, convection and radiation
CO 4	Analyze the performance of refrigeration systems
CO 5	Demonstrate understanding of the principle and operation of air-conditioning systems.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1								1
CO2	3	2	2									1
CO3	3	2	2	1								
CO4	3	2	2									1
CO5	3	2	2									1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

Module I

Introduction: Basic definitions (System, Control volume, work, heat property, process etc.); Zeroth law of thermodynamics; Ideal gas-equation of state.

First law of thermodynamics

Closed system undergoing a cycle; closed system undergoing a change of state; Internal energy of a system; Expansion work; Process using ideal gas -constant pressure, constant volume, isothermal; adiabatic and polytropic process -work done and heat added in different process; First law applied to one -dimensional steady flow process, flow energy, steady flow energy equation (ID).

Second law of Thermodynamics

Different statements; Reversible and irreversible process; Corollaries of second law - Absolute temperature scale; Carnot cycle -Carnot engine, refrigerator and heat pump. Clauscius inequality and definition of entropy, change of entropy of an ideal gas. Pure substance. Equilibrium diagram -T-s, p-V, p-T, h-s, etc.

Module II

Gas power cycles and I.C.Engines: Gas power cycles: Carnot cycle, Brayton cycle, Erricson cycle, Sterling cycleetc.; Air standard cycles-Otto-Diesel, Dual and Joule cycle; Evaluation of thermal efficiency and mean effective pressure. Internal Combustion engine: Classification of I.C. engines -Principle of operation of spark Ignition and Compression Ignition engines both two stroke and four stroke, Stages of combustion in S.I. and C.I. engines

Knocking and detonation-factors controlling knock and detonation, methods of preventing Knocking and detonation

Steady State Heat Transfer: Modes of heat transfer and their mechanisms, Conduction Fourier 's law of heat conduction-Heat conduction through composite walls and cylinders

Module III

Steady state heat convection, Free and forced convection-Definition of Nusselt, Reynolds, Praudtl and Grashoff's number and their significance. Estimation of convective heat transfer coefficient using empirical formula for free convection over horizontal and vertical plates and cylinders, forced convection thorough pipes.

Heat exchangers: Different types-Log mean temperature difference for parallel flow and counter flow heat exchangers, Radiative heat transfer, Emissive Power-Stephan Boltzmann law-Definition of black body, grey body, Emmissivity, Absorptivity etc.,Kirchoff‘s law of radiation. Estimation of heat transfer by radiation for sample cases like infinite parallel planes infinite concentric cylinders, and concentric spheres

Module IV

Refrigeration: Definition and purpose, Principle of operation of Simple vapour compression system. Representation on T.S. and p-h charts. Estimation of coefficient of performance and refrigerant flow rate. Factors affecting coefficient of performance. Absorption refrigeration system, Comparison with vapour compression systems. Principle of operation of vapour absorption system like Aqua ammonia system, Electrolux system, Lithium bromide absorption refrigeration system etc., Steam jet refrigeration system working principle, Refrigerants, Classification and designation-properties and requirements-Important refrigerants like NH3, CO2, Methyl chloride, Methylene chloride, Freon ‘s etc. Factors influencing selection of refrigerants. Secondary refrigerants.

Module V

Air conditioning principles: Definition and purpose, Psychometry-psychrometric properties of air-Psychrometric chart-Adiabatic saturation, Psychrometric process, Sensible heating and cooling, Humidification and dehumidification, Cooling and humidification, Cooling and dehumidification-Heating and humidification, Heating and dehumidification, Adiabatic mixing of air streams –cooling and heating load calculations, Summer and winter air conditioning –Estimation of the state of supply air to the conditioned space-Quantity of air supply etc. for simple winter air conditioning systems.

References:

1. Nag, P.K., B Patil, T.K.Juna: Engineering Thermodynamics and fluid mechanics, Tata McGraw-Hill Publishing Co. Ltd. 2011.
2. Ballaney, P.L.; Thermal Engineering, Vol. I, Khanna Publishers, New-Delhi., 2005.
3. James P. Todd & Herbert B. Ellis; Applied Heat Transfer, Herper& Row Publishers, New York,1982.
4. Holman, J.P.; Thermodynamics, McGraw-Hill-International Student Edition, 1987.
5. KalyanAnnamalai, Ishwar K Puni, Milind .A Joy: Advanced Thermodynamics engineering, CRC press, 2011.
6. S.Murugan, Engg. Thermodynamics, Alpha Science Intl. Ltd., 2014.
7. R.K.Rajput: Textbook of Engineering Thermodynamics, Laxmi Publications, 2016.
8. Ramalingam K.K., IC engines, Scitech publishers, 2011.
9. P.N.Ananthanarayanan, Basic Refrigeration & Air conditioning, McGraw Hill education, 2013.
10. M.A.Zaher, Refrigeration and Air conditioning Fundamentals,,createspaceindependentpublishing, 2013.
11. Singh, Onkar Applied Thermodynamics 4 PB 699 2015 New age Publication.
12. Prasad, Manohar Refrigeration and Air Conditioning3 PB 399 2015, New age Publication.

24-215-0406 -MATERIALS SCIENCE

Course Description: The aim of this course is to offer students a solid background in the fundamentals of materials- conceptual perspective for origin of materials, structure/property/performance correlation and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to connect the concepts of material science with the core programme.

24-215-0406	Materials Science	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2024

Pre-requisites: Higher Secondary Level physics, Chemistry and Mathematics of materials.

Course Objectives: This is an Engineering course, designed to provide the fundamental concepts of Materials and their application by comprehending the structure, properties and processing and their relationships for metallic, ceramic, polymeric, composite materials and advanced materials.

Course outcome: After the completion of the course the students will be able to

CO 1	Recognize/recall the various types of materials with structure property correlation and understand metallic materials based on structure, properties, processing and applications
CO 2	Comprehend the phase diagram for various alloys and apply this to the heat treatment for different alloys.
CO 3	Apply mechanical testing of materials to differentiate various materials
CO 4	Evaluate metallic and non-metallic materials based on structure, properties, processing and applications for designing engineering application
CO 5	Understand advanced materials based on structure, properties, processing and applications.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1									
CO2	2	3	1									
CO3	2	3	1									
CO4	2	3	1									
CO5	2	2	1									

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3hours

Course Content:

Module I

Introduction to materials Science and its importance, Classification of materials, Structure properties correlation- Atomic structure and Crystal Structure, single and polycrystalline structures, Packing geometry in metallic materials, Crystal planes - and directions, Crystal Defects, point, line, surface and volume defects, Diffusion, Fick's 1st and 2nd law equation

Module II

Phase Transformation and Phase Diagram: Nucleation& Growth, homogeneous& heterogeneous nucleation, Phase rule, isomorphous system, lever rule, eutectic, peritectic, eutectoid & peritectoid system, ternary diagram, iron-carbon diagram, T-T-T diagram, Annealing, normalizing, hardening& tempering, recovery, recrystallization & grain growth, Precipitation hardening, Structure of ferrous and nonferrous alloys.

Module III

Mechanical Properties: Plastic deformation, slip twinning, Critical resolved shear stress, theoretical shear strength of perfect crystal, role of dislocation in plastic deformation, viscoelasticity, methods of strengthening crystalline materials. Stress-strain diagrams of metallic, ceramic and polymeric materials, hardness, hardenability, impact strength, creep, fatigue, ductile and brittle fracture

Module IV

Structural materials: Metallic Materials-Ferrous materials, their classification, composition, properties and application. Non-Metallic Materials-Non-ferrous materials, their classification, composition, properties and application.

Module V

Advanced Materials: Smart materials, Nanomaterials, Shape Memory alloys, Piezoelectric materials, Mangetostrictive materials, Sensors, Optical fibre, Micro elctro mechanical systems (MEMS), Energy Materials - Photovoltic, Solar cells, Metamaterials, super alloys, self-assembly, bio-inspired materials.

References:

1. Callister W D, "Materials Science and Engineering:An Introduction", 7th Edition, John Wiley & Sons, Inc., 2007.
2. Raghavan V, ―Materials Science and Engineering: A First Course", Prentice Hall of India Pvt. Ltd., 2004.
3. Van Vlack L H, "Elements of Materials Science and Engineering", 6th Edition, Addison Wesley, New York, 2002.
4. Stephen. C. Dexter-Handbook of Oceanographic Engineering Materials, A Wiley Series, 1985.
5. V. Raghavan-Material Science and Engineering, Prentice-Hall of India (P) ltd New Delhi, 2015.
6. Donald S Clark-Physical Metallurgy for Enginers, East West Press(P) ltd, New Delhi, 2004.
7. A.G.Guy- Introduction to Materials science, McGraw Hill ltd, International Student Edition, 1972.
8. Kakani, S.L., Material Science 3, PB, 675, 2016, New age Publication.

24-215-0407 FLUID MECHANICS LAB

Course Description: This lab is mainly focused to develop a platform where the students can enhance their engineering knowledge in the fluid mechanics domain by applying their theoretical knowledge acquired.

24-215-0407	Fluid Mechanics Lab	Category	L	T	P	Credit	Year of Induction
		ESC	1	-	2	2	2024

Prerequisite: Nil.

Course Objective: The objective of this training is to familiarize the major instruments commonly used in the field of fluid mechanics and practice different experiments in the fluid mechanics domain

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify major instruments commonly used in the field of fluid mechanics.
CO 2	Identify and practice different experiments in the fluid mechanics domain.
CO 3	Apply the theoretical knowledge gained in the class room with the physical world.
CO 4	Compare different techniques and instruments used in Fluid flow measurements.
CO 5	Carry out scientific experiments as well as accurately record and analyse the results of such experiments.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3								1			1
CO2	3	3			2							1
CO3	3	3		3								1
CO4	3	3			2							1
CO5	3	3	3		1			2	1			1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	5	5	-
Understand	10	10	-
Apply	10	10	-
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	-

Continuous Internal Evaluation Pattern:

Attendance: 5 marks

Continuous Assessment: 20 marks

Internal Test /Evaluation: 25marks

Total Marks: 50 marks

List of Experiments

1. Pressure measurements
2. Velocity and rate of flow measurements
3. Verification of Bernoulli's Theorem
4. Calibration of Venturimeter
5. Determination of Friction factor
6. Critical velocity and Reynold 's number at steady pipe flow
7. Calibration of small orifices and Notches
8. Determination of metacentric height of a floating model

24-215-0408 MODEL MAKING TECHNIQUES LAB

Course Description: Ship models helps to scale down the dimensions of a ship so that all important parameters of a prototype can be estimated and analysed on a model scale and finally extrapolated to full scale. Models are useful for stability study, sea keeping and manoeuvring characteristics study, resistance and propulsion tests.

24-215-0408	Model Making Techniques Lab	Category	L	T	P	Credit	Year of Induction
		PCC			3	2	2024

Prerequisite: Nil

Course Objective: i) To impart knowledge of various types of modelling materials and methods used in ship model making. ii) To gain practical exposure on handling tools and machineries used in model making

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand various types of models used in ship building industry.
CO 2	Understand various materials, **tools** and techniques used in ship model making.
CO 3	Make ship models using pattern and frame method.
CO 4	Apply the knowledge gained in the class room with the physical world.
CO 5	Improve the skills of using various hand tools and machineries.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1							1		1
CO2	3									1		1
CO3	2									1		1
CO4	3	2								1		1
CO5	2	1								1		1

Assessment Pattern:

Bloom 's Category	Continuous Assessment Tests		End Semester Examination
	Test 1	Test 2	
Remember	5	5	-
Understand	10	10	-
Apply	10	10	-
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	-

Continuous Internal Evaluation Pattern:

Attendance: 5 marks

Continuous Assessment: 20 marks

Internal Test /Evaluation: 25marks

Total Marks: 50 marks

List of Experiments

1. Study on tools and machineries used in model making
2. Preparation of drawings
3. Model making using pattern method
4. Model making using frame method

SEMESTER V

24-215-0501 PROPULSION OF SHIPS

Course Description: Types of propellers and propulsion systems, performance of propellers in open water and behind-ship conditions, requirements in propeller design, analysis and design of propellers given constraints, analysis and design of engine-propeller-hull systems.

24-215-0501	Propulsion of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Basic Fluid Mechanics and Engineering Mathematics.

Course Objectives: The propulsion system is a part of the ship that Naval Architects design. Design of propellers, selection of engines, determination of the optimum speed of the ship, etc. are also a part of ship design. Propulsion of Ships in conjunction with other courses such as Resistance, Controllability, and Structural Design is an essential part of the Naval Arch curriculum.

Course outcome: After completion of the course the students will be able to:

CO 1	Understand the various types of propulsion systems for ships and the geometry of screw propellers.
CO 2	Appreciate the performance of propellers in ideal open-water and actual behind-ship conditions. Appreciate the detrimental effect of cavitation and how to avoid it.
CO 3	Know the various available series of propellers and their characteristics. Select the best propeller for specified thrust or power. Know how to test model propellers in open-water and behind-ship conditions and scale the results to full-size.
CO 4	Determine the rpm of a propeller fitted on a ship for a specified self-propulsion speed. Know engine characteristics. Determine the power needed and rpm at trial and service conditions considering the constraints imposed by the engine.
CO 5	Understand how to select the materials used in propellers, and the stresses in propellers. Understand the need for special types of propellers, their advantages and disadvantages.

Mapping of course outcomes with program outcomes: Level - Low (1), Medium (2) and High (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2											1
CO 2	3	2	2	2	1							1
CO 3	2	2	2	2	1							2
CO 4	2	2	2	2	1		1					2
CO 5	2	1	1	1			1					2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	50
Apply	20	20	30
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0501 PROPULSION OF SHIPS

Course Content

Module I

Propeller as a thrust producing mechanism; historical development. Screw propeller: geometry, cylindrical sections, propeller drawing, construction details. Propeller theories: Momentum theory, Blade-element-momentum theory, Circulation theory.

Module II

Interaction between Hull and propeller: Wake and wake fraction, Resistance augment and thrust deduction factor, propulsive efficiency in open water and behind ship conditions, hull efficiency, quasi propulsive coefficient, transmission efficiency. Cavitation: Types, Cavitation Number, Effects of cavitation, Cavitation bucket, Cavitation charts and equations

Module III

. Design of propellers: Propeller families and series. Open water characteristics in KT-KQ diagrams, Bp-δ diagram, and other modern diagrams. Selection of optimum propeller given requirements and constraints. Open-water test. Self-propulsion test. Extrapolation to full scale.

Module IV

Self-propulsion points of a ship fitted with a propeller (speed vs rpm). Types of engines and their characteristics. Matching of engine with propeller: Power and rpm at trial, service, and maximum continuous rating conditions.

Module V

Materials and their qualities. Stresses in propellers. Ducted propellers. Super cavitating propellers. Controllable pitch propellers.

Practicals. Optimal propeller design using diagrams or equations for series propellers. Self-propulsion points of ship fitted with a propeller. Selection of engine based on trial and service requirements.

References

1. Anthony F. Molland, S. R. Turnock, and D. A. Hudson. Ship Resistance and Propulsion. 2nd Ed. Cambridge University Press, 2011
2. J. P. Ghose and R. P. Gokarn. Basic Ship Propulsion. KW Publishers. 2015.
3. L. Birk. Fundamentals of Ship Hydrodynamics. Wiley 2019.
4. John Carlton. Marine Propellers and Propulsion. 3rd Edition. Butterworth-Heinemann, 2012.
5. D.W. Taylor. The Speed and Power of Ships. A Manual of Marine Propulsion. Reprinted by Maritime Press, 2013.
6. Justin E. Kerwin and Jacques B. Hadler. Propulsion. The Principles of Naval Architecture Series. SNAME, 2010.

24-215-0502 SHIP MOTIONS IN SEAWAY

Course Description: This course is designed to offer the students an understanding of the concept of seakeeping of ships.

24-215-0502	Ship Motions in Seaway	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Nil

Course Objectives: The objective of the course is to provide the learners with an understanding of the ship motions, motion control and seakeeping performance of ships in a seaway.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Explain various wave theories.
CO 2	Explain the equations of motion for various ship-motions and the hydrodynamic forces acting on ships
CO 3	Explain the dynamic effects on ships in a seaway
CO 4	Discern various methods of ship-motion control
CO 5	Explain the seakeeping performance of ships and seakeeping-related design aspects of high-performance ships

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1										1
CO 2	3	1										
CO 3	2	1										
CO 4	2	1										
CO 5	2	1										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	50
Apply	10	10	30
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0502 SHIP MOTIONS IN SEAWAY

Course Content

Module I

Ocean Waves – Wind generated waves, regular wave theory, waves of Finite Height, Trochoidal Waves, Group Waves, Irregular Seaway, Point and Directional spectras, Wave Slope Spectra, Encounter Frequency Spectra, Idealised Spectral Families.

Module II

Ship in Regular Waves – Co-ordinate Systems, Equations of Motion (uncoupled Heave, Pitch and Roll; Coupled Heave and Pitch), Hydrodynamic Forces, Radiation Forces, Strip Theory.

Module III

Ship in Seaway and Dynamic effects – Linear Superposition, Response Amplitudes Operator, Pitch and Roll in Irregular Waves, Local and Relative Motions, shipping of green Water, Slamming, Yawing and Broaching, Added Resistance, Powering in waves, Wave Loads.

Module IV

Ship Motion Control – Control of Roll – Passive Stabilisers (Bilge Keel, Sails, Free Surface Tanks, U-tanks, Moving weight), Active Stabilizers (fin, gyro, active-tank), Rudder Stabilisation, Control of Pitch.

Module V

Sea-keeping Performance and Design Aspects – Sea-keeping performance criteria and ship seaways responses, factors affecting pitching, heaving and rolling, guidelines for design, Sea-keeping features of high-performance ships (catamarans, SWATH, Planning Craft, Hydrofoil Craft, Air Cushion Vehicles and Surface and Surface Effect Ships, Submarines).

References

1. SC Misra, Design Principles of Ships and Marine Structures, 2016, CRC Press
2. Edward M. Lewandowski, The Dynamics of Marine Crafts, 2004, World Scientific Publishing Co. Pt. Ltd.
3. Bhattacharyya. R, 'Dynamics of Marine vehicles', 1978, Wiley Inter Science, New York.
4. Lamb.H; 'Hydrodynamics', 1945, Cambridge University Press, UK
5. Newman J.N; 'Marine Hydrodynamics', 1977, MIT Press, USA
6. Newman J.N; 'Theory of Ship Motions', Advances in Applied Mechanics, Vol., 1980.
7. Price W.G & Bishop R.E.D; 'Probabilistic theory of Ship Dynamics', 1982, Chapman & Hall, London.
8. Alexandr I. Korotkin, Added masses of Ship Structures (Fluid Mechanics and Its Applications), 2010.
9. Bertram, Volker, Practical ship hydrodynamics, Amsterdam Elsevier 2012
10. Hermans, A J., Water Waves and Ship Hydrodynamics an introduction, Heidelberg Springer 2011.

24-215-0503 MARINE ENGINEERING

Course Description: Aim of this course is to expose students to various marine systems which include main and auxiliary system used for propulsion and those systems which aid for propulsion and also to have basic knowledge for preparing an engine room plan.

24-215-0503	Marine Engineering	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Applied Thermodynamics, Introduction to Naval Architecture

Course Objectives: To understand the various main and auxiliary systems in ships. To develop understanding about the Engine room arrangement in the design of ships.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Understand the role of various marine machinery and systems essential for ship operations.
CO 2	Analyzing the functions of critical onboard machinery, fostering an appreciation of their contribution to efficient ship operations
CO 3	Recognize and address engineering challenges through innovative design and construction strategies to enhance machinery performance and reliability.
CO 4	Gain expertise in the operation and significance of automation systems onboard ships to improve operational control and efficiency.
CO 5	Master the skills required to design and plan an efficient engine room layout, ensuring safety, functionality, and ease of operation.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2		2					
CO 2	3				2	3	2					
CO 3	2				2							
CO 4	2				2							
CO 5	3	3	3		2	3	2					

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	15	15	30
Apply	10	10	20
Analyse	10	10	20
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0503 MARINE ENGINEERING

Course Content

Module I

Introduction to Marine Engineering, Marine Engineering and Naval Architect, Ships and machinery, design and selection consideration. Marine diesel engines – general engine principles, Low speed and medium speed diesel engines, Two/Four stroke Marine engines, Scavenging and turbo charging, Fuel oil system, lubricating oil systems, cooling systems, torque and power measurement, starting air systems and reversing systems, controls and safety devices, Couplings and Gearboxes, Specific Fuel Consumption. MARPOL regulations and Energy Efficiency Design Index (EEDI), Ship Energy Efficiency Management plan (SEEMP)

Module II

Aux. systems- Air compressors, boilers, heat exchangers, cooling, evaporators, distillers, waste heat recovery systems, hot water, drinking water, cooling water and sea water systems. Bilge and Ballast systems – Sewage disposal, Oily water separator, incinerator, IMO/MARPOL regulations, galley equipment, Refrigeration system, HVAC.

Module III

Marine Steam turbines –Types of turbines, compounding, reheat, turbine construction, rotors, blades, casing, Gland sealing, diaphragms, nozzles, bearings etc. Lubrication systems, expansion arrangements, Gearings. Marine gas turbines – fundamentals of G.T, Structure of gas turbines, gearing, operational features, controls, combined cycles. Nuclear propulsion –physical principles of the operation of nuclear reactors – use of nuclear propulsion on seagoing vessels, Electrical Propulsion.

Module IV

Marine pumps, piping and automation systems Marine and special duty pumps, Details of pumps for marine purpose viz. condenser circulating pumps. Condensate and drain pumps, boiler feed pumps, bilge and ballast pumps rotary pumps. Marine piping – various types of piping system fitted-in ships, Expansion arrangements for pipes. Materials, Basics of automation and its significance in marine engineering., Overview of control systems used on board ships (e.g., PLCs, SCADA systems).Engine room monitoring and remote control systems., Alarm systems and safety interlocks for critical machinery., Real-time data acquisition and analytics for machinery performance**..**

Module V

Environmental and Sustainable Engineering Practices- IMO regulations on emissions, energy efficiency, and ballast water management, overview of MARPOL conventions and compliance requirements, Exhaust gas cleaning systems (scrubbers) and selective catalytic reduction (SCR), LNG, biofuels, ammonia, and hydrogen .Carbon capture and storage (CCS) technologies on board ships, Energy Efficiency Design Index (EEDI) and its impact on ship design., Ship Energy Efficiency Management Plan (SEEMP) implementation. Case studies on successful implementation of energy-saving devices. Renewable Energy Integration, Solar panels, wind-assisted propulsion, and hybrid energy systems, Hydrogen fuel cells and their role in future maritime applications., Challenges and opportunities in adopting renewable technologies

.**References:**

1. Doug Woodyard; Pounder's Marine Diesel Engines & Gas Turbines, 9th Edition, 2014
2. Harrington; Marine Engineering, SNAME Publications, 1992
3. Alan Rowen, Introduction to Practical Marine Engineering, Society of Naval Architects,2005
4. T.K. Grover, Basic Marine Engineering, Anmol, New Delhi, 2007
5. H. D. McGeorge; General Engineering Knowledge Routledge; 3rd edition 2012
6. Taylor, D.A.; Introduction to Marine Engineering, Butterworth-Heinemann, 2003.
7. IMO, MARPOL Consolidated edition, 2011
8. IMO, SOLAS Consolidated Edition, 2014
9. A. J. Wharton, Anthony John Wharton ; Diesel Engines 3rd edition Butterworth-Heinemann 2013

24-215-0504 SHIP STRUCTURAL ANALYSIS - I

Course Description: The course is designed to offer the students an understanding of the basic concepts in structural analysis of ships.

24-215-0504	Ship Structural Analysis - I	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	4	2024

Pre-requisites: Should have attended AOS (required), should have attended or be attending SMS (desired).

Course Objectives: The objective of the course is to provide the learners an understanding of the determination of loads acting on the ship structure, the analysis of longitudinal and transverse strength of ships and the bending of plates.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Discern the types of loads acting on ship structure and determine the magnitude of loads acting on ships.
CO 2	Explain the global response of hull girder in terms of longitudinal bending and sheer.
CO 3	Analyse transverse strength of ships.
CO 4	Understand the procedure used to determine wave loads using traditional approach and using class codes. The learner should also be introduced to the probabilistic approach used to determine the wave loads.
CO 5	Gain a general understanding of the theory of bending of plates.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											1
CO 2	3	2	1									
CO 3	3	2	1		1							1
CO 4	2	1										
CO 5	2											

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0504 SHIP STRUCTURAL ANALYSIS - I
Course Content

Module I
Loads acting on ship structures:

Introduction: Nature of Ship Structures, Size and Complexity of Ships, Multipurpose Function of Ship Structural Components, Variability of Ship Structural Loads, Probabilistic Nature of Structural Behaviour, Modes of Ship Structural Failure, Design Philosophy and Procedure

Classification of loads: Static loads, Low-frequency dynamic loads, High-frequency dynamic loads, Impact loads. General introduction to springing, slamming, whipping, shipment of green water.

Determination of weight distribution, w(x): Distribution of continuous material (hull weight): Biles method, Comstock method, method of Cole. Distribution of semi-concentrated items, distribution of cargo, total weight distribution, weight distribution as a step curve. Determination of buoyancy curve b(x) in static condition, conversion to step curve. Load, shear force and vertical bending moment distributions in still water. Wave induced loads (low frequency dynamic loads), Approximation of wave bending moment by static hogging and sagging waves, use of L/20 and other wave profiles. Probabilistic estimate of wave induced loads in random seas, Long term and short term distribution of sea loads.

Module II
Global response of hull girder-Bending and Shear:
Longitudinal bending: Application of beam theory, Characteristics of shear force and bending moments, distinction between still water loading and wave loading, bending stress distribution, Calculation of neutral axis, moment of inertia and section modulus of cross section, structural members to be included in the calculation of moment of inertia (effective members), combined vertical and horizontal bending, composite beam, change in section modulus due to addition/subtraction of material in cross section, departures from beam theory.
Shear: General Introduction to shear stress in open section due to shear load, shear stress in multi cell sections, shear lag, effective breadth, hull super structure interaction.

Module III
Transverse strength:
Loads to be considered in transverse strength, modelling of the transverse structure for analysis, application of moment distribution method. Bending of beams and girders (with more than two supports), analysis of bulkhead stiffeners.

Module IV
Wave loads:
Basic elements of probability: Normal distribution, log-normal distribution, Rayleigh distribution, probability density, functions of two variables.
Random process: Stationery and ergodic random process, autocorrelation, spectral density, moments of spectral density, narrow band process, distribution of peak, extreme values, long term and short term extreme values.
Sea surface representation: Ocean wave spectra- mathematical representation, transfer function, response spectrum, characteristic values of wave loads.

Module V
Plate bending:
Small deflection theory: Long plates (cylindrical bending), Love Kirchhoff assumptions, plate bending equation for lateral load, boundary conditions. Solution of special cases: Simply supported plates, clamped plates, Combined membrane and bending stresses
Large deflection theory, membrane tension, effect of initial imperfections.
Buckling of plates: Buckling of wide column, buckling of simply supported plate, influence of other boundary conditions on buckling strength of plates.

References:

1. Alaa Mansour, Don Liu, Principles of Naval Architecture Series: Strength of ships and
2. Ocean Structures, SNAME, New Jersey, 2008.
3. Owen. F. Hughesand Jeomkee Paik Ship Structural Analysis And Design, SNAME, New York., 2008.
4. Mohammed Shama Torsion And Shear Stresses In Ships, Springer - Verlag, 2010.
5. Mohammed Shama Buckling Of Ship Structures, Springer - Verlag, 2013.
6. Yasuhisa Okumoto Design Of Ship Hull Structures- A Practical Guide For Engineers, Springer Verlag, 2009.
7. Yasuhisa Okumoto, Yu Takeda, Masaki Mano, Tetsuo Okada; Design Of Ship Hull Structures, Springer, 2010
8. Chandrasekaran Srinivasan; Advanced Marine Structures, Springer, 2010.

24-215-0505 STRUCTURAL DESIGN OF SHIPS

Course Description: The objective of the course is to provide the learners an understanding of the concept of design aspects of ship's structure and the procedures to design various structural members onboard and to develop design and drawings of mid-ship section of ships and boats.

24-215-0505	Structural Design of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	4	2024

Pre-requisites: Nil

Course Objectives: The objective of the course is to provide the learners an understanding of the concept of design aspects of ship's structure and the procedures to design various structural members onboard and to develop design and drawings of mid-ship section of ships and boats.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Discern various kinds of materials used onboard and general aspects in design of structure of ships
CO 2	Explain various structural systems and subsystems and their role in ensuring structural integrity of ships.
CO 3	Explain the procedures of calculation of scantlings of structural members of ships
CO 4	Explain various structural arrangements onboard highlighting the importance of compatibility with other aspects of ship design.
CO 5	Develop a model mid-ship and other structural systems, including shell expansion of a ship, using ship classification society rules and other shipbuilding practices.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1										1
CO 2	3	1										
CO 3	3	1										1
CO 4	3	1										1
CO 5	3	1										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0505 STRUCTURAL DESIGN OF SHIPS

Course Content

Module I

Introduction

Shipbuilding materials – transition from wood to steel (historical review), shipbuilding quality steels (properties, steel grades); Ship structural design concepts – specialisation of the structure, general considerations in structural design, external loads , structural analysis models, design criteria, steps in structural design procedure, design according to classification rules. IMO-goal based standards and IACS common structural rules (CSR)

Module II

Ship structural systems –

Ship as stiffened plate structure – framing systems, common stiffener sections, corrugated construction, design of strakes (butts, seams), welding sequences, shell expansion; Structural subsystems – break up into bottom structure, side structure, deck structure, bulkhead structure, end structure, superstructure etc., general structural arrangements of different types of ships (historical review); subassembly, stiffened panels and volume sections.

Module III

Bottom structure and Side structure

Bottom structure – framing system, functions, single bottom and double bottom construction, structural components and scantlings, openings, cut outs, connection details, bilge keel; Side structure – framing system, functions, structural components and scantlings.

Module IV

Decks and Bulkheads

Deck structure – functions, framing system, structural components and scantlings, hatch ways, pillars, bulwarks, guard rails, fenders; Bulkhead structure – type of bulkheads, functions, framing system, structural components and scantlings, Superstructures and Deck houses, expansion joints.

Module V

End structures

Fore end structure – functions, structural arrangements (panting), structural components & scantlings; Aft end structure – functions, structural arrangements, structural components &scantlings;Structural arrangements in engine room, Main engine foundation, Skylight and Funnel, Structural connections – compatibility, bottom & side, side & deck, bulkhead with deck, side & bottom.

Practicals – Design and Drawing of Midship Section, Drawing of Shell expansion

Reference:

1. Taggart; Ship Design and Construction, SNAME, 1980.
2. D'Arcangelo; Ship Design and Construction, SNAME, 1969.
3. Yong Bai , Marine Structural Design, Elsevier Science, 2003.
4. Eyres D.J.; Ship Construction , William Heinemann Ltd, London, 2011
5. Owen. F. Hughes and JeomKee Paik – Ship Structural Analysis and Design, SNAME, New York., 2008
6. Yasuhisa Okumoto, Yu Takeda, Masaki Mano, Tetsuo Okada; Design of Ship Hull Structures, Springer, 2010
7. ChandrasekaranSrinivasan; Advanced Marine Structures, Springer, 2010.

24-215-0506 MARINE HYDROSTATICS & HYDRODYNAMICS LAB

Course Description: This lab is mainly focussed on developing a platform where the students can enhance their engineering knowledge on carrying out marine hydrostatics and hydrodynamics experiment and calculations.

24-215-0506	Marine Hydrostatics & Hydrodynamics Lab	Category	L	T	P	Credit	Year of Induction
		PCC	-	-	4	2	2024

Pre-requisites: Knowledge on Stability, Resistance and Propulsion of ships.
Course Objectives:

Course Outcomes: After completion of the course the students will be able to:

CO 1	Identify major equipment‘s commonly used in analysing ships hydrodynamics characteristics.
CO 2	Identify different components and parameters obtained in tests.
CO 3	Apply the theoretical knowledge gained in the class room with the physical world.
CO 4	Compare different techniques and equipment‘s for various testing methods.
CO 5	Carry out scientific experiments as well as accurately record and analyse the results of such experiments.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3								1			1
CO 2	3	3			2							1
CO 3	3	3		3								1
CO 4	3	3			2							1
CO 5	3	3	3		1			2	1			1

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50		

Continuous Internal Evaluation Pattern:
Attendance : 5 marks
Continuous Assessment : 20 marks
Internal Test /Evaluation : 25marks
Total Marks : 50 marks

List of Experiments

1. Witness model test to predict ship resistance, flow line test, shallow water resistance test.
2. Witness Open water test, self-propulsion test, bollard pull test.
3. Witness Seakeeping tests
4. Carry out scaled down model inclining experiment
5. Carry out experiments to differentiate between list and loll.
6. Carry out experiments to understand Archimedes principle and neutral buoyancy.

24-215-0507 MATERIAL TESTING LAB

Course Description: This lab introduces the students to experimental techniques to determine the properties and behaviour of engineering materials, with focus on stress-strain relations, strength, and deformation mechanisms.

24-215-0507	Material Testing Lab	Category	L	T	P	Credit	Year of Induction
		ESC	-	-	4	2	2024

Pre-requisites: Engineering Mechanics, Mechanics of Solids
Course Objectives:
Course Outcomes: After completion of the course the students will be able to:

CO 1	Familiarize with experimental methods for characterizing material behavior
CO 2	Evaluate material behavior using experimental test results and theoretical formulae
CO 3	Compare the measured experimental results with the calculated theoretical values
CO 4	Compare different techniques and equipment to determine the physical and mechanical properties of materials
CO 5	Carry out scientific experiments as well as accurately record and analyse the results of such experiments.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of Course Outcomes against Program Outcomes

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3								1			1
CO 2	3	3			2							1
CO 3	3	3		3								1
CO 4	3	3			2							1
CO 5	3	3	3		1			2	1			1
CO 6	1	3						2	3	2		2

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50		

Continuous Internal Evaluation Pattern:
Continuous Assessment: Class work 50%
Marks Internal Tests: 50% Marks

List of Experiments

1. Standard tension test on UTM (Al or MS Rod)
2. Shear strength of MS rod on UTM
3. Deflection characteristics of open and closed springs
4. Determination of rigidity modulus using a torsional pendulum.
5. Hardness measurement – Brinell, Rockwell
6. Charpy and Izod impact tests
7. Maxwell‘s theorem and estimation of Young‘s modulus
8. Natural frequency and damping of cantilever beams

24-215-0508 ENVIRONMENTAL STUDIES

Course Description: This course equips students with the knowledge and skills to address environmental challenges, emphasizing sustainable practices and global environmental stewardship. The curriculum integrates ecological principles, conservation strategies, and the socio-environmental implications of marine and shipbuilding activities.

		Category	L	T	P	CREDIT	Year of Induction
24-215-0508	Environmental Studies	HMC	1	1	-	0	2024

Pre-requisites: Engineering Chemistry

Course Objectives: To equip students with knowledge of environmental concepts, sustainable practices, and the impacts of human activities, emphasizing eco-friendly approaches in maritime and shipbuilding industries.

Course Outcomes: After the completion of the course the students will be able to:

CO1	To enlighten students about the importance of conservation of renewable and non-renewable natural resources, and promote equitable resource utilization for sustainable living.
CO2	To provide a comprehensive understanding of ecosystem structure, functions, and dynamics, with a focus on energy flow, food webs, and the interdependence of different ecosystems.
CO3	To explore biodiversity conservation strategies and address threats at global and regional levels.
CO4	To analyze pollution, waste management, and socio-environmental challenges, particularly in shipping.
CO5	To assess the impacts of climate change on oceans and explore renewable energy solutions for maritime sustainability.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2										1
CO 2	2	2	1									1
CO 3	2	2	2	1	2		1					1
CO 4	3	3	2	2	1		2					1
CO 5	2	3	2	2	1		1					1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	-
Understand	20	20	-
Apply	20	20	-
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	

24-215-0508 ENVIRONMENTAL STUDIES

Course content

Module 1

Natural Resources

Natural resources-Renewable and non-renewable resources; Characteristics, uses and conservation of natural resources- Forest resources, Water resources, Mineral resources, Food resources, Energy resources and Land resources. Equitable use of resources for sustainable lifestyles.

Module 2

Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the different ecosystems- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3

Biodiversity and its conservation

Introduction – Definition: genetic, species and ecosystem diversity; Biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values;

Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module 4

Environment and Social Issues

Environmental Pollution; Cause, effects and control measures of different types of pollution; Solid waste Management; Shipboard waste management and treatment technologies. Disaster management. Social Issues and the Environment, From Unsustainable to Sustainable development. Environmental ethics. Climate change, global warming, nuclear hazards, ill-effects of fireworks. Wasteland reclamation. Laws and acts in India for environment protection. MARPOL regulations and compliance.

Module 5:

Climate Change and Ocean Dynamics

Impact of climate change on oceans (sea level rise, ocean acidification, coral bleaching), Role of shipping in greenhouse gas (GHG) emissions, International conventions and initiatives: IMO GHG strategy, Paris Agreement, Renewable energy for ships (wind, solar, and wave energy).

References:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publications Limited, Bikaner, India
2. Erach Bharucha. 2013. Textbook of Environmental Studies for Undergraduate Courses. University Grants Commission, New Delhi
3. N. Arumugam and V Kumaresan. 2014. Environmental Studies (UGC Syllabus), Saras Publications, Nagarkoil, India
4. D.K. Asthana and Meera Asthana. 2010. A Textbook of Environmental Studies. S. Chand Publishing, New Delhi.
5. B.S. Chauhan. 2015. Environmental Studies. Laxmi Publications, New Delhi.
6. Marine Pollution Control by C.D. van Meerkerk
7. Handbook of Marine Environment Protection by Markus Salomon & Till Markus
8. Climate Change and Maritime Industries by Regina Asariotis
9. Sustainable Shipping by Harilaos N. Psaraftis

24-215-0509 INTERNSHIP

Course Description: Impart students the application of theoretical knowledge on practical work related to Naval Architecture. Work experience is cooperatively planned by the department and employer to fulfill the student's objectives.

24-215-0509	Internship	Category	L	T	P	Credit	Year of Induction
		PCC	-	-	-	2	2024

Pre-requisites:

Course Objectives:

Course Outcomes: After completion of the course the students will be able to: Course outcome: After the completion of the course the students will be able to

CO 1	Apply classroom and laboratory concepts and principles in a Shipping industry related working environment.
CO 2	Establish goals by working with supervision to define work objectives for the internship experience.
CO 3	Demonstrate time and project management skills by completing the work objectives within the specified time limits.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Demonstrate the ability to work as a team member to successfully complete the assigned work objectives in an assigned company work group.
CO 6	Demonstrate and promote a proper work ethic.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	2	2	2	2	2	2	2	2	2	2	2	2
CO 3	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	2	2	2	2
CO 5	2	2	2	2	2	2	2	2	2	2	2	2
CO 6												

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50		

24-215-0509 INTERNSHIP

Assessment Pattern:
Each student will work with their supervisor from the concerned company/organization to jointly develop projects / activities, which will be accomplished during the internship program. The projects/activities should be unique and must be related to the knowledge and/or skills attained during their degree program in Naval Architecture and related areas. The projects must be approved by the instructor/supervisor from the concerned industry/company and/or lead faculty member from the Department of Ship Technology, CUSAT.

Assessment Method:
Each student is required to maintain a comprehensive daily work log detailing their activities. This log should be generated using a word processing software such as Word or a database program like Excel. Emphasis should be placed on maintaining a professional and well-organized format. It is essential to record major activities undertaken on each day of work, ensuring that adequate detail is provided to sufficiently describe the performed tasks. While the following format is suggested, it is imperative to ensure that the log captures a thorough depiction of the work conducted:

Cochin University of Science and Technology **Department of Ship Technology** **Daily Log (Template)**
Course and Semester:
Name of the student:
Name of the Employer:
Supervisor's Name:
Date:
Activities for the particular date:

Furthermore, students are required to maintain precise documentation of their internship projects in an engineering notebook. The notebook must be securely bound and should have page numbers. Its primary purpose is to serve as a repository for key meetings, ideas, outcomes, observations, references, and all pertinent information associated with the internship. Entries into the notebook should be made directly in ink. This meticulous documentation ensures a thorough and replicable record of the internship's activities and outcomes.

Mark distribution:
The assessment will remain exclusively internal. The allocation of marks for the training program adheres to a scale of 50, categorized as follows: 20 marks attributed to the internship workbook, endorsed by the supervisor; 20 marks assigned to the viva voce examination; and 10 marks designated for the final report submitted during the viva voce session.

SEMESTER VI

24-215-0601 JOINING TECHNIQUES IN SHIPBUILDING TECHNOLOGY

Course Description: The aim of the course is to offer students a solid background in the fundamentals of welding Technologies and to impart that knowledge in joining metals in practices. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of welding processes and its application with the core programmes.

24-215-0601	Joining Techniques in Shipbuilding Technology	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Basics Science and Engineering Sciences

Course Objectives: To impart knowledge on the various welding processes and how these can be used in ship building.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Recognise/recall the basic of welding and its metallurgy.
CO 2	Comprehend the various welding processes with reference to ship construction
CO 3	Apply various welding processes to shipbuilding
CO 4	Analyse different types of weld defects for weld quality standards
CO 5	Apply various other types of joining processes to nonferrous materials

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1									2
CO 2	2	2	1	2								1
CO 3	2	2	1	2								
CO 4	2	2	2	2								1
CO 5	2	1	1									1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0601 JOINING TECHNIQUES IN SHIPBUILDING TECHNOLOGY

Course Content

Module I

Science of Welding, Types of Joints, Classification of Welding Processes, Electric Arc Welding, Heat Sources,Power Sources, Arc Phenomena, Arc Blow, Power Source Characteristics, V-I Relationship, Flux Covering Different Types of Electrodes and their applications, Different Metal Transfers, Power Source, Shielding Gas Electrodes, and Gas welding and Flame Characteristics

Module II

SAW, PAW,MIG, TIG, FCAW, Electro-slag welding, Electro-gas welding, One-sided welding, Different types of backing Materials, Mechanised system in welding, Friction Welding, Laser Welding, Hybrid Laser Arc Welding, Underwater Welding, Explosion welding.

Module III

Welding codes and Standards, welder performance qualification, Welding Procedure Specification, Procedure Qualification Records, Nomenclature of Electrodes, Common Weld defects and acceptance criteria. Residual Stresses and Distortion- Causes, Measurement and Methods of Prevention of Distortion, Preheat and Post Weld Heat Treatments, Welding Sequence types and their significance. Introduction to Non-destructive tests and acceptance criteria, Destructive Tests and acceptance criteria

Module IV

Welding Metallurgy: Weldability of steel, stainless steel and aluminium, Presence of alloy elements, Heat flow - temperature distribution-cooling rates - influence of heat input on base-metals, Weld metal solidification, Weld Corrosion- Weldment corrosion and its control in various alloy systems.

Module V

Weld Design- Design of weld Joints, Weld Design for Static and Dynamic Loads,Structural Adhesive Bonding as a joining technique – Adhesives and adhesive bonding methods and joint design, cutting processes and surfacing processes.

Reference:

1. Davies, A.C.; Welding, Cambridge University Press, Low Price Edition, 1996.
2. Richard, Little; Welding Technology, McGraw Hill Publications, New Delhi, 2001.
3. Joe Lawrance; Welding Principles for Engineers, Prentice-Hall Inc. Englewood Cliffs, N.J., 1951.
4. Welding Handbook – Vol.:1, 2, 3; American Welding Society, 1991.
5. O.P. Khanna; A Textbook of Welding Technology, DhanpatRai&Sons, 2011.
6. G.D.Garg, A text book of welding technology, S.K.Kataria and Sons, 2012.
7. Sreenivasan N.K, Welding Technology, Khanna, 2008.
8. Baldev Raj, Welding Technology for Engineers, ASM International, 2006.
9. David J. Hoffman Welding, Pearson Publication,2017.

24-215-0602 CONTROLLABILITY OF SHIPS

Course Description: This course is designed to offer the students an understanding of the concept of motion stability and controllability of ships.

24-215-0602	Controllability of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	1	3	2024

Pre-requisites: Should have attended Fluid Mechanics Courses and Math 3 (Required), should have attended or be attending SMS (desired).

Course Objectives: The objective of the course is to provide the learners an understanding of the concept of controllability of ships and the methods to determine the controllability and motion stability of ships, and also to familiarise them with the design of rudders.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Discern various kinds of motion stabilities of ships.
CO 2	Explain various parameters which influence the design of rudders.
CO 3	Explain the procedures of model experiments to determine hydrodynamic derivatives
CO 4	Explain various manoeuvres conducted during trials of ships to assess the controllability
CO 5	Estimate the rudder force, rudder torque and rudder area for ships

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1										
CO 2	3	1										
CO 3	3	1										1
CO 4	3	1										
CO 5	3	2	1									

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	60
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0602 CONTROLLABILITY OF SHIPS
Course Content:

Module I
Manoeuvring Fundamentals – the control loop, path keeping, equations of motion, linearised equations, hydrodynamic coefficients, model tests.

Module II
Stability and control in horizontal plane. Control fixed stability indices. Definitive manoeuvres and turning trials.

Module III
Control surface hydrodynamics – geometry of control surface (rudder), flow around rudder, aspect ratio, influence of hull shape on aspect ratio, influence of fixed structures. Control surface design - specification of requirements and constraints on rudder design, rudder location and orientation, number of rudders, type of rudder, geometric properties of rudder, maximum rudder deflection angle and deflection rate, rudder stock location.

Module IV
Influence of ship features on controls fixed stability - fixed fin, propeller, hull, configuration
Experimental determination of hydrodynamic derivatives (rotating arm technique, planar motion mechanism).

Module V
Introduction to Non-linear Manoeuvres, Simulation, IMO Regulations and Recommendations. Introduction to autopilot and autonomous vessels.

References:

1. Lewis,E.U, Principles of Naval Architecture, (2ndRev.), SNAME, New Jersey, U.S.A, 2010.
2. Abkowitz,M.A.; Lectures on Ship Hydrodynamics – Steering and Manoeuvrability, Danish Technical Press, Copenhagen, Denmark, 1964.
3. KhacDuc Do and JiePan,Control of Ships and Underwater Vehicles, Springer, 2009.
4. Perez, Tristan, Ship motion control: course keeping and roll stabilisation using rudder and fins, London Springer 2005.
5. Do, KhacDuc.,Control of ships and underwater vehicles, London Springer - Verlag ltd. 2009.Dubrovsky. V ; Multi Hull Ships, Backbone Publishing Company .2011.
6. Justin E Kerwin, Jacques B Halder:Principles of Naval Architecture series -Propulsion, SNAME, New Jersey, 2010.
7. Antony F Molland, Stephen R turnock, Ship resistance and propulsion-practical estimation of propulsive power,2011.
8. John Carlton, Marine Propellers and propulsion, Butterworth-Heinemann2007.
9. Baker George Stephen, Ship form, Resistance and screw propulsion, Hard press publishing, 2013.
10. D. W. Taylor ; Resistance of Ships and Screw Propulsion, Unikum,
11. R. P. Gokarn, J. P. Ghose, Basic Ship Propulsion,KW Publisher, 2012.

24-215-0603 SHIP PRODUCTION TECHNOLOGY

Course Description: This course is designed to offer the students an understanding of manufacturing of ships

24-215-0603	Ship production Technology	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	4	2024

Pre-requisites: Nil
Course Objectives: The objective of the course is to provide the learners an understanding of the concept of manufacturing aspects of ship's hull and the shipbuilding practices
Course Outcomes: After completion of the course the students will be able to:

CO 1	Discern the characteristics and lay out of shipbuilding yards
CO 2	Explain various prefabrication and fabrication processes involved in manufacturing of parts and steel components in shipbuilding.
CO 3	Explain various assemblies and grand assemblies and processes involved in manufacturing of units and blocks in shipbuilding.
CO 4	Explain the erection procedures and special joining techniques the shipbuilding practice
CO 5	Develop the launching calculations and plans of ships in drydocks and slipways

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1										1
CO 2	3	1										
CO 3	3	1										
CO 4	3	1										
CO 5	3	2	1									

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	60
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0603 SHIP PRODUCTION TECHNOLOGY

Course Content

Module I

Characteristics of shipbuilding process as heavy and one off kind maritime industry, general principles on layout of shipyards, Relation with supply industry, subcontractors. Storage and preparation of material–Introduction, material handling and storage, transport system in steel stockyard, material preparation (straightening of plates and rolled sections, shot blasting, pre-painting

Module II

Fabrication of component parts:–the cutting process tools, physical chemical background of the cutting process, mechanical cutting, devices for thermal cutting, general description of the various machines, photoelectric and NC control devices, edge preparation, problems of accuracy; Bending of rolled and built up sections general description of bending, control of the bending process, automation of bending; Plate bending, uniaxial bending, biaxial bending

Module III

Assembly of Ship's Structures: Pre-fabrication–general remarks, basic problems of pre-fabrication, pattern of prefabrication, welding in prefabrication, Data generation for ship building process. Basic welding in shipbuilding, welding methods, standards, symbols

Subassemblies: built up T bars ,web frames, machine foundations etc.; welding deformation and straightening; Prefabrication of flat sections –panels, panel production line, preassembly of biaxial stiffened panels –welding procedures .Assembly of corrugated sections, flat sections with curvature–assembly jigs, welding process, it's nature, theoretical background, strengthening of flat sections. Preassembly of volume units–Preassembly of double bottom sections–different structural arrangements, variants of the assembly process, welding problems; Preassembly of side tank units–structural arrangement; Special assembly systems , Preassembly of the fore and aft end structure; Preassembly and outfit of superstructures. Outfitting shops- Mechanical, Piping, Insulation.

Module IV

Erection of ship's hull–General assembly methods, handling of preassembled units in the erection area–cranes, heavy duty truck; Preassembly of blocks–special types, advantages and disadvantages; Hull assembly–different methods of hull assembly, auxiliary devices; Welding in ship's hull assembly – welding methods applied, welding defects, welding deformation of the ship's hull; Quality control (X-ray tests etc.); Scaffolds. Activities in shipyard pipe, machine and shipwrights shops

Module V

Launching – General methods, Launching by floating off (building dock, launching dock, floating dock), Mechanical launching methods (slip, lift),Launching from inclined building berths– stern launching, side launching; Tipping, Pivoting, Dry-dock and Slipways

Practicals–Shell Expansion Drawing and Docking Plan

Reference:

1) Taggart; Ship Design and Construction, SNAME, 1980.
2) Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
3) Dormidontov V.K. &et.al. Shipbuilding Technology, Mir Publishers, Moscow, 1990.
4) Eyres D.J.; Ship Construction William Heinemann Ltd, London, 2011
5) A W Carmichael, Practical Ship Production, Salzwasser-VerlagGmbh, 2004.
6) Andrew Williams Carmichae, Practical Ship Production, Biblio Bazaar, 2009.
7) Thomas Lamb, Ship Design and construction, SNAME, 2003
8) Journal of ship production London SNAME

24-215-0604 SHIP DESIGN

Course Description: This course is designed to offer the students an understanding of methodologies practiced in ship design

24-215-0604	Ship Design	Category	L	T	P	CREDIT	Year of Induction
		PCC	3	1	1	3	

Pre-requisites*:* Basic Ship Theory, Stability of Ships, Resistance and Propulsion of Ships, Structural Design of Ships

Course Objectives: The objective of the course is to provide the learners an understanding of the concept of design aspects of ship's hull and general arrangement and the procedures to design ships.

Course Outcomes: After the completion of the course the students will be able to:

CO 1	Discern various techno-economical aspects general aspects in ship design.
CO 2	Explain various design methodologies which are being used in design of ships.
CO 3	Explain the types of ships and various design approaches which are followed in the design of type ships.
CO 4	Apply the ship design methodologies to develop various hull forms of typical ships.
CO 5	Understand the effect of important sea worthiness factors influencing the ship design

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1										1
CO 2	3	1										1
CO 3	3	1										
CO 4	1	2	1		1							
CO 5	3	2										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	15
Understand	15	15	40
Apply	10	10	30
Analyse	10	10	15
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0604 SHIP DESIGN

Course Content

ModuleI

Introduction – General aspects of Marine Activities, Transportation of cargoes, Marine services & Operations, Marine Industries; Engineering Economics in Ship Design – Economic criteria, Initial cost, Operating cost, RFR; Owner's requirements

Module II

Methods of ship design -Design using basic type ships, Design using coefficients, Design using iteration methods; design spiral; design categories (dead-weight carrier, capacity carrier, linear dimension ship).

Module III

Ship parameters – displacement, displacement coefficient, displacement equation, volume equation, solution of the cubic equation Ship dimension – length, breadth, depth, draught, form coefficients; Shape of the hull Mass estimation - lightship mass – steel mass, outfit mass, engine plant mass; dead weight. Hold capacity and stowage factor

Module IV

Naval Architectural Drawings and Plans- General Naval Architecture Drawings, Ships Lines plan, Introduction to the development of Ships Lines Plan, Development of Stem and Stern forms, General Arrangement Plan, Fire Fighting Appliances (FFA)and Life Saving Appliances (LSA) drawings, Capacity Plan

Module V

Machinery Installation, Propulsion and Steering Devices – Selection of Main Engine, Selection of propeller, selection of rudder, matching of the propeller with the main engine, Statutory and commercial considerations Compliance to International and National rules and regulations.

Practical:-Development of Lines plan, General Arrangement

Reference:

1. Apostolos Papanikolaou, Ship Design: Methodologies of Preliminary Design, , SNAME, 2014.
2. Amelio M. D Arcangelo; Ship Design and Construction
3. DGM Watson, Practical Ship Design, Elsevier Ocean Engineering Book Series 2002
4. Schneekluth, H; Ship Design for Efficiency and Economy, Butterworths, 1987
5. Taggart; Ship Design and Construction, SNAME, 1980.
6. Thomas Lamb; Ship Design and construction, SNAME, 2003.
7. Antony F Molland; A Guide to ship design, construction and operation, SNAME, 2008
8. Misra S.C.; Design Principles of Ships and Marine Structures, CRC Press, 2016
9. Myung-II Roh, Kyu-Yeul Lee; Computational Ship Design, Springer, 2018.

24-215-0605 ELECTRICAL SYSTEMS IN SHIPS AND SHIPYARDS

Course Description: This course is designed to offer the students an in-depth understanding of the theory, design, operation, protection and maintenance of electrical systems of ships.

24-215-0605	Electrical Systems in ship and shipyards	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Basic Electrical Engineering, Fundamentals of Electrical Circuits, Basic Electronics, Electrical Machines etc

Course Objectives: The objective of the course is to impart basic knowledge in Electrical Systems in Ships and Shipyards and impart understanding of the electrical power generation, distribution, protection electric propulsion and governing rules of installation of electrical system on board ships.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Understand the components of electrical systems and their specifications, types of electrical power plants and generators used in ships.
CO 2	Explain the power distribution system in ships, protection scheme given to the equipments and introduction to emergency power generation in ships.
CO 3	Describe the components of electrical systems in ships such as transformer, motors and starting methods, cables and various lighting systems.
CO 4	Understand electric propulsion, control of various propulsion motors, introduction to fuel cells and energy storage systems in ships
CO 5	Understand the marine communication systems and communication equipments used in ships as well as the basics of shipyard electrical system
CO 6	Apply learnt concepts to draw the single line diagram of a ship's electrical distribution system

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1			1						
CO 2	3	2	1			1						
CO 3	3	2	1			1						
CO 4	3	2	2	1		1						
CO 5	3	2	1			1						
CO 6	3	2	1			1						

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0605 ELECTRICAL SYSTEMS IN SHIPS AND SHIPYARDS

Course Content

Module I

Introduction to components of electrical system on board ships – Electrical power requirements on ships. Shipboard electrical systems (AC/DC), Standard voltages. Electrical system design tasks, Electrical load analysis-load factor, Power system configuration on various ships. Power generation on board ships- comparison of diesel, thermal and nuclear power plants as prime movers, Marine generators and alternators-terminal performance and power output. Shaft driven generators - Brushless generators. Emergency generators and power backup systems in ships. Capacity calculation of main power plant -Diversity factor Relevant SOLAS regulations on shipboard electrical systems installation, safety and maintenance.

Module II

Power Distribution Systems in ships- Ring and radial system. AC single phase & 3-phase system- DC systems Typical distribution scheme, Grounded and ungrounded systems. Earthed and insulated AC systems Switchgear and protection of shipboard electrical systems- role of switchgear in marine electrical systems- Single line layout-Fuses, Switches, Relays-types contactors, circuit breakers-types- MCB, ELCB,RCCB, Protection for generators of main power plant, preferential tripping Emergency Power and Protection -Different emergency loads , Switchgear for emergency generators and systems. Safety and quality of supply-Rules governing the distribution systems.

Module III

Transformers on ships-Categories-for power and lighting-Distribution transformer-isolation transformers. Specification of transformers. **Cables-** specification of cables- testing of cables –Megger - design and selection of cables. Installation rules. Cable drop in dc two wire distributors fed at one end- fed at both ends. **Motors on ships -**AC and DC motors, motor starters-Star-Delta sarter-DOL starters, soft starters Variable frequency drives, Special motors for ship propulsion, Torque verse speed comparison**. Lighting systems in ships-**Different sources of light - lighting arrangements in engine room, accommodation place, weather deck etc. Navigation and Signal lights Emergency lighting. Special rules for tankers and fighting crafts – Special regulation for installation of electrical system in steering system

Module IV

-Electrical Propulsion Systems on Ships- advantages – applications-electric propulsion architecture-Propulsion motors-types-motor drives and speed control-Super conductors in navy ships, fuel cell power, hybrid propulsion, Energy storage-batteries and battery charging

Module V

Introduction to Maritime Communication Systems Importance of communication in ship, shipboard and ship-to-shore communication systems Internal and external communication equipments Automatic Identification System (AIS) for vessel tracking, Communication for electronic navigation charts (ENCs) and e-navigation, Weather reporting systems and meteorological data communication Satellite Communication, Regulatory bodies: IMO, GMDSS, and SOLAS, Electrical system in shipyards - power factor improvement- power tariff - essential regulations -main loads.

.

Practical: Preparation of Ship electrical system diagrams.

Reference:

1. Marine Electrical Knowledge, Willem Maes, Antwerp Maritime Academy, 2014.
2. Marine Electrical Equipment and Practice, H.D McGeorge, Butterworth-Heinemann, June 2014.
3. Offshore Electrical Engineering, Geoff MacAngus-Gerrard, Gulf Professional Publishing, 2017
4. E. A. Fernandez, Marine Electrical Technology, 2014.
5. Mukund R. Patel,Electrical Power Systems, 2012 CRC Press .
6. G.O.Watson, Marine Electrical Practice,ButterworthHeineman, 1990.
7. Harrington L.Roy, Marine Engineering, SNAME Publications, 1992.
8. Christopher Lavers and Edmund G.R. Kraal, Reed's Vol.7, Advanced Electro Technology for Marine Engineers, 2014.
9. Generation, Transmission and Utilisation of Electrical Power, A.T. Starr, 1957.

24-215-0606 SHIP STRUCTURAL ANALYSIS II

Course Description: This course provides an in-depth study of the structural behaviour of hulls under torsion, vibration, fatigue, and ultimate load conditions. It emphasizes analytical and practical approaches to ensure the reliability, strength, and durability of maritime structures.

24-215-0606	Ship Structural Analysis II	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	4	2024

Pre-requisites: Analysis of Structures, Structural Analysis I

Course Objectives: To analyze the structural behaviour of ship and submarine hulls under diverse loading conditions. To design reliable and durable maritime structures using advanced strength and reliability concepts. To impart knowledge on the application of finite element analysis in ship structural analysis

Course Outcomes: After completion of the course the students will be able to:

CO 1	Analyse torsional behaviour of ship and submarine hulls.
CO 2	Apply shell theories to evaluate submarine hull performance.
CO 3	Assess hull girder vibrations and calculate natural frequencies.
CO 4	Evaluate fatigue and fracture behaviour of ship structures.
CO 5	Perform reliability and ultimate strength analysis of hull girders.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1										1
CO 2	2	1										1
CO 3	2	2										2
CO 4	2	2										2
CO 5	2	2										2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	20
Understand	10	10	30
Apply	15	15	30
Analyse	10	10	20
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0606 SHIP STRUCTURAL ANALYSIS II

Course Content

Module I

Global response–Torsion

Loads causing torsion of hull, single cell closed cross section, multi-cell closed cross section, open cross section, warping torsion, Cross sections with both open and closed cross sections, torsional analysis of hulls

Module II

Analysis of submarine hulls

General behaviour of shells, Shells in nature, load resistance action of a shell, geometry of shells of revolution, membrane theory of shells, bending theory of cylindrical shells, submarine hulls, preferred shapes for submarines, method of stiffening for the hull and bulkheads, failure modes.

Module III

Hull girder vibrations

Sources of vibration in ships, Propeller induced forces, machinery induced forces, wave induced forces, vibration of hull as uniform beam, Natural frequencies and mode shapes, empirical formulae for determination of natural frequencies of ships

Module IV

Fatigue and fracture of hull girder

Fatigue of metals, SN-curve and fatigue damage accumulation, low cycle fatigue, high cycle fatigue, Fatigue strength of welded joints, influence of weld defects. Introduction to Linear Elastic Fracture Mechanics (LEFM) and Elastic Plastic Fracture Mechanics (EPFM), Fracture toughness method of improving fatigue strength in ship structure.

Module V

Reliability analysis and ultimate strength of hull girder

Reliability based analysis of ship structures; Classification of FEA analysis – Global Strength Analysis, Partial Strength Analysis and Local Strength Analysis; limit states of ship structures; ultimate strength of plates, stiffened plates and hull girder; plastic theory and application to beams; ultimate bending moment of hull girder.

References:

1. Chandrasekaran Srinivasan; Advanced Marine Structures, Springer,2010
2. Alaa Mansour, Donald Liu, Principles of Naval Architecture Series: Strength of ships and oceanstructures, SNAME,NewJersey,2008.
3. Owen.F. Hughesand Jeom Kee Paik–Ship Structural Analysis and Design, SNAME,NewYork,2010
4. Mohammed Shama–Torsion and Shear Stresses inShips, Springer-Verlag,2010.
5. Mohammed Shama–Buckling of Ship Structures, Springer-Verlag,2013.
6. Yasuhisa Okumoto–Design of Ship Hull Structures-A practical guide for Engineers, Springer–Verlag,2010.
7. Sergei V Pertinov: Fatigue analysis of Ship structures, SNAME,2003.
8. Christian Lalanne, Fatigue Damage, Wiley,2009
9. Yong Bai,Marine Structural Design,Elsevier,2003
10. Fatigue and Fracture-understanding the basics,F.C.Campbell(ed.),ASMinternational,2012.
11. Load and Global Response of Ships, J.J.Jensen, Elsevier ocean engineering book series,2001
12. Gurney. T.R,fatigue of welded structures, Cambridge University Press,1979.
13. Maddox .S.J,fatigue strength o fwelded structures,Woodhead publishing,2014
14. Roy Burcher, Louis.J.Rydill,Conceptsin Submarine Design,Cambridge University Press,2014.
15. Ansel.C.Ugural,Stresses in Beams, plates and Shells,CRC,Press,2010.

24-215-0607 MARINE ENGINEERING LAB

Course Description: This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge and to provide experience on testing of marine IC engine performance.

24-215-0607	Marine Engineering Lab	Category	L	T	P	Credit	Year of Induction
		PCC	1		3	2	2024

Pre-requisites: Marine Engineering, Applied Thermodynamics
Course Outcomes: After completion of the course the students will be able to:

CO 1	Identify major types and classification of IC engines.
CO 2	Evaluate engine performance characteristics.
CO 3	Apply the theoretical knowledge gained in the classroom with the physical world.
CO 4	Compare different machineries used in marine application.
CO 5	Carry out scientific experiments as well as accurately record and analyse the results of such experiments.
CO 6	Function as a member of a team, communicate effectively and engage in further learning and problem solving.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3								1			1
CO 2	3	3			2							1
CO 3	3	3		3								1
CO 4	3	3			2							1
CO 5	3	3	3		1			2	1			1

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50		

Attendance: 5 marks
Continuous Assessment : 20 marks
Internal Test /Evaluation: 25marks
Total Marks : 50 marks

List of Experiments

1. Energy balance of a Diesel engine
2. Determination of the characteristics of diesel engine.
3. Determination of the characteristic curves of compressors.
4. Determination of the characteristic curves of pumps and piping.

SEMESTER VII

24-215-0701 SHIP PRODUCTION MANAGEMENT

Course Description: Impart students on introduction to Ship Production, Characteristics of Shipbuilding, Layout of a Shipyard, Shipyard Organization Structure, Product Oriented Work Breakdown Structure, Storage and Preparation of Material.

24-215-0701	Ship Production Management	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	4	2024

Pre-requisites: Joining Techniques and Ship building Technology, Ship production Techniques.

Course Objectives: To impart knowledge on shipbuilding practices policies and sequence of ship production from a middle management and upwards perspective.

Course outcome: After the completion of the course the students will be able to

CO 1	Learn a typical shipyard organization and components of integrated approach in planning ship production
CO 2	Apply knowledge and understanding of various machining process in fabrication of prepared plates from storage area to units.
CO 3	Understand the practice of prefabrication prior to erection and sequence of erection of hull.
CO 4	Demonstrate knowledge and understand various technologies involved during erection of hull.
CO 5	Apply CPM and PERT on production management.

Mapping of course outcomes with program outcomes: Level – Low (1), medium (2) and high (3)

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	2											
CO 2	3	1										1
CO 3	2	1										
CO 4	2	1										2
CO 5	3	3										2

Assessment Pattern:

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0701 SHIP PRODUCTION MANAGEMENT

Course Content:

Module 1

Production system: Evolution of shipbuilding practices. System wise work break down system, Product wise work break down system, Group Technology and Zone based Outfitting, IHOP

Module 2

Zone Production design–application of the principles of design for production in shipbuilding–joining of parts, relations between structural design and prefabrication, simplifications in structural design (design for welding). Production Standards– production standards in several parts of the ship production process, work measurement systems, methods of man- hour determination.

Module 3

Application of models for process planning, scheduling and control Gantt charts. Special aspects of application of these in shipbuilding process.

Introduction to operation research. Operation planning and control production planning scheduling network models (PERT, CPM). Application of network models with critical path scheduling in shipbuilding.

Module 4

Relevance of Project management in Ship building/repair/conversion projects.

Enterprise resource Planning-Data Management Systems and their impact in heavy engineering projects.

Module 5

Quality Assurance, Quality Control, Problems of accuracy – tolerances, standards, measuring techniques.

General Shipbuilding and Shipyard Activities: Business Development, Safety, Security, Housekeeping, Training.

References:

1. Taggart; Ship Design and Construction, SNAME, 1980.
2. Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
3. Dormidontov V.K. &et.al., Shipbuilding Technology, MirPublishers, Moscow.
4. Eyres D.J.; Ship Construction William HeinemannLtd, London,1982
5. Elwood S.Buffa; ModernProduction/Operations Management, Wiley EasternLtd., 2004.
6. Richard J. Hopeman;Production – Concepts, Analysis, Control, 3rdEdition, Charles E. MerrilPublishing Co. , 1976.
7. ArthurC.Laufer; Operations Management,SouthWesternPublishing Co.
8. Khanna,O.P.; Industrial Engineering andManagement,Dhanpat Rai Publication., 1999.
9. Richard I. Levin, et.al.Production/Operations Management : Contemporary Policyfor Managing OperatingSystems, TataMcGraw Hill Publishing Co. Ltd., 1974.
10. Rajesh Kumar Arora; Optimisation. Algorithm and Applications, CRC Press, 2015
11. R. Paneerselvam; Operations Research, PHI Learning Private Ltd., 2017

24-215-0702 PRACTICAL SHIP DESIGN

Course Description: To be able design basic components in ship design process using design methodologies, calculations and knowledge of safety considerations and to synthesise information for presentation in the form of standard drawings.

24-215-0702	Practical Ship Design	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Ship Design

Course Objectives: Learn and implement basic ship design processes, including understanding design principles and their practical application.

Course Outcomes: After completion of the course the students will be able to:

CO 1	Do design of a ship based on the methodology and tools used in the ship design process
CO 2	Know, interpret and apply statutory and non-statutory regulations/ requirements in designing of shipboard spaces and area and their accesses.
CO 3	Determine the anchoring and mooring arrangements and cargo handling systems in the ship design process
CO 4	Provide various LSA and FFA systems on board of a ship meeting the regulations.
CO 5	Realize various cargo access systems and their design for safe ship operations.
CO 6	Do the structural design of rudder and rudder stock using Class rules.
CO 7	Disseminate this knowledge for presentation by preparing standard ship drawings.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2										2
CO 2	2	2										2
CO 3	2	2										2
CO 4	2	3										2
CO 5	2	1										2
CO 6	2	1										2
CO 7	2	1										2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0702 PRACTICAL SHIP DESIGN

Module I
Ship outfitting design
Anchoring and Mooring: Calculation of Equipment number, determination of number and weight of anchors, size of anchor chain, number and type of mooring ropes, design of chain locker. Cargo handling equipment, lifting devices; Design of swinging derrick system.
Cargo Access: Design of hatch coamings, Design of Lifting type Container Hatch covers

Module II
Machinery selection, installation and propulsion system
Selection of Main Machinery, IMO Tier-I, II, III engines; Selection of propeller, Selection of Rudder and Steering Gear, Selection of Auxiliary Machinery; Scrubbers and waste heat recovery systems

Module III
Design and drawing of General arrangement of a seagoing vessel
Subdivision of the ship‘s hull and erections, arrangement of spaces, arrangement of tanks, superstructure and deckhouses, arrangement of engine plants.

Module IV
Basics of electrical, navigation and communication equipment selection
Electrical powering calculations, Sea load, Harbor load, Selection of Generators, Emergency generators, Switch boards, Power distributions; Navigation and communication equipment, lighting requirements in accommodation and other important compartments.

Module V
Cost Estimation
Ship design and Ship building cost - cost of material, machinery and propulsive installation, accommodation/ equipment/ outfitting, labour and overheads, Tender Document Preparation

Reference:

1. Taggart; Ship Design and Construction, SNAME, 1980.
2. Thomas Lamb, Ship Design and construction, SNAME, 2003.
3. ApostolosPapanikolaou, Ship Design: Methodologies of preliminary design, , SNAME, 2014.
4. Antony F Molland, A Guide to ship design, construction and operation, SNAME, 2008.
5. SOLAS Convention, IMO Publication.

24-215-0703COMPUTATIONAL HYDRODYNAMICS AND STRUCTURAL ENGINEERING

Course Description: The course introduces Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA), focusing on fluid flow simulations, numerical methods, and structural analysis. Students will learn to apply discretization techniques, solvers, and mesh generation for accurate simulations, with a special emphasis on ship structure analysis and stress evaluation using FEA.

24-215-0703	Computational Hydrodynamics and Structural Engineering	Category	L	T	P	CREDIT	Year of Induction
		PCC	3	1	-	3	2024

Pre-requisites: Fluid Mechanics, Mechanics of Solids.

Course Objectives:

Course Outcomes: After completion of the course the students will be able to:

CO 1	**To understand** the basics of fluid dynamics and apply conservation laws to solve fluid flow problems using governing equations.
CO 2	To apply discretization techniques in CFD and solve linear systems using direct and iterative methods.
CO 3	To introduce students to the method of incorporating MATLAB/Python to simulate fluid flow, implement solvers, and apply mesh generation for accurate simulations.
CO 4	**To understand** and apply the procedure of FEA, including variational formulations, shape functions, and convergence criteria.
CO 5	**To analyze** ship structures using beam theories, perform strength analysis, and apply Von-Mises stress criteria for failure evaluation.

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	3									
CO 2	2	2	2		2							
CO 3	3	2	2		3	2						
CO 4	3	3	3	2	1	2						2
CO 5	3	3	3	2	3	2						2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember			
Understand	10	10	20
Apply	15	15	30
Analyse	15	15	30
Evaluate	10	10	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0703 COMPUTATIONAL HYDRODYNAMICS AND STRUCTURAL ENGINEERING

Course content

Module I

Introduction to Computational Fluid Dynamics (CFD): Basics of Fluid Dynamics: Definitions, scope, and steps in computational modeling. Conservation of mass and momentum, Euler equation, Bernoulli's equation, potential flow, boundary conditions, fixed and moving bodies, Green's theorem and distributions of singularities.

Module II

Numerical Methods for Fluid Dynamics: Discretization Techniques: Finite volume method (FVM), Finite element method (FEM). Solution of Linear Systems: Direct methods (Gauss elimination), iterative methods (Jacobi, Gauss-Seidel, SOR).

Module III

CFD Algorithms: Use of MATLAB or Python for simple flow simulations. Overview of solvers for fluid flow problems (pressure-based solvers, SIMPLE algorithm). Mesh generation techniques and grid independence. Time-Dependent Problems: Explicit and implicit methods for solving transient problems.

Module IV

Basics of Finite Element Analysis: Introduction to FEA, Types of Finite Elements in FEA. General Procedure of Finite Element Analysis – Variational formulations**.** Shape functions, Convergence Criteria.

Module V

Ship Analysis: Timoshenko Beam Theory and Bernoulli Beam Theory; Local Strength Analysis, Global Strength Analysis and Partial Strength Analysis. Failure criteria using Von-Mises stress criteria. Stress concentration areas in a ship structure. Practical ship problems using FEA.

References:

1. Grewal, B.S. (2019). Numerical Methods in Engineering and Science. Khanna Publishers.
2. Dukkipati, Rao V. *(2011).* Applied Numerical Methods Using MATLAB. *New Age* International.Sengupta, T.K. (2014). Computational Fluid Dynamics. University Press (India).
3. Srinivasan, R. (2018). Fundamentals of Computational Fluid Dynamics. *PHI Learning.*
4. Chapra, S.C., & Canale, R.P. (2015). Numerical Methods for Engineers (7th ed.). McGraw-Hill Education.
5. Date, A.W. (2011). Introduction to Computational Fluid Dynamics. Pearson Education India.
6. Seshu, P. (2003). Textbook of finite element analysis. PHI Learning Pvt. Ltd.
7. Owen. F. Hughes and JeomKee Paik – Ship Structural Analysis and Design, SNAME, New York, 2010

24-215-0704 PROJECT WORK PHASE I

Course Description: Students shall undertake an independent Ship Design Project spanning one year, divided between the 7th and 8th semesters. The project involves comprehensive design work, starting with preliminary tasks such as Parent Ship Analysis, determination of main dimensions, and defining the hull of the vessel, which are to be completed in the 7th semester. The detailed design and remaining work will be carried out in the 8th semester.

24-215-0704	Project Work Phase I	Category	L	T	P	Credit	Year of Induction
		PCC	2	2	6	6	2024

Course Outcomes: After completion of the course the students will be able to

CO 1	Demonstrate the ability to apply classroom and laboratory concepts and principles to develop a preliminary ship design along with hands-on experience in ship design software tools.
CO 2	Exhibit proficiency in analysing design requirements and constraints, enabling the formulation of effective solutions during the initial stages of ship design.
CO 3	Develop comprehensive technical reports and design documents that clearly articulate the design process, methodologies employed, and preliminary outcomes.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Establish a solid foundation for the subsequent detailed design phase by completing all preliminary design tasks.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	2	2	3		3	3
CO 2	3	3	3	3	3	2	2	2	3		3	2
CO 3	1	1		1				2	2	3	1	
CO 4	2	2		2				2	2	3	1	
CO 5	2	2		2		2	2	2	2		1	3

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
400	400	-	-

Assessment Pattern: Progress will be monitored and evaluated periodically by the assigned project guides. At the end of the project, students will undergo an internal viva-voce, assessed by a panel of professors, to determine their performance and understanding.

Mark distribution: Ensures a balanced evaluation of both technical and soft skills, reflecting the comprehensive nature of the project. It aligns with common engineering project assessment criteria, emphasizing research, design, execution, creativity, documentation, and presentation.

The allocation of marks for the project adheres to a scale of 400, categorized as follows: 40% marks attributed to the execution of the project, endorsed by the supervisor; 50%marks assigned to the viva voce examination; and 10% marks designated for attendance.

24-215-0705 INTERNSHIP

Course Description: Impart students the application of theoretical knowledge on practical work related to Naval Architecture. Work experience is cooperatively planned by the department and employer to fulfil the student's objectives.

24-215-0705	Internship	Category	L	T	P	Credit	Year of Induction
		PCC	-	-	-	2	2024

Pre-requisites:
Course Objectives:
Course Outcomes: After completion of the course the students will be able to: Course outcome: After the completion of the course the students will be able to

CO 1	Apply classroom and laboratory concepts and principles in a Shipping industry related working environment.
CO 2	Establish goals by working with supervision to define work objectives for the internship experience.
CO 3	Demonstrate time and project management skills by completing the work objectives within the specified time limits.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Demonstrate the ability to work as a team member to successfully complete the assigned work objectives in an assigned company work group.
CO 6	Demonstrate and promote a proper work ethic.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	2	2	2	2	2	2	2	2	2	2	2	2
CO 3	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	2	2	2	2
CO 5	2	2	2	2	2	2	2	2	2	2	2	2
CO 6												

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50		

24-215-0705 INTERNSHIP

Assessment Pattern:
Each student will work with their supervisor from the concerned company/organization to jointly develop projects / activities, which will be accomplished during the internship program. The projects/activities should be unique and must be related to the knowledge and/or skills attained during their degree program in Naval Architecture and related areas. The projects must be approved by the instructor/supervisor from the concerned industry/company and/or lead faculty member from the Department of Ship Technology, CUSAT.

Assessment Method:
Each student is required to maintain a comprehensive daily work log detailing their activities. This log should be generated using a word processing software such as Word or a database program like Excel. Emphasis should be placed on maintaining a professional and well-organized format. It is essential to record major activities undertaken on each day of work, ensuring that adequate detail is provided to sufficiently describe the performed tasks. While the following format is suggested, it is imperative to ensure that the log captures a thorough depiction of the work conducted:

Cochin University of Science and Technology Department of Ship Technology Daily Log (Template)
Course and Semester:
Name of the student:
Name of the Employer:
Supervisor's Name:
Date:
Activities for the particular date:

Furthermore, students are required to maintain precise documentation of their internship projects in an engineering notebook. **The notebook must be securely bound and should have page numbers**. Its primary purpose is to serve as a repository for key meetings, ideas, outcomes, observations, references, and all pertinent information associated with the internship. Entries into the notebook should be made directly in ink. This meticulous documentation ensures a thorough and replicable record of the internship's activities and outcomes.
.

Mark distribution:

The assessment will remain exclusively internal. The allocation of marks for the training program adheres to a scale of 50, categorized as follows: 20 marks attributed to the internship workbook, endorsed by the supervisor; 20 marks assigned to the viva voce examination; and 10 marks designated for the final report submitted during the viva voce session.

ELECTIVE SUBJECTS - SEMESTER VII

24-215-0706 MARINE CORROSION AND PREVENTION

Course Description: The aim of the course is to offer students a solid background in the fundamentals of corrosion- and to impart that knowledge in corrosion control practices. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of corrosion and its prevention with the core programmes.

24-215-0706	Marine corrosion and Prevention	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Basics Science and Engineering Sciences.

Course Objectives: To impart knowledge on the type of corrosion and how this is being controlled in marine environment.

Course outcome: After the completion of the course the students will be able to

CO 1	Recognise/recall the various types of corrosion in Marine Environment.
CO 2	Comprehend the corrosion control by design, materials selection, corrosion inhibitors, corrosion monitoring and management.
CO 3	Apply various surface preparation to control of corrosion
CO 4	Understand different types of paints based on composition, mechanism and select the appropriate paint for marine structure
CO 5	Evaluate cathodic protection system and design it for marine application

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1				1					2
CO 2	2	1	1				1					1
CO 3	2	1	1									
CO 4	2	2	2	2			2					1
CO 5	3	2	2	2			2					1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	
Understand	25	25	
Apply	10	10	
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0706 MARINE CORROSION AND PREVENTION
Course Content:

Module I

Introduction- Corrosion in nature, Corrosion losses, importance of corrosion protection, theories of corrosion-electrochemical series- types of corrosion and mechanisms- its identification-remedies-factors affecting corrosion-fouling-effect of fouling on ships-factors affecting growth and settlement.

Module II

Corrosion control by design, corrosion inhibitors, Metallic coating -corrosion management practices in ships- Corrosion Testing and Monitoring.

Module III

Marine Environmental zones, Principles of Materials Selection and Failure Prevention, selection of Ship building materials, Specific Engineering Materials, Corrosion of Steel in Concrete and its Prevention, Case Studies, Failure analyses.

Module IV

Marine paints-Role of constituents of paints-classification of paints-mechanism of anticorrosive paint-paint types-selection of paint-paint scheme- Surface preparation and treatments-antifouling paints- principles of antifouling paints -coating failure.

Module V

Cathodic protection-Mechanism of cathodic protection, sacrificial anode, design of sacrificial anode system impressed current system for ship, advantages and disadvantages of cathodic protection.

References:

1. Fontana M. G, Greene N. D, ‗Corrosion Engineering', McGraw Hill, 2nd Edition, 1978
2. Raj Narayan, ‗An Introduction to Metallic Corrosion and its Prevention', Oxford and IBH,1983
3. Jones D. A, ‗Principles and Prevention of Corrosion', 2nd Edition, Prentice-Hall, 1965
4. T. Howard Rogers ―Marine Corrosion‖ first Edition, George Newness Ltd London, 1968
5. Harvey P Hack, Designing Cathodic Protection Systems for Marine structures and vehicles, SNAME, 2000.

24-215-0707 DESIGN OF FISHING VESSELS

Course Description: To provide an overview on types and design features of fishing vessel, materials and preservation.

24-215-0707	Design of Fishing Vessels	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites**: Nil**

Course Objectives: To impart basic knowledge on the design and construction of fishing vessels. To impart knowledge on the performance characteristics of fishing vessels. To familiarize with characteristics of fish ground and fishing gears.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the functions and setup organization for fishing
CO 2	Understand the traditional fishing techniques and recent developments in fishing
CO 3	List main parameters of fishing vessels and understand the design sequence of vessel.
CO 4	Fix main dimension of fishing vessels taking into special consideration of Sea keeping/Maneuvering performance of fishing vessel.
CO 5	Classify various materials used in construction of fishing vessel and its application. And also to understand fundamentals of preservation of fish, and protection of vessel from corrosion and biofouling.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2											
CO 2	2	1										1
CO 3	3	1										
CO 4	3	3										2
CO 5	3	1	1									2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0707 DESIGN OF FISHING VESSELS
Course Content

Module I

Introduction: definitions of fishing vessel, special features of fishing vessels, regulations for the safety of fishing vessels, classification of fishing vessels, fish production in India, organizational setup and shore facilities, fisheries organizations and activities, administrative systems on fishing vessels

Module II

Fishery: Characteristics of fish ground; Fishing gear and methods, drift net, long line, drag net, siene net, dredging, with electric light, harpoon/whale catching, trawling (side and stern trawlers, single and pair trawling, pelagic &bottom trawling).Dressing, processing and freezing

Module III

Design Procedure: Owner‘s specifications, Economy, fuel efficiency, hull form, investment cost, operating revenues and costs. Design of Main Dimensions and form: parent vessel data analysis, space requirement (capacity) of the whole ship, estimation of main dimensions, estimation of form coefficients, estimation of light ship weight, estimation of dead weight, design of lines. General arrangement: Engine room, fish holds, erections, deck machinery arrangement, crew accommodation, fuel, fresh-water, ballast tanks, bulkhead positions.

Resistance, powering and propeller selection: friction resistance, wave making resistance, eddy resistance, net resistance, powering calculations, propeller selection, Propulsion Systems and other machinery/equipment, different propulsion systems and selection of main engine, selection of equipment‘s/instruments for fish finding, navigation, communication, firefighting, lifesaving and net monitoring Seakeeping and manoeuvring considerations.

Module IV

Material and construction methods: mechanical properties of materials, comparison of hulls of different material, type of construction, details of steel construction, construction methods in FRP/GRP, Aluminium and Ferro-cement.

Module V

Fish holds and preservation facilities: insulation materials and properties, methods fish preservation

References:

1. Design of small fishing vessels, John F. Fyson, Food and Agriculture Organization of the United Nations 1985
2. Fishing Boats and Their Equipment, Dag Pike, 1992
3. Fishing boat designs, 3small trawlers, Issues 188191, John F. Fyson, Food and Agriculture Organization of the United Nations, 1980
4. Modern Fishing Gear Technology, M Shahul Hameed

24-215-0708 REFRIGERATION AND AIR CONDITIONING OF SHIPS

Course Description: This course provides an in-depth understanding of refrigeration and HVAC systems used in marine applications. Students will explore the principles of refrigeration cycles, the design and operation of refrigerating machinery, and the selection and properties of refrigerants, considering environmental protocols. The course also covers cargo cooling techniques, air conditioning systems, and advanced HVAC configurations for ships, emphasizing energy efficiency, safety, and compliance with marine standards. Through theoretical learning and practical insights, students will gain the knowledge required to design, operate, and maintain marine refrigeration and HVAC systems.

24-215-0708	Refrigeration and air conditioning of ships	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Applied Thermodynamics

Course Objectives: Understand the principles of marine refrigeration, including vapor compression and absorption cycles. Learn about refrigerating machinery components and refrigerant properties, focusing on environmental compliance. Explore cargo cooling methods and marine HVAC systems, including standards and advanced configurations.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand refrigeration principles for marine applications, including vapor compression and absorption cycles.
CO 2	Analyze refrigerating machinery components and evaluate refrigerant properties with a focus on environmental regulations.
CO 3	Apply cargo cooling methods and estimate refrigeration plant loads for marine environments.
CO 4	Demonstrate knowledge of air conditioning fundamentals, including psychrometrics, heating, cooling, and heat pump operations.
CO 5	Design and assess marine HVAC systems, including airflow calculations and compliance with industry standards.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3										
CO 2		3				2		2				
CO 3			2			2						
CO 4				3								2
CO 5			3			2			2			

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	10	30
Understand	15	15	30
Apply	15	15	30
Analyse		10	10
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0708 REFRIGERATION AND AIR CONDITIONING OF SHIPS
Course contents:

Module I:

Introduction to Marine Refrigeration Systems

Marine applications of mechanical refrigeration, Refrigerated ship's stores and refrigeration at sea, Cargo types and carrying conditions, Thermodynamical principles, Vapor compression cycles (Carnot, superheating, subcooling, multistage operation), Absorption cycles.

Module II:

Refrigerating Machinery and Refrigerants

Principal components: compressors, condensers, evaporators, regulators, Refrigerant properties: demands, choice, safety, and lubricants, Refrigerant classification: numbering system, blends, and alternative refrigerants, Environmental considerations: ozone depletion, Montreal Protocols, and secondary refrigerants.

Module III

Cargo Cooling Methods and Load Estimation

Cooling methods for cargo chambers in conventional reefers, Cooling techniques for containers, Insulation and heat leakage estimation, Calculation of total load on the refrigeration plant.

Module IV:

Air Conditioning Fundamentals

Basic concepts and definitions of air conditioning., Psychrometric chart and its applications, Air conditioning (heating): heat sources, heat exchangers, and heat pumps, Air conditioning (cooling): principal arrangements and equipment.

Module V

Advanced HVAC Systems and Standards

Standards for marine air conditioning systems: air flow and capacity calculations. HVAC system types and components: Single zone, multiple zones, terminal reheat, and dual duct systems, Variable air volume and water systems, Cargo hold dehumidification systems, Design and performance evaluation of air conditioning systems for marine applications.

References:

1. Munton& Stot ;Refrigeration at Sea; Elsevier Science Ltd, 1967
2. Earl S. Shulters; Marine Air Conditioning and Refrigeration; Cornell Maritime Press 1952.
3. James A. Harbach; Marine Refrigeration and Air-Conditioning; Cornell Maritime Press, 2005.
4. Shan K. Wang; Handbook of Air Conditioning and Refrigeration, McGrawq Hill, 2000
5. P.I. Ballaney ;Refrigeration and Air Conditioning ;Khanna PublishersKhanna, 1985
6. Manohar Prasad, Refrigeration And Airconditioning, New Age International Pvt Ltd, 2021
7. Elstan A. Fernandez & Lakshman Singh Yadav ,Equipment and Systems: Refrigeration and Air Conditioning on Ships, Shroff Publishers, 2022.

24-215-0709 OFFSHORE STRUCTURE DESIGN

Course Description: This course is designed to offer the students an elemental understanding of major fixed and floating offshore structures, their structural design and installation works.

24-215-0709	**Offshore Structure Design**	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Stability of Ships, Structural Design of Ships and Ship Structural Analysis -1.

Course Objectives: The objective of the course is to familiarize the students with major offshore structures, their structural parts, the codes used in their structural design and installation works. The course also intends to equip the students to apply the knowledge already gained in ship structural design for the design of offshore structures.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the various major offshore structures and to identify the major structural components that make up such structures.
CO 2	Differentiate between the structural design principles followed in offshore structures as opposed to ship structures.
CO 3	Understand design process of fixed and floating offshore structures using relevant codes and standards.
CO 4	Understand the fundamentals of mooring calculations.
CO 5	Gain a elemental insight in offshore structure installation process and appreciate the complexities in the same.

Mapping of course outcomes with program outcomes:

Level - Low (1) , medium(2) and high(3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3	1										
CO 2	3	2										
CO 3	3	3										
CO 4	3	3			1							
CO 5	3	2			1	1						

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution:

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0709 OFFSHORE STRUCTURE DESIGN
Course Content:

Module I

Introduction to offshore structures, Classification of offshore structures. Description, details and features of Jacket, Gravity, Jack up, Guyed towers, TLP, Spar, Semi-submersible, FPSO. Design Principles, WSD and LRFD.

Module II

Loads: Description of environmental loads, dead loads and operational load, calculation of wave, wind, current loads. Morison's Equation.

Module III

Introduction to design of FSO, FPSO, FSRU. Various mooring arrangements and fundamental calculations associated with the same.

Module IV

Design of Jacket structures, Combined axial compression and bending, Design of Joints- Punching shear load and determination of stress concentration, Design for fatigue strength. Introduction to API Codes.

Module V

Design of Jackup structures, Description of the structural components, Fundamental Design of hull structures, leg, lifting components. Introduction of MODU codes

Reference:

1. Dawson, Offshore Structural Engineering, Longman higher education, 1983.
2. Teng. H, Applied Offshore Structural Engineering., Gulf publishing, 1984.
3. Berteaux H.D, Buoy Engineering, John Wiley, NewYork, 1976.
4. S.K.Chakrabarti, Handbook of Offshore Engineering (Vol I & II), 2005
5. W.J.Graff, Introduction to Offshore Structures- Design, Fabrication, Installation, gulf publishing co., 1981.
6. El-Reedy, Mohamed A.Marine structural design calculations Oxford Butterworth- Heinemann 2015

24-215-0710 SHIP RECYCLING

Course Description: This course provides students a general idea about **Ship recycling is the process of breaking down ships to recover and reuse their materials and equipment.**

	SHIP RECYCLING	Category	L	T	P	Credit	Year of Induction
24-215-0710		PEC	3	1	-	4	2024

Pre-requisites: Nil

Course Objectives: Students shall identify ship recycling as a sustainable practice that can be environmentally sound and energy efficient. Familiarize with the importance, regulations, process and goals related to ship recycling

Course outcome: After the completion of the course the students will be able to

CO 1	Explain the concept of sustainable development of the world and importance of shipping industry in this process.
CO 2	Explain the various stages of life cycle of ships, operations in life stages and effective management of the stages.
CO 3	Differentiate between various recycling Methods and describe the processes.
CO 4	Develop a Model layout of Ship Recycling yard and explain the various facilities.
CO 5	Understand the Rules and regulations in ship recycling and the role of NGOs

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3					1	1					1
CO 2	3						1					
CO 3	3	2					1					
CO 4	3	2				1	1					1
CO 5	3					1	1					1

Assessment Pattern:

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0710 SHIP RECYCLING
Course Content:

Module I

Introduction-Definition of Ship Recycling Relevance of Ship Recycling-Concept of sustainable development of the world-Factors contributing to the sustainable development, Role of maritime industrial sector, Statistics of global shipping and ship building.

Module II

Ship life cycle stages-Various stages of life cycle of ships, Operations in life stages and effective management of the stages. Importance of ship recycling in life cycle stage management

Module III

Recycling Methods-Decision on decommissioning of ships-Preparations for transferring obsolete vessels to Recycling Yards-Planning, Commercial matters, Transportation methods, Survey before positioning, Legal matters Positioning of obsolete ships-Beaching, Buoy and Dock methods

Module IV

Operation in Ship Recycling Ship dismantling process, Access, Cleaning, Marking, cutting, handling, lifting, sorting, stacking, storing, Marshall Concept of recycling

Reuse and landfilling in ship recycling Design for ship recycling-Vessel specific dismantling: Safety Issues. Model layout of Ship Recycling yard, ISO recommendations, Application of Information Technology in Ship Recycling.

Module V

Rules and regulations in ship recycling- Rule of various international and national agencies, IMO, UNEP (BASEL CONVENTION), EPACUSA), GMB (GUJARATH), ILO, DNV, Statutory Certificates for Ship Recycling, Green passport and Green ship Role of NGOs (Green Peace foundation, Ban Asbestos Network)-Inventory list Safety matters/ requirements-Chances of Environmental pollution, effect on life / organisms at sea.

References:

1. Purnendu Misra, Anjana Mukharjee, Ship Recycling , A Hand book for mariners, Narosa Publication, House, New Delhi, 2009.
2. A guide for ship scrappers, tips for regulatory compliance, United States Environmental Protection Agency, Summer 2000.
3. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 8 October, 2005.
4. IMO guidelines on ship Recycling, Resolution A. 962(23), 2004.
5. Industry code of practice on ship Recycling, Marisec, London, August 2001.
6. Safety and health in ship-breaking guidelines for Asian countries and Turkey, International Labour Office, 2004.
7. U.K ship recycling strategy Department for Environment Food and Rural Affairs, February 2007.
8. United Nations Environment Programme, Conference of the parties to the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, UNEP/CHW.6/23.

24-215-0711 MARITIME ENGINEERING CONTRACTS AND COMMERCIAL MANAGEMENT

Course Description: This course is designed to offer the students an elemental understanding of maritime contracts, and the basic concepts of cost estimation and cost control engineering.

24-215-0711	Maritime Engineering contracts And Commercial Management	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Ship Production Technology

Course Objectives: To introduce the learner to the fundamentals of maritime contracts and equip them to carry out typical cost estimations exercises and equip them to carry out cost control and negotiation activities.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the relevance of commercial management and its fundamental elements.
CO 2	Calculate and analyze the cost and price associated with elemental ship repair, ship conversion and ship new building activities.
CO 3	Understand the underlying principles associated with cost control engineering.
CO 4	Understanding the basics of marine contracts and the major contractual terms.
CO 5	Understand the relation between technical and economical features in maritime sector and the need for a holistic understanding of the sector.

Mapping of course outcomes with program outcomes:

Level - Low (1) , medium(2) and high(3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2							3	2			
CO 2	2			3				3				
CO 3	2			3			2					
CO 4	2							2		3		
CO 5	2		2					3				

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution:

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0711 MARITIME ENGINEERING CONTRACTS AND COMMERCIAL MANAGEMENT
Course Content

Module I

Introduction, Basic Divisions of Shipyard Activities, Introduction to Activity based costing (ABC) – cost categories (Material costs, labour costs, sub-contractor cost, overhead costs), activity-based budgeting, support costs. Importance of costing in competitive shipbuilding, Cost and Price, Approximate or budget prices, Approximate or budget costs.

Module II

Principles and Definitions: Role of Estimator, Invoicer, Preparator and higher management in the cost estimation and bidding process. Elements of Cost, Materials, Labour and other Expenses. Difference in Costing Methods for Commercial Vessels, Defense Projects and One-off Projects. Existing methods for estimating costs for various trades in a typical shipyard.

Module III

Cost Control Engineering: Introduction to 'Should-Cost' analysis and 'Time and Motion' studies. Role of astute time keeping and ERP software in the cost estimation and cost control process. Introduction to Price Comparison Exercises and the negotiation process.

Module IV

Basics of Shipbuilding contracts: Inception of a tender, Invitation of tenders, initial negotiations, risk assessment and risk review, Buyer's representatives, Sub-contractors, Modifications, Payment, Purchase price deductions, Guarantee and warranty of quality, Insurance, Trials, Delivery, Termination, Liquidated Damages provisions, letters of intent, bridging contracts, final negotiations, standard forms of contract, acceptance test procedure, trials, documents and delivery, warranty, dispute resolution.

Module V

Economic Considerations in Shipbuilding and operation - Freight market and operating economics. Chartering of ships. Alternative maritime designs. Overall optimization for speed size combinations of ships. Relative importance of technical and economic features. Management practices in maritime projects. Introduction to Commercial, marketing, legal and financial aspects of shipbuilding and shipping.

Practical: Cost estimation and Bid Submission for the drydocking of a typical seagoing vessel.

References:

1. Management of Marine Design, Erichsen. Stian, Butterworth & Co. (Publishers) Ltd, 1989, The Law of Shipbuilding Contracts, Simon Curtis, 2002, Lloyd's Shipping Law Library, Informa Professional.
2. Maritime Economics, second edition, Martin Stopford, Routledge, London. ISBN 0-415- 15309-3
3. Fundamentals of Ship Design Economics - Lecture Notes By Harry Benford, University of Michigan (available on the University website)
4. DGM Watson**,** Practical Ship Design, Elsevier Ocean Engineering Book Series 2002

24-215-0712 COMPOSITE BOAT DESIGN

Course Description: This course explores fiber-reinforced polymer (FRP) composites and their use in boat design. It covers the basics of materials, principles, and techniques used in building composite boats. Students will learn both the theory and practical skills needed to design and construct FRP boats. The course includes topics like micro-mechanical analysis, structural design, and quality control. Students will gain hands-on experience and learn how to create strong, durable, and sustainable boats.

	Composite	Category	L	T	P	Credit	Year of Induction
24-215-0712	Boat Design	PEC	3	1	-	4	2024

Pre-requisites: Mechanics of solids, Theory of structures

Course Objectives: The course aims to: Introduce students to the fundamentals of composite materials and their applications in marine vessels. Teach the construction techniques used in fabricating FRP boats, including single-skin and sandwich construction. Develop an understanding of micro-mechanical and structural analysis for designing composite boat components. Provide a framework for structural design using classification society rules to ensure safety and compliance. Familiarize students with quality control methods for FRP boat construction, including both destructive and non-destructive testing.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand the properties of composite materials and their processing methods for boat construction.
CO 2	Apply construction techniques for FRP boats, including single-skin and sandwich construction.
CO 3	Conduct micro-mechanical and structural analysis to evaluate and optimize composite materials for marine applications.
CO 4	Design FRP boat components, including shell and stiffeners, using classification society guidelines.
CO 5	Employ quality control techniques to ensure the structural reliability and performance of FRP boats.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3					1						
CO 2		2							2			2
CO 3			3			2	2				1	
CO 4			3			3	1		2			
CO 5				2	1		1	3				

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	10	30
Understand	20	10	30
Apply	10	20	30
Analyse		5	5
Evaluate		5	5

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0712 COMPOSITE BOAT DESIGN
Course content:

Module I:

Introduction to composite materials: History of fibre reinforced composites, Constituent materials, Fibres, matrix, fillers, additives, Properties of typical composite materials, Application of composites, Processing FRP composites: Molding – Spray up, hand lay-up, Compression moulding – matched dies moulding, Forming methods employing gas pressure, low pressure closed moulding, Pultrusion, Filament winding.

Module II:

FRP boat construction: Single skin, sandwich construction, Types of frames (Top hat, with or without core), Bulkhead, Typical midship section of FRP boat, Connections – Hull to deck, bulkhead to hull, Hull moulding, Deck moulding-Environmental control, temperature and humidity control.

Module III:

Micro mechanical analysis: Volume and weight fractions, Longitudinal strength and stiffness, Transverse section modulus, Shear modulus, Poisson ‘s ratio.

Structural Analysis: Elastic properties of unidirectional lamina, Stress strain relationships, Analysis of laminated composites, Basic assumptions, stress- displacement / stress-strain relationship, coupling effect, Types of laminate configuration (symmetric, anti-symmetric)

Module IV:

Structural design of FRP boats: Basic structural arrangement using classification society rules, Determination of boat shell lamination using classification society rules, Determination of stiffener lamination and size using classification society rules.

Module V:

FRP boat construction quality control: Destructive testing, Non-destructive testing (Ultrasonic, Infrared thermograph, laser shearography)

Practical: Design of Mid Ship section of FRP Boat

References:

1. Jones, Robert M. Mechanics of composite materials. CRC press, 1998.
2. Mukhopadhyay, Madhujit; Mechanics of composite materials and structures. Universities Press, 2005.
3. Indian Register of Shipping. Rules and regulations for the construction and classification of high speed crafts and light crafts, 2016.
4. Greene, E. Marine Composites, Eric Greene Associates, Inc., Maryland, USA 1999.
5. Chawla, Krishnan K. Composite materials: science and engineering. Springer Science & Business Media, 2012.
6. Barbero, Ever J. Introduction to composite materials design. CRC press, 2010.
7. Noton, Bryan R. Engineering applications of composites. Vol.3. Academic Press, 1974.
8. Teale, JohnHow to design a boatLondonAdlard Coles Nautical 2003
9. T. W. Clyne & D. Hull ,An Introduction to Composite Materials, Cambridge University Press; 3rd edition , 2019

24-215-0713 COMPUTER AIDED DESIGN & DRAFTING

Course Description: Course Description: To give a fundamental understanding to computer aided design process and mathematical representation of curves and surfaces

24-215-0713	**Computer Aided Design & Drafting**	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Basics of Computers and Computer Programming

Course Objectives: The objective of the course is impart a basic understanding to computer aided design process and to equip students with the skills to create precise technical drawings and models using specialized software for engineering, architectural, and design applications.

Course outcome: After the completion of the course the students will be able to

CO 1	Have a comprehensive understanding of the principles and applications of computer-aided design and drafting in engineering.
CO 2	Develop the ability to understand, apply, and manipulate two-dimensional and three-dimensional transformations and interact with computer graphics in engineering design.
CO 3	Apply mathematical representation of parallel and non-parallel projections and their application in CAD systems
CO 4	Understand mathematical representation of computational geometry by planar and space curves
CO 5	Develop the ability to represent, analyze, and optimize complex surfaces using advanced techniques like sweep surfaces, piecewise representation, and Bezier and B-spline modeling for engineering applications.

‘

Mapping of course outcomes with program outcomes:Level - Low (1) , medium(2) and high(3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3					1	1	1	3	3	3	3
CO 2	3	3	1	2								2
CO 3	1	3	1	2								2
CO 4	3	2	1	2	1							2
CO 5	3	1	1	2	1							2
CO6	2		1		1	1				2		2

Assessment Pattern:

Bloom‘s Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0713 COMPUTER AIDED DESIGN & DRAFTING

Course Content:

Module I

Computer Aided Design and Drafting – An overview, Engineering design, designer vs computer; computer as a design medium- software tools, analytical tools, development of CAD software. Object oriented approach to CAD-Paradigm shift in programming, POP vs OOP, features of OOP, Languages for OOP

Module II

C++ and object-oriented programming: Streamlining I/O with C++ - cin, cout, cerr, the >> extraction and << insertion operators. Reference variables – definitions, initialisation. Function overloading and default argument in functions. C++ structures – syntax rules. Object oriented programming – traditional structured programming, object-oriented terminology, encapsulation and class hierarchy.

Classes: Introduction – member variables and functions, interfaces and implementations, construction and destruction. Derived class – single inheritance, multiple inheritance, access control, abstract class and polymorphism. Operator overloading – operator functions, function call, increment and decrement. Computer Graphics and Geometric Modelling:

Module III

Introduction to computer graphics: Representing, preparing and presenting pictures, interacting with the pictures - description of various graphics devices.

Two Dimensional Transformations: Transformation of points and lines - scaling, reflection, shearing, rotation; Translation and Homogeneous co-ordinates; Combined transformations.

Three Dimensional Transformations: Scaling, shearing, reflection, rotation, translation, multiple transformations; Projections - Orthographic, axonometric, oblique, perspective projections.

Module IV

Curve representation: Nonparametric and parametric curves; Plane curves - circle, ellipse, hyperbola, parabola; Space curves - Cubic spline, Parabolic blending, Bezier and B-Spline curves.

Module V

Surface representation: Surface of revolution, sweep surfaces; Piecewise surface representation - bilinear surfaces, ruled and developable surfaces, Bezier and B-spline surfaces.

Practical: Preparation of computer programs to understand various concepts and techniques included in the Course Content.

References:

1. Rojers, D.F. & Adams, J.A., Mathematical Elements of Computer Graphics, McGraw Hill International Editions, 2012.
2. Krishnamoorthy, C.S. & Rajeev, S.; Computer Aided Design- Software and Analytical Tools, Narosa Publishing House, New Delhi, 1995.
3. Bjarne Stroustrup; The C++ Programming Language, Addison-Wesley Publishing Company, 1995.
4. Vera B. Anand; Computer Graphics and Geometric Modelling for Engineers; John Wiley & Sons, Inc., 1993.
5. Steven Harrington: Computer Graphics-A Programming Approach; Second Edition, McGraw Hill International Edition, 1987.
6. Donald Hearn and M. Pauline Baker; Computer Graphics; Prentice Hall, 1997
7. William M. Newman & Robert F. Sproull; Principles of Interactive Computer Graphics; McGraw Hill International Editions, 1997.
8. Sunil Kumar Srivastava, Computer Aided Design-a Basic and Mathematical approach, I.K. International publishing house, 2012.
9. Khushdeep Goyal: Fundamental of computer aided design, S.K. Kataria& Sons, 2013.
10. Harrington, Computer graphics, McGraw Hill education, 2014.

SEMESTER VIII

24-215-0801 SPECIAL PROBLEM AND SEMINAR

Course Description: The course requires students to select topics related to Naval Architecture and Marine Engineering, conduct an in-depth study through research and analysis, and prepare a comprehensive presentation. Students are then expected to present their findings in a seminar, demonstrating their understanding, analytical skills, and ability to communicate complex concepts effectively.

24-215-0801	Special Problem And Seminar	Category	L	T	P	Credit	Year of Induction
		PCC	-	2	-	2	2024

Course Outcomes: After completion of the course the students will be able to

CO 1	Gain a thorough understanding of a specific topic in Naval Architecture and Marine Engineering through detailed research.
CO 2	Develop the ability to conduct independent research, critically evaluate information, and synthesize findings effectively.
CO 3	Enhance their analytical skills by assessing complex engineering problems and proposing viable solutions within their chosen topic.
CO 4	Improve the ability to present complex technical concepts clearly and concisely through well-structured presentations.
CO 5	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2		2								2
CO 2	1	2		1								
CO 3	1			1							1	
CO 4	1										1	
CO 5	1										1	1

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
50	50	-	-

Assessment Pattern: The assessment will remain exclusively internal and categorized for presentation (50%), and report (50%).

24-215-0802 PROJECT WORK PHASE II & VIVA

Course Description: Analysis of the preliminary Hull designed by the students in 7th semester is to be undertaken in the semester. This analysis includes preliminary resistance prediction, propulsion design, structural analysis, and related aspects.

24-215-0802	**P**roject Work Phase II & Viva	Category	L	T	P	Credit	Year of Induction
		PCC	8	2	10	14	2020

Course Outcomes: After completion of the course the students will be able to

CO 1	Demonstrate the ability to perform comprehensive analyses of ship hull designs utilizing appropriate engineering principles and methodologies.
CO 2	Exhibit competence in employing industry-standard software and computational tools for simulating and evaluating various aspects of ship performance and structural integrity.
CO 3	Develop comprehensive technical reports and design documents that clearly articulate the design process, methodologies employed, and preliminary outcomes.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Establish a solid foundation for the subsequent detailed design and analysis phase by completing all preliminary design tasks and ensuring readiness for more complex design challenges

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	2	2	3		3	3
CO 2	3	3	3	3	3	2	2	2	3		3	2
CO 3	1	1		1				2	2	3	1	
CO 4	2	2		2				2	2	3	1	
CO 5	2	2		2		2	2	2	2		1	3

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
800	500	300	-

Assessment Pattern: Progress will be monitored and evaluated periodically by the assigned project guides. At the end of the project, students will undergo an internal viva-voce, assessed by a panel of professors, to determine their performance and understanding. The projects/activities should be unique and must be related to the knowledge and/or skills attained during their degree program in Naval Architecture and related areas.

Mark distribution: Ensures a balanced evaluation of both technical and soft skills, reflecting the comprehensive nature of the project. It aligns with common engineering project assessment criteria, emphasizing research, design, execution, creativity, documentation, and presentation.

The allocation of continuous assessment marks for the project categorized as follows: 40% marks attributed to the execution of the project, endorsed by the supervisor; 50%marks assigned to the viva voce examination; and 10% marks designated for attendance. The end semester evaluation marks will be endorsed 100% by the external examiner.

.

ELECTIVE SUBJECTS - SEMESTER VIII

24-215-0803 EXPERIMENTAL TECHNIQUES ON SHIPS AND MODELS

Course Description: This course is designed to provide view of ship hydrodynamics test facilities and procedure of conducting model test and analyse the results.

24-215-0803	Experimental Techniques on Ships and Models	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Ship hydrodynamics

Course Objectives: The objective of this course is to familiarize the students with the experimental techniques in prediction of performance of ships and models.

Course Outcomes: After completion of the course the students will be able to

CO 1	Explain various Ship Hydrodynamic Test Facilities and modelling laws
CO 2	Analyze the Ship Resistance Model Test results and predict full-scale results.
CO 3	Explain the procedure of conducting Ship Propulsion Model Tests and infer the test results.
CO 4	Explain the procedure of Standard manoeuvring tests and interpret the results.
CO 5	Describe typical seakeeping model tests, procedure and interpretation of results.

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1										
CO 2	2	1										1
CO 3	2	1										1
CO 4	2	1										1
CO 5	2	1										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
Remember	15	15	30
Understand	25	25	50
Apply	20	20	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	-

24-215-0803 EXPERIMENTAL TECHNIQUES ON SHIPS AND MODELS

Contents

Module I

Ship Hydrodynamic Test Facilities - Towing tank, maneuvering and seakeeping basins, wave basin & flumes, circulating water channel, cavitation tunnel; Modeling Laws - Geometrical similarity, kinematical similarity, dynamical similarity; Instrumentation - Measurements of position, velocity, acceleration, pressure, force, wave elevation, data acquisition, instrument calibration.

Module II

Ship Resistance Model Test: Ship model making; Components of ship resistance, ITTC guidelines, model making and preparation, test arrangements and resistance measurement, model test data presentation, extrapolation methods.

Module III

Ship Propulsion Tests: Propeller model making; Open water test - setup, procedures and measurements, preparation of open water diagram; Ship-propeller interaction; Self-propulsion test – setup, procedures and measurements; Determination of wake and thrust deduction fractions, propulsive efficiencies; Propeller model tests for cavitation.

Module IV

Ship Maneuvering Tests: Mathematical models for ship maneuvering; Standard maneuvering tests – turning circle, zigzag maneuver, stopping maneuver, spiral test; Maneuvering model tests – straight line test, rotating arm test, PMM test; Determination of hydrodynamic coefficients; Free running model preparation and tests.

Module V

Ship Seakeeping Tests: Ship model preparation for seakeeping tests – tests to determine model LCG, VCG, TCG and radii of gyration; Motion measurement and recording system; Wave generators and wave parameters; Roll decay test and roll damping determination; Measurement of heave, roll and pitch motions and RAO plot preparation. Wave energy and response spectrum

References

1. Lewis, E.U; Principles of Naval Architecture '(2nd Rev.) Vol. III, 2010, SNAME New York
2. J.P.Ghose, R.P. Ghokran _Basic Ship Propulsion',2015
3. Harvald S.A.; ―Resistance and Propulsion of Ships‖, John Wiley &Sons., 1983.
4. Antony F Molland, Stephen R Turnock, Ship resistance and propulsion-practical estimation of propulsive power, 2011
5. ITTC RECOMMENDED PROCEDURES Maneuverability – Captive Model Test Procedures. Proceedings of 23rd ITTC, 2002.ITTC RECOMMENDED PROCEDURES Resistance Tests. Proc
6. eedings of 23rd ITTC, 2002.
7. ITTC RECOMMENDED PROCEDURES Propulsion, Propulsor Open Water Tests. Proceedings of 2rd ITTC, 2002.
8. Booth, T. B. and R.E.D. Bishop. The Planar Motion Mechanism, 1973.
9. Morton Gertler. The DTMB Planar Motion Mechanism System, Hydromechanics Laboratory Test and Evaluation Report, Report No. 2523, 1967.
10. ITTC Proceedings: http://ittc.info/downloads/proceedings
11. John Carlton, Marine Propellers and Propulsion Butterworth-Heinemann 2012

24-215-0804 FINITE ELEMENT METHODS AND APPLICATIONS

Course Description: The course give an introduction to advanced structural analysis using finite element approach, to solve complex engineering problems such as ship structural analysis and analysis of offshore structures.

24-215-0804	Finite Element Methods and Applications	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Mechanics of Solids and Analysis of Structures

Course Objectives: The objective of the course is to make the students familiarize with the fundamental concepts of finite element method and to introduce its ability to solve complex engineering real life problems

Course outcome: After the completion of the course the students will be able to

CO 1	Familiarize with the fundamental concepts of finite element method
CO 2	Understand the basic concepts of formulating the shape functions, development of stiffness matrix, and application of boundary conditions
CO 3	Demonstrate the ability to carry out computer implementation of FEM, using numerical methods
CO 4	Demonstrate the ability to create finite element modelling of ship structure and simple plate analysis
CO 5	Apply FEM for analyzing offshore jacket structures

Mapping of course outcomes with program outcomes:Level - Low (1) , medium(2) and high(3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	2											
CO 2	1	2										
CO 3	2	1	2		3							2
CO 4	2	2	3		3							3
CO 5	2	1	3		3							3

Assessment Pattern:

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	5	5	10
Understand	15	15	20
Apply	30	30	70
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0804 FINITE ELEMENT METHODS AND APPLICATIONS
Contents

Module I

Scope of finite element method as a solution strategy for engineering problems, historical development of FEM, General steps in finite element analysis, variational formulations and weighted residual methods.

Module II

Shape functions, Convergence criteria, General equations for calculation of stiffness matrix in the form Derivation of stiffness matrix for truss beam, Planestress, plane strain, axisymmetric elements.

Module III

Computer Implementation of FEM- organization of computer program, Numerical methods for various property matrix calculations, fundamentals of stability and Dynamic analysis.

Module IV

Ship Structural Analysis using FEM- formulation of plate finite elements, issues associated with plate formulation of finite elements. Numerical examples on simple plate analysis. One dimensional and two-dimensional finite element modelling of ship structure.

Module V

Analysis of offshore jacket structures using FEM – static and free vibration analysis – including foundation. Analysis of Jackup structures using stick model. Numerical examples of simplified structures.

References

1. O.C.Zienkiewicz; Finite Element Method, 7th edition , Mc Graw Hill, 2013
2. R.D.Cooke ; Concepts and Application of FE Analysis ; John Wiley & Sons, 2001
3. C.S.Krishnamoorthy ; Finite Element Analysis for Engineering Design,; TMH New Delhi 1988
4. S.Rajasekaran; Finite Element Analysis; Wheeler publishing Company 2006
5. K.J .Bathe; Finite Element Methods for Nonlinear Problems; Springer 2012
6. David V. Hutton Fundamentals Of Finite Element Analysis Mcgraw Hill Education 2017
7. R. Dhanraj, K. Prabhakaran Nair Finite Element Method 1st Edition Oxford University Press, India 2015.
8. Seshu, P. Textbook of Finite element Analysis, Prentice Hall India ,2003
9. Ivo Babuska Finite Elements: An Introduction to the Method and Error EstimationOxford University press 2011
10. Klaus-Jürgen Bathe; Finite Element Procedures; Klaus-Jürgen Bathe; second edition 2014

24-215-0805 SHIP REPAIRING AND SURVEYING

Course Description: This course provides students with a general idea about ship surveying and repair activities carried out and also students will be able to explain activities of statutory bodies involved in surveying.

24-215-0805	Ship Repairing and Surveying	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites**: Nil**

Course Objectives: To study various types of surveys and certifications concerning ship design, Construction and Operation. To understand various types of repair works carried out on-board ships and their monitoring and certification by survey agencies.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand various Safety measures to be taken for repair and maintenance of a Merchant Navy Ship.
CO 2	Understand the role of ship survey agencies and various types of surveys.
CO 3	Have knowledge of maintenance and repair of ship‘s hull and deck at various stages of operation.
CO 4	Familiarise with welding and NDT techniques in ship repair
CO 5	Make an efficient ship repair yard layout

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	2	1	1									2
CO 2	1	1										2
CO 3	3	2	2									2
CO 4	2	1										1
CO 5	3	2	1		1							2

Assessment Pattern:

Bloom‘s Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0805 SHIP REPAIRING AND SURVEYING
Course Content:

Module I

Repair of ship hull – Introduction; cause of wear and damage in ship‘s hull: Comparison between different types of repair activities (Afloat, berthed, etc.); Repair of hull and other parts while afloat, docking plan-replacement of hull plates and stiffeners, decks and bulkheads; repair of stem and stern frames and shaft bracket; NDT and X-ray tests. Testing for water-tightness and hull continuity etc.

Module II

Underwater welding – welding equipment; quality control and standards; degree of automation. Safety during repair – various operations involving risk, safety devices and plans, problems during docking. Ship repair facilities in a modern repair yard-repair docks, machine shop, scaffolding; Subcontracting policies by shipyard in repair project, layout of repair yard.

Module III

Various types of marine surveys. Roles and responsibilities of marine surveying agencies. Historical development of ship classification societies, Major activities of classification societies, rules and class notation; IACS and joint projects. Comparison of ship class rules by LRS and ABS.

Module IV

International Ship classification societies and UN agencies involved in marine and offshore activities. Activities of classification societies and surveying agencies bodies Classification society – Design approval, construction survey, survey on operation, repair conversion. Industrial surveys, third party accreditation.

Module V

Statutory surveys – role of MMD. Activities of statutory bodies – MMD, Inspectorate of boats – design approval; construction inclination experiment, keel sighting, registration, surveys during – repair conversion and operation. Activities of other bodies – port authority; IWAI; Local bodies; canals etc. Warship construction warship overseeing team, inspection during construction; lineout inspection; Introduction of Marine Insurance, Marine Cargo Survey, Survey dry, liquid and container, cargoes.

References:

1. Bulk Carriers – Guidelines for Surveys, Assessment and Repair of Hull Structures; Witherby seamanship International 2017
2. John R Knott; Lashing and securing of deck cargoes; Nautical Institute, 1985
3. Norman Millard ; Lloyds Survey handbook; LP Professional Publishing; 7th Revised edition 1999
4. Huibert, Jan Lekkerkerk; GNSS Survey & Engineering: Handbook for Surveyors and Survey Engineers; The Nautical mind 2017
5. Don Butler A Guide to Ship Repair Estimates in Man-hours, Butterworth-Heinemann, 2012.

24-215-0806 MARINE POLLUTION PREVENTION AND MANAGEMENT

Course Description: Provides students a general idea about various types of marine pollution and their mitigation measures.

24-215-0806	Marine Pollution Prevention And Management	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites**: Nil** Course Objectives:

Course Objective: To understand types and effects of marine pollution. To evaluate pollution risk from ships

Course outcome: After the completion of the course the students will be able to

CO 1	Understand various types of marine pollution.
CO 2	Comprehend marine pollution mitigation measures.
CO 3	Apply safe design consideration for ships.
CO 4	Understand impact of pollution risk from ships.
CO 5	Apply Environment Management System.

Mapping of course outcomes with program outcomes:Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2				2					
CO 2	2	2	2				2					
CO 3	2	2	2									2
CO 4	2	2	2									1
CO 5	2	2	2				1					1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	40
Understand	25	25	40
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0806 MARINE POLLUTION PREVENTION AND MANAGEMENT

Course Content:

Module I

Marine pollution- definition- classification of pollutants- environmental impacts - Oil pollution - thermal, radioactive- Pollution due to port and harbor, Industrial pollutants- Pollution risks from ships -air pollution - Heavy metals- hazards Wastes- Solid waste pollution: classification and disposal of solid wastes and liquid sewage- sewage treatment, Pollution due to Protection methods against corrosion and fouling.

Module II

Prevention & Treatment of oil pollution – operational measures and accidental discharges, Double hulls standards, Safe tankers design and operation-safe navigation channels- oil pollution containment and recovery , Oil spill response plans , marine pollution monitoring and abatement programs.

Module III

Environmental threats from ballast water- Bilge water / waste oil operational management- ballast water treatment- International maritime dangerous goods (IMDG)-Dumping of ship wastes and other materials, Stringent standards for SOx, NOx and particulate matter, ship breaking and associated issues and ship recycling.

Module IV

Environmental Management Systems -Performance of Ocean environmental management- Ocean environmental management process-role of international, national and local authorities: IMO, MEPC, MARPOL, Key IMO Conventions, Environmental auditing-EIA for ocean development projects- Ocean environmental management-ISO 14000 .Energy Efficient Design Index (EEDI)-Energy Efficient Operational Indicator (EEOI), , Mandatory technical and operational energy efficiency measures.

Module V

The oceans – Maritime zones; Need for marine environment protection, the law of the sea and marine pollution – exclusive economic zone, continental shelf, deep seabed mining, exploitation regime - International Oil Pollution Compensation (IOPC) Funds-United Nations Convention on Law of Sea (UNCLOS)-Small Tanker Oil Pollution Indemnification Agreement (STOPIA)-Tanker Oil Pollution Indemnification Agreement (TOPIA).

References:

1. S.M.Tyagi,; Maritime Pollution and Prevention; Anmol Publication Pvt. Ltd, New Delhi ,2017. Ernst Frankel; Ocean Environmental Management,Edn.1995; Prentice Hall ,Inc., New Jersey, USA
2. AradhanaSalpekar; Marine Pollution; New Delhi JnanadaPrakashan, 2008
3. Clark, R.B; Marine Pollution; New York, Oxford University,1997
4. Johnston R.; Marine Pollution; London Academic Press, 1976.
5. MARPOL Consolidated Edition, 2017
6. Michael G Faure, Han Lixin and Shan Hongjun; Maritime Pollution Liability and Policy China, Europe and the US; Austin Wolters Kluwer 2010

24-215-0807 INLAND WATER TRANSPORT

Course Description:

This course is designed to offer the students an understanding of the characteristics of inland water transportation as well as the types and design of inland vessels.

24-215-0807	Inland water Transport	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Nil

Course Objectives: Objective of the course is to impart knowledge that will make students capable of developing concept design of inland vessels.

Course outcome: After the completion of the course the students will be able to: -

CO 1	Explain the characteristics of inland water transportation and the regulatory environment.
CO 2	Explain the restrictions, prospects and challenges of improving the inland water transportation in India
CO 3	Explain hydrodynamic aspect of inland water design such as hull form development, resistance and propulsion.
CO 4	Develop a preliminary General Arrangement layout of inland vessels
CO 5	Explain the structural design and construction of inland vessels

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3	1										
CO 2	3	1										1
CO 3	3	1										1
CO 4	3	1										1
CO 5	3	1										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	50
Apply	10	10	30
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0807 INLAND WATER TRANSPORT

Course Content

Module I

Introduction – Characteristics of Inland Water Transport - Inland water transport in India Classification of Inland Waterways.

Module II

Types of Inland vessels including special types and river sea vessels– Preliminary design – Dimensional Restrictions of Waterways – Bridges, bends, locks and gates, Design using empirical relations –weight estimation – Rules and regulations of Inland vessels – IV acts – Role of IWAI

Module III

Hull shapes of Inland vessels-chine hull forms – development of hull forms – round bilge, chine, multihull – stability of Inland vessels – Resistance and propulsion of Inland vessels - shallow water effect-Determination of shallow water resistance

Module IV

General Arrangement – Cargo handling & equipment on board systems – piping systems – FFA - LSA-super structure arrangements, mooring and anchoring.

Module V

Structural design - materials of construction – methods of construction and production technologies

References:

1. Recommendations on Harmonised Europe-Wide Technical Requirements for Inland Navigation Vessels, Resolution No. 61, Economic Commission for Europe, Inland Transport Committee, United Nations, 2011.
2. Report of the Working Party on the Standardization of Technical and Safety Requirements of Inland Navigation, Economic Commission for Europe, Inland Transport Committee, United Nations, 2013.
3. Kerala Inland Vessels Rules, 2010, Directorate of Ports, Govt. of Kerala, Department of Coastal Shipping and Inland Navigation.
4. 4) Safety Code for Passenger Ships Operating Solely in U.K. Categorised Waters, Merchant Shipping Notice MSN 1823 (M), The Maritime & Coastguard Agency, U.K., 2010.
5. Manual on Modernization of Inland Water Transport for Integration with a Multi-Modal Transport System, Economic and Social Commission for Asia and the Pacific, U.N., 2005.
6. BIRMINGHAM: Boat Building Techniques, Adlard Coles Nautical, London, 2006.
7. LAMB, THOMAS Ed: Ship Design and Construction, Vol 3, SNAME, New Jersey, 2003.
8. MCCARTNEY: Inland Navigation, American Society of Civil Engineers, USA 1998.
9. ROORDA: Small Sea Going Craft and Vessels for Inland Navigation, Technical Publishing Company, Holland, 1957.
10. STEWARD, ROBERT: Boat Building Manual, International Marine, USA, 1994.
11. NICOLSON, JAN: Boat Data Book, Adlard Coles Nautical, London, 1979.
12. INLAND & MARITIME: Waterways & Ports - Design, Construction & Operation, Pergamon Press, Oxford, 1981.
13. Adlard CDU PLESSIS , HUGO: Fibreglass Boats, 4tholes Nautical, London.
14. WHITENER, JACK R: Ferro Cement Boat Construction, Cornell Maritime Press, Cambridge, Maryland.
15. SIMS, ERNEST H: Aluminum Boat Building, Adlard Coles Nautical, London.
16. Sulaiman Oladokun Olanrewaju Safety and Environmental Risk Model for Inland Water Transportation 2012.

24-215-0808 ARTIFICIAL INTELLIGENCE IN MARINE TECHNOLOGY

Course Description: This course explores the application of AI technologies to enhance efficiency, safety, and sustainability in marine operations, including navigation, vessel design, and predictive maintenance. Students will learn to integrate machine learning, robotics, and data analytics to address challenges in the maritime industry and optimize decision-making processes.

24-215-0808	**Artificial intelligence in marine Technology**	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: NIL

Course Objectives: The objective of the course is to equip students with the knowledge and skills to apply AI technologies for improving efficiency, safety, and innovation in maritime operations and engineering.

Course outcome: After the completion of the course the students will be able to

CO 1	Understanding of AI's definition, evolution, and its applications in engineering and marine technology
CO 2	Develop a foundational understanding of machine learning paradigms.
CO 3	Gain proficiency in the concepts and architecture of Artificial Neural Networks and deep learning techniques
CO 4	Understand the fundamentals of data science, including its need, methodology, data quality, types, formats, and representation, along with sampling techniques
CO 5	Develop an understanding of Support Vector Machines and their mathematical foundations, and apply SVM to marine applications

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3											
CO 2	3	1										
CO 3	3	1										
CO 4	3	1										1
CO 5	3	1										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	50
Apply	10	10	30
Analyse			
Evaluate			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
200	100	100	3 hours

24-215-0808 ARTIFICIAL INTELLIGENCE IN MARINE TECHNOLOGY

Contents

Module I

Artificial Intelligence in Marine Technology- Overview of AI: Definition, evolution, and its role in engineering and marine applications. AI in Marine Navigation and Operations, Safety, Risk Management, and Environmental Sustainability

Module II

Introduction to Machine Learning: Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation. Regression - Linear regression with single and multiple variables, gradient descent algorithm and matrix method, Overfitting and Underfitting, Linear Methods for Classification- Logistic regression, Naive Bayes, Decision tree. Machine learning applications in marine systems. Real-time data processing and analysis for maritime operations

Module III

Artificial Neural Networks (ANN) and Introduction to deep learning Artificial Neural Networks: Perceptron, ANN Architectures, learning strategies, supervised, and unsupervised learning, reinforcement learning, Hebb Network, Training Algorithm, Perceptron Model, **Single Layer Perceptron**: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm. Multilayer feed forward network, Activation functions, Backpropagation algorithm. Deep models: L2 and L1 Regularization, Constrained Optimization and Under-Constrained problems. Deep learning applications in underwater imaging and object detection

Module IV

Introduction to Data Science-Need of Data Science, Data Science Methodology, Data : Data quality, Types of Data, Data Formats, High dimensional data, Data representation, Data Sampling, Probability sampling, Non-Probability sampling.

Module V

Support Vector Machines for Marine Applications Support Vector Machines (SVM) - Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, Maximum Margin linear separators, soft margin SVM classifier. Applications in marine navigation: Collision avoidance, route optimization, anomaly detection. Environmental monitoring: Water quality analysis, pollution detection, and HAB identification. Underwater applications: Object detection, sonar signal processing, and species classification.

References

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
2. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition
3. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.
4. Ian Goodfellow, Yoshoua Bengio, and Aaron Courville Deep Learning MIT Press Ltd, Illustrated edition
5. Simon Haykin, Neural Networks Comprehensive Foundation, 2nd ed., Pearson Education, 2005.
6. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991
7. Ingo Steinwart,,Andreas Christmann, Support vector machines,Springer PublishingCompany, 2008
8. Shigeo Abe Support Vector Machines for Pattern Classification, Springer PublishingCompany,2005
9. Abraham Silberschatz, Henry F. Korth, S. Sudarshan; Database System Concepts,McGraw Hill Publications, 2013

24-215-0809 ADVANCED COMPUTATIONAL FLUID DYNAMICS IN MARINE TECHNOLOGY

Course Description: Theory of computational fluid dynamics and application to ship hydrodynamics and offshore structures.

24-215-0809	Advanced Computational Fluid Dynamics In Marine Technology	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	4	2024

Pre-requisites: Ship Resistance, Propulsion of ships, Controllability of ships.

Course Objectives: Understand the difficulties in modelling turbulent flow and how to wisely use available computational facilities to model real life flows.

Course outcome: After the completion of the course the students will be able to

CO 1	Understand incompressible fluid flow and numerical methods used to analyse them.
CO 2	Understand methods used to determine the average characteristics of turbulent flow
CO 3	Understand methods to assemble and solve large matrix equations.
CO 4	Understand the capabilities and limitations of numerical packages to model complex flows and the effect of details on the solution. Appreciate the need for verification of every numerical analysis and the way to do it.
CO 5	

Mapping of course outcomes with program outcomes: Level - Low (1) , medium(2) and high(3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3											
CO 2	3	1										
CO 3	3	1										
CO 4	3	1										1
CO 5	3	1										1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	50
Apply	10	10	30
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

24-215-0809 ADVANCED COMPUTATIONAL FLUID DYNAMICS IN MARINE TECHNOLOGY

Course Content

Module I

What is CFD? Conservation laws for incompressible fluid flow. Boundary conditions. Review of numerical methods in engineering.

Module II

Reynolds Averaged Navier Stokes Equations. Turbulence models: mixing length, $k-\varepsilon$, and $k-\omega$.

Module III

The finite volume method. Staggered grids. The SIMPLE method for pressure-velocity coupling in steady flows. Worked examples.

Module IV

Use of software packages for basic CFD analysis. Effect of mesh and boundary conditions on solutions. Verification and validation.

Module V

Use of software packages for computational ship hydrodynamics, open-water characteristics of propeller, heaving motion of floating bodies, offshore structures in waves.

Practical. Flow over a flat plate. Cross-flow over a cylinder. 3D flow over an AUV. Resistance of a ship. Open water characteristics of a propeller. Heaving motion of floating bodies Offshore structures in waves.

References

1. H. K. Versteeg, W. Malalasekera. An Introduction to Computational Fluid Dynamics: The Finite Volume Method. Pearson. 2011.
2. Volker Bertram. Practical Ship Hydrodynamics. Elsevier. 2012.
3. Takanori Hino, Frederick Stern, Lars Larsson, Michel Visonneau, Nobuyuki Hirata, and Jin Kim (Editors) Numerical Ship Hydrodynamics: An Assessment of the Tokyo 2015 Workshop. Springer. 2021.
4. Christopher J. Greenshields and Henry G. Weller. Notes on Computational Fluid Dynamics: General Principles.https://doc.cfd.direct/notes/cfd-general-principles/
5. FOSSEE, IIT Bombay. Textbook Companion Project. https://cfd.fossee.in/textbook-companion-project

BTech HONOURS IN NAVAL ARCHITECTURE AND SHIP BUILDING -SYLLABUS

24-215-0510 COURSE I (H)

Course Description: This course to be completed in core areas of Naval Architecture and Ship Building as MOOC courses with minimum 3 credits, hosted in SWAYAM platform/ offered by CUSAT in offline/online mode after approval from Department Council (DC)

		Category	L	T	P	CREDIT	Year of Induction
24-215-0510	**COURSE I (H)**	PCC				3	2024

Pre-requisites: As per the BTech NA&SB Regulations 2024.

Assessment Pattern: The assessment of the MOOC courses will be as per the university rules and regulations regarding MOOC courses.

24-215-0608 COURSE II (H)

Course Description: This course to be completed in core areas of Naval Architecture and Ship Building as MOOC courses with minimum 3 credits, hosted in SWAYAM platform/ offered by CUSAT in offline/online mode after approval from Department Council (DC)

		Category	L	T	P	CREDIT	Year of Induction
24-215-0608	**COURSE II (H)**	PCC				3	2024

Pre-requisites: As per the BTech NA&SB Regulations 2024.

Assessment Pattern: The assessment of the MOOC courses will be as per the university rules and regulations regarding MOOC courses.

24-215-0714 MINI PROJECT I (H)

Course Description: The mini project is to be selected from broad areas of Naval Architecture and Ship Building such as Fluid Mechanics, Stability, Material Science, Applied Mechanics, Thermal Engineering, Ship Dynamics, (Powering, Ship Motions, Controllability), Electrical/ Control Systems in Ships/ Shipyards, Marine Engineering.

		Category	L	T	P	CREDIT	Year of Induction
24-215-0714	**Mini Project I (H)**	PCC			6	6	2024

Pre-requisites: As per the BTech NA&SB Regulations 2024.

Course Outcomes: After completion of the course the students will be able to

CO 1	Demonstrate the ability to apply classroom and laboratory concepts and principles to solve a practical problem.
CO 2	Exhibit competence in employing industry-standard software and computational tools for engineering problems.
CO 3	Develop comprehensive technical reports and design documents that clearly articulate the design process, methodologies employed, and preliminary outcomes.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Establish a solid foundation for the detailed design and analysis and ensuring readiness for more complex design challenges

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	2	2	3		3	3
CO 2	3	3	3	3	3	2	2	2	3		3	2
CO 3	1	1		1				2	2	3	1	
CO 4	2	2		2				2	2	3	1	
CO 5	2	2		2		2	2	2	2		1	3

Mark distribution:

Total Marks	**CIE**	**ESE**	**ESE Duration**
100	100	-	-

Assessment Pattern: The assessment of the mini projects for earning credits shall be carried out by a department committee consisting of at least three faculty members. Representatives from industry/Research Institutions also to be included in the committee in the case of an external projects.

Progress will be monitored and evaluated periodically by the assigned project guides. At the end of the project, students will undergo an internal viva-voce, assessed by a panel of professors, to determine their performance and understanding.

Mark distribution: Mark distribution ensures a balanced evaluation of both technical and soft skills, reflecting the comprehensive nature of the project. It aligns with common engineering project assessment criteria, emphasizing research, design, execution, creativity, documentation, and presentation.

The allocation of marks for the mini project adheres to a scale of 100, categorized as follows: 50% marks attributed to the execution of the project, endorsed by the supervisor; 50% marks assigned to the viva voce examination.

24-215-0810 MINI PROJECT II (H)

Course Description: The mini project is to be selected from broad areas of Naval Architecture and Ship Building such as Numerical Analysis (FEA or CFD), Marine Hydrodynamics, Ship Design, Green Technology, Ship Production, Heating Ventilating and Air Conditioning (HVAC) system design.

		Category	L	T	P	CREDIT	Year of Induction
24-215-0810	**Mini Project II (H)**	PCC			6	6	2024

Pre-requisites: As per the BTech NA&SB Regulations 2024.

Course Outcomes: After completion of the course the students will be able to

CO 1	Demonstrate the ability to apply classroom and laboratory concepts and principles to solve a practical problem.
CO 2	Exhibit competence in employing industry-standard software and computational tools for engineering problems.
CO 3	Develop comprehensive technical reports and design documents that clearly articulate the design process, methodologies employed, and preliminary outcomes.
CO 4	Demonstrate the ability to effectively present ideas and solutions in the context of written, oral, and electronic media.
CO 5	Establish a solid foundation for the detailed design and analysis and ensuring readiness for more complex design challenges

Mapping of Course Outcomes against Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	3	3	2	2	3		3	3
CO 2	3	3	3	3	3	2	2	2	3		3	2
CO 3	1	1		1				2	2	3	1	
CO 4	2	2		2				2	2	3	1	
CO 5	2	2		2		2	2	2	2		1	3

Mark distribution:

Total Marks	**CIE**	**ESE**	**ESE Duration**
100	100	-	-

Assessment Pattern: The assessment of the mini projects for earning credits shall be carried out by a department committee consisting of at least three faculty members. Representatives from industry/Research Institutions also to be included in the committee in the case of an external projects.

Progress will be monitored and evaluated periodically by the assigned project guides. At the end of the project, students will undergo an internal viva-voce, assessed by a panel of professors, to determine their performance and understanding.

Mark distribution: Mark distribution ensures a balanced evaluation of both technical and soft skills, reflecting the comprehensive nature of the project. It aligns with common engineering project assessment criteria, emphasizing research, design, execution, creativity, documentation, and presentation.

The allocation of marks for the mini project adheres to a scale of 100, categorized as follows: 50% marks attributed to the execution of the project, endorsed by the supervisor; 50% marks assigned to the viva voce examination.