CURRICULUM FRAMEWORK AND COURSE CONTENT FOR OUTCOME BASED EDUCATION

IN

B.Tech Program (Degree in Naval Architecture and Ship Building)

FOR THE STUDENTS ADMITTED FROM THE
ACADEMIC YEAR 2020-2021 ONWARDS

Cochin University of Science & Technology

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Cochin University of Science & Technology

Department Of Ship Technology

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 ShipBuilding throughinnovative teaching and learning processes.
- To prepare the students to be professionally competent to face the challenges inacademics, the 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.

Programme Educational Objectives (PEO)

Graduates of NA&SB program will be

PEO1: 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.
PEO2: Applying research and entrepreneurial skills augmented with a rich set of communication, teamwork and leadership skills to excel in their profession.
PEO3: Showing continuous improvement in their professional career through life-long learning, appreciating human values and ethics.

Graduate Attributes for Naval Architecture and Ship Building Programme (GA)

1. Computational Knowledge:
Apply knowledge of Naval Architecture fundamentals, allied subjects and domain knowledge appropriate for the Naval Architecture specialization to the abstraction and conceptualization of ship structural models from defined problems and requirements.
2. Problem Analysis:
Identify, formulate, research literature, and solve *complex Naval Architecture* problems reaching substantiated conclusions using fundamental principles of Basic Science, Engineering science, and relevant domain disciplines.

3. Design /Development of Solutions:
Design and evaluate solutions for *complex Naval Architecture* problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

4. Conduct Investigations of Naval Architecture 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.

5. Modern Tool Usage:
Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex Naval Architecture activities, with an understanding of the limitations.

6. Professional Ethics:
Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional Naval Architecture.

7. Life-long Learning:
Recognize the need, and have the ability, to engage in independent learning for continual development as a Naval Architecture professional.

8. Project management and finance:
Demonstrate knowledge and understanding of the Naval Architecture principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

9. Communication Efficacy:
Communicate effectively with the Naval Architecture community, and with society at large, about *complex Naval Architecture and Shipbuilding* activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

10. Societal and Environmental Concern:
Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional Naval Architecture practice.

11. Individual and Team Work:
Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

12. Innovation and Entrepreneurship
Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

Programme Outcomes (PO) for Naval Architecture and Shipbuilding (2020-2021)

On completion of *Naval Architecture and Shipbuilding* programme, the students are expected to

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Naval Architecture and ship building problems.

2. Problem analysis: Identify, formulate, review research literature, and analyse complex Naval Architecture and ship building problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex Naval Architecture and ship building 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.
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.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex Naval Architecture and ship building activities with an understanding of the limitations.
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 Naval Architecture and Ship Building practice.
7. Environment and sustainability: Understand the impact of the professional Naval Architecture and ship building solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Naval Architecture and ship building practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex Naval Architecture and ship building 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.
11. Project management and finance: Demonstrate knowledge and understanding of the Naval Architecture and ship building 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.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change in Naval Architecture and ship building field.

Bloom category assessment for Course outcome

Level	Description	Sample Objectives
Remember	Recognizes students' ability to use rote memorization and recall certain facts	The students will *recall* the four major food groups without error. The students will *list* at least three characteristics peculiar to the Cubist movement.
Understand	Involves students' ability to read course content, understand and	The students will *summarize* the main events of a story in

	interpret important information and put other's ideas into their own words	grammatically correct English. The students will *describe* in prose what is shown in graph form.
Apply	Students take new concepts and apply them to another situation	The students will *apply* previously learned information about socialism to reach an answer. The students will *demonstrate* the principle of reinforcement to classroom interactions.
Analyze	Students have the ability to take new information and break it down into parts to differentiate between them	The students will read a presidential debate and *point out* the passages that attack a political opponent personally rather than the opponent's political programs. Students will *discriminate* among a list of possible steps to determine which one(s) would lead to increased reliability for a test.
Create	Students are able *to take* various pieces of information and *form* a whole *creating* a pattern where one did not previously exist	After studying the current economic policies of the United States, student groups will *design* their own goals for fiscal and monetary policies. The students will write a different but plausible ending to a short story.
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	Given any research study, *evaluate* the appropriateness of the conclusions reached based on the data presented. The students will *compare* two pieces of sculpture, giving reasons for their positive evaluation of one over the other.

COURSE CONTENT B.TECH (NA&SB)

1st SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0101	Technical Communication	2	1	-	3	2	100	100	200
20-215-0102	Mathematics I	3	1	-	4	3	100	100	200
20-215-0103	Applied Physics	3	1	-	4	3	100	100	200
20-215-0104	Applied Chemistry	3	1	-	4	3	100	100	200
20-215-0105	Engineering Mechanics I	4	1	-	5	4	100	100	200
20-215-0106	Engineering Graphics	4	1	-	5	4	100	100	200
20-215-0107	Workshop Practice I	2	-	3	5	1	50	-	50
Total		**21**	**6**	**3**	**30**	**20**	**650**	**600**	**1250**

2nd SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0201	Mathematics II	3	1	-	4	3	100	100	200
20-215-0202	Computer Programming	3	-	1	4	3	100	100	200
20-215-0203	Professional Ethics	2	1	-	3	2	100	100	200
20-215-0204	Electrical Engineering	3	1	-	4	3	100	100	200
20-215-0205	Machine Drawing	4	1		5	4	100	100	200
20-215-0206	Introduction to Naval Architecture	3	1	-	4	3	100	100	200
20-215-0207	Workshop Practice II	1	-	2	3	1	50	-	50
20-215-0208	Electrical Engineering Lab	1	-	2	3	1	50	-	50
Total		**20**	**5**	**5**	**30**	**20**	**700**	**600**	**1300**

3rd SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0301	Mathematics III	3	1	-	4	3	100	100	200
20-215-0302	Fluid Mechanics I	3	1	-	4	3	100	100	200
20-215-0303	Mechanics of Solids	3	1	-	4	3	100	100	200
20-215-0304	Instrumentation	3	1		4	3	100	100	200
20-215-0305	Applied Thermodynamics	3	1	-	4	3	100	100	200
20-215-0306	Basic Ship Theory	3	1	-	4	3	100	100	200
20-215-0307	Fluid Mechanics Lab	2	-	4	6	1	50	-	50
20-215-0308	Internship	-	-	-	-	1	50	-	50
	Total	**20**	**6**	**4**	**30**	**20**	**700**	**600**	**1300**

4th SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0401	Mathematics IV	3	1	-	4	3	100	100	200
20-215-0402	Fluid Mechanics II	3	1	-	4	3	100	100	200
20-215-0403	Design of Machine Elements	2	2	-	4	3	100	100	200
20-215-0404	Analysis of Structures	3	1	-	4	3	100	100	200
20-215-0405	Material Science	3	1	-	4	3	100	100	200
20-215-0406	Stability of Ships	3	1	-	4	3	100	100	200
20-215-0407	Language Lab	-	-	2	2	1	50	-	50
20-215-0408	Material Testing Lab	-	-	4	4	1	50	-	50
Total		**17**	**7**	**6**	**30**	**20**	**700**	**600**	**1300**

5th SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0501	Resistance of Ships	3	1	-	4	3	100	100	200
20-215-0502	Propulsion of Ships	3	1	-	4	3	100	100	200
20-215-0503	Controllability of Ships	3	1	-	4	3	100	100	200
20-215-0504	Ship Motions in Seaway	3	1	-	4	3	100	100	200
20-215-0505	Electrical Systems on Ships & Shipyards	3	1	-	4	3	100	100	200
20-215-0506	Joining Techniques in Ship building Technology	3	1	-	4	3	100	100	200
20-215-0507	Model Making Techniques Lab	2	-	4	6	1	50	-	50
20-215-0508	Internship	-	-	-	-	1	50	-	50
Total		**20**	**6**	**4**	**30**	**20**	**700**	**600**	**1300**

6th SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0601	Computer Aided Design & Drafting	3	1	-	4	3	100	100	200
20-215-0602	Ship Structural Analysis – I	3	1	-	4	3	100	100	200
20-215-0603	Structural Design of Ships	3	1	-	4	3	100	100	200
20-215-0604	Ship Design	3	1	-	4	3	100	100	200
20-215-0605	Ship Production Technology	3	1	-	4	3	100	100	200
20-215-0606	Marine Engineering	3	1	-	4	3	100	100	200
20-215-0607	Marine Hydrodynamics Lab	1	-	2	3	1	50	-	50
20-215-0608	Marine Engineering Lab	1	-	2	3	1	50	-	50
Total		**20**	**6**	**4**	**30**	**20**	**700**	**600**	**1300**

7th SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0701	Ship Production Management	4	-	-	4	3	100	100	200
20-215-0702	Ship Structural Analysis – II	3	1	-	4	3	100	100	200
20-215-0703	Practical Ship Design	3	1	2	6	3	200		200
20-215-E7n	Elective I	3	1	-	4	3	100	100	200
20-215-E7n	Elective II	3	1	-	4	3	100	100	200
20-215-0704	Project Work	2	2	4	8	4	100		100
20-215-0705	Internship	-	-	-	-	1	50	-	50
Total		**18**	**6**	**6**	**30**	**20**	**750**	**400**	**1150**

The codes for the Electives shall be as 20-215-E7n, where 'n' represents the serial number of the elective given in the list of electives for 7th Semester.

8th SEMESTER

Code	Subject	Hrs/Week				Credit	Marks		
		L	T	P	Total		Internal Exam	University Exam	Total
20-215-0801	Special Problem & Seminar	-	2	-	2	2	100	-	100
20-215-E8n	Elective III	3	1	-	4	3	100	100	200
20-215-E8n	Elective IV	3	1	-	4	3	100	100	200
20-215-0802	Project Work& Viva Voce	12	-	8	20	12	300	200	500
Total		**18**	**2**	**10**	**30**	**20**	**800**	**400**	**1200**

The codes for the Electives shall be as 20-215-E8n, where 'n' represents the serial number of the elective given in the list of electives for 8th Semester.

Total Credits : **160**
Total Internal Exam Marks : **5700**
Total University Exam Marks : **4400**
Grand Total Marks : **10100**

SEMESTER-I

20-215-0101 TECHNICAL COMMUNICATION

Course Description: To provide overview on Eco system and to improve soft skills of students.

20-215-0101	Technical Communication	Category	L	T	P	Credit	Year of Induction
		HMC	2	1	-	2	2020

Pre-requisites: Nil

Course Objectives:

- To provide knowledge on effective Techical communication methods
- 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 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	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 Examination
	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

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content

1. **Module I**
   Written Communication : note making and note taking; summarizing; notes and memos, developing notes into text, organization of ideas, cohesion and coherence, paragraph writing, ordering information in space and time, short essays, description and argument, comparison and contrast, illustration, using graphics in writing, tables and charts, diagrams and flow – charts, maps, plans and graphs.
2. **Module II**
   Spelling rules and tips, writing a rough draft, editing and proof reading, writing the final draft, styling text, filling in complex forms, standard letters, CV, writing a report, writing leaflets and brochures, writing references, essay writing expository writing,

3. **Module III**
   Description of processes and products, classification, the instructional process, arguments and presentation of arguments, narrating events chronologically. (Emphasis should be given to the practice sessions for developing the oral and written communication skills of students).

4. **Module IV**

   Types of communication in scientific society, types of reports in professional life, Art of writing scientific report, and Technical presentation skill.

   Module V

   Cognitive process, techniques for effective reading, effective reading of a scientific paper, publishing in Conference and journal papers.

References:

1. Clifford Whilcomb& Leslie E, Effective inter-personal and team communication skills for engineers,WhilcombWoley -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 BjornHow to Write and Illustrate a Scientific Paper, Cambridge University Press

20-215-0102 MATHEMATICS I

Course Description:

Mathematics 1 subjects give the Knowledge regarding trace standard curves in engineering practice and their propertiesand to learn about hyperbolic functions, series expansion of function and concept and application of partial differentiation

20-215-0102	Mathematics I	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	0	3	2020

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 n th 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.

4. 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	Familiarize with important curves in engineering practice and learn about curvature
CO 4	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)

	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				2	1					2
CO 2	3	1										
CO 3	2	2		2	2							
CO 4	2	2	1	1	2							1
CO 5	3	3	2	1		2	2					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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 3 sub-divisions and carry 16 marks.

Course Content:

1. Module I

Hyperbolic functions: Definitions, properties; Inverses expressed as logarithms.

Series for Cos hx, Sin hx, Mutual conversion of hyperbolic and circular functions.

2. Module II

Leibnitz's rule for finding nth derivative, Taylor's and MacLauren's series

3. Module III

Standard curves in engineering practice such as conics, cycloids, hypocycloids, catenaries. Lemniscates, cardioids. Curvature, centre of curvature. Tangents & normal,

4. Module IV

Envelopes and evolutes. The latter viewed both as loci of centre of curvature and envelope of normal.

5. Module V

Partial derivatives. Total differentials. Euler's theorem on homogeneous functions. Errors and approximations

References:

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

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

3) James McMohan: Hyperbolic functions, Independent publishing platform, 2013.

4) Dexter J Booth, K.A.Stroud: Engineering Mathematics, Industrial press, 2013.

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

6) Luther PfahlerEisenhart: A treatise on the differential geometry of curves and surfaces, Dover Publications,2013.

7) R.K.jain, S.R.K Iyengar, Advanced engineering mathematics, Narosa, 2011

20-215-0103 APPLIED PHYSICS

CourseDescription: The aim of the Engineering Physics Program 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

20-215-0103	Applied Physics	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	-	3	2020

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	Recall the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 2	Understandthe diffraction and refraction principlesto explore its possible applications in engineering fields.
CO 3	Apply the comprehended knowledge about laser and holography, Ultra sound waves into possible applications in engineering fields.
CO 4	Apply the principles the working of solid state lighting devices and fibre optic communication system
CO 5	Analyse the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics 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)

	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						2
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 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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

Course Content:

1. **Module I**
   Interference of Light: Interference on thin films, colours of thin films-Newton's rings (reflected system). Determination of wavelength and refractive index. Air wedge diameter of thin wire-Testing of plainness of surfaces, Production of X-rays-continuous and characteristic x-rays-Mosley's law-Diffraction of x-rays-Bragg's law-Bragg's x-ray spectrometer-Compton effect-expression for change in wavelength.

2. **Module II**
   Diffraction-Fresenel and Fraunhofer diffraction-Zone place-plane diffraction grating-Measurement of wavelength-dispersive power of grating. Resolving power-Raleigh's criterion-Resolving power of telescope and grating. Double refraction-Positive and negative crystals- Nicol prism-Huygen's theory of double refraction. Quarter wave and double wave plates. Production and analysis of plane polarised and circularly polarised light using crystal plates. Optical activity-Fresnel's theory-Specific rotation-Half shade polarimeter.

3. **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. Ultra sound waves-Production, properties and application, Recording and reproduction of sound- Magnetic tape recording-sound recording on cine films

4. **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.

5. **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.

References:

1) Theraja, Modern physics, S Chand, 2013.
2) Charles Kittel, Solid State Physics, Wiley, 2012.
3) Agarwal, Optical fibre communication, S Chand, 2007.
4) AjoyGhatak, Optics, McGraw Hill, 2012.
5) Dale Even & Neill Schurter, Applied Physics, Prentice Hall, 2011,
6) Steve Cook, Interference, Double dare Publishers, 2014
7) S.Mani Nadu, A text Book of Engg. Physics, Pearson, 2010.
8) Prabhir.K.Vasu, A text Book of Engg. Physics, Ane book, 2010.
9) Bhavikatti, S.S. Solid State Physics , 7,PB 499,2019,New age Publication.
10) Sharma, S.S. Engineering Physics: Theory and Experiments (All india),3,PB 360,2018,New age Publication.

20-215-0104 APPLIED 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.

20-215-0104	Applied Chemistry	Category	L	T	P	Credit	Year of Induction
		BSC	3	1	-	3	2020

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	Recognise/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	Analyse 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)

	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	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
	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

ContinuousInternalEvaluationPattern:

Attendance : 10marks
Continuous Assessment: 40marks
Internal Test : 50marks

EndSemesterExaminationPattern: Therewillbetwoparts;PartAandPartB.PartAcontain5questionswith1questions fromeachmodule,having4marksforeachquestion.Studentsshouldanswerallquestions.PartBcontains2questionsfromeachmoduleofwhichstudentshouldansweranyone.Eachquestioncanhavemaximum2sub-divisionsandcarry16marks.

Course Content:

1. 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.

2. 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 (H_2/O_2). Electrochemical corrosion and it application.

3. Module III
   Fuels and Combustion – Solid, liquid and gaseous fuels, calorific value of fuels, 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, LPG, Producer gas, combustion zone, reduction zone, water gas, coal gas, oil gas. Combustion calculations, explosives. Propellants, Nuclear fuels – nuclear fission and fusion.

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

5. 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) Uppal, M.M, A Text Book of Engineering Chemistry, Khanna Publishers, New-Delhi, 2002.
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) R.N.Goyal&HarmendraGoel, A text book of Engineering Chemistry, Ane books, 2011.
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 (All India) 2 PB 325 2018, ew age Publication,2020.

20-215-0105 ENGINEERING MECHANICS

CourseDescription:
Goalofthiscourseistoexposethestudentstothefundamentalconceptsofmechanicsandenhancestheirproblem-solvingskills.
Itintroducesstudentstotheinfluenceofappliedforcesystemandthegeometricalpropertiesoftherigidbodieswhilestationaryorinmotion.
Afterthiscoursestudentswillbeabletorecognizesimilarproblemsinreal-worldsituationsandrespondaccordingly.

20-215-0105	Engineering Mechanics I	Category	L	T	P	Credit	Year of Induction
		ESC	4	1	-	4	2020

Prerequisite: Nil

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

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

CO1	Recallprinciplesandtheoremsrelatedtorigidbodymechanics
CO2	Identifyanddescribethecomponentsofsystemofforcesactingonarigid body
CO3	Applytheconditionsofequilibriumtovarious practicalproblemsinvolvingdifferentforcesystem.
CO4	Applyappropriatetheorems, principlesorformulaetosolveproblemsofmechanics
CO5	Solveproblemsinvolvingrigidbodies, applyingthepropertiesofdistributedareasandmasses

Mappingofcourseoutcomeswithprogramoutcomes

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

AssesmentPattern

Bloom'sCategory	ContinuousAssessmentTests		EndSemesterExamination(Marks)
	Test1(Marks)	Test2(Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESEDuration
200	100	100	3hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
Continuous Assessment: 40marks
Internal Test : 50marks

EndSemesterExaminationPattern: Therewillbetwoparts;PartAandPartB.PartAcontain5questionswith1questionsfromeachmodule,having3marksforeachquestion.Studentsshouldanswerallquestions.PartBcontains2questionsfromeachmoduleofwhichstudentshouldansweranyone.Eachquestioncanhavemaximum2sub-divisionsandcarry16 marks.

Course Content:

1. **Module1**

IntroductiontoEngineeringMechanics-statics-basicprinciplesofstatics-Parallelogramlaw, equilibriumlaw, principlesofsuperpositionandtransmissibility, lawofactionandreaction(review) freebodydiagrams.

2. **Module2**
   Friction–slidingfriction-Coulomb'slawsoffriction–analysisofsinglebodies–wedges, ladder-analysisofconnectedbodies.
   Parallelcoplanarforces–couple-resultantofparallelforces–centreofparallelforces–equilibriumofparallelforces–
   Simplebeamsubjecttoconcentratedverticalloads.Generalcoplanarforcesystem-resultantandequilibriumequations.

3. **Module3**
   Centroidofcompositeareas-–momentofinertia-parallelaxisandperpendicularaxistheorems.Polarmomentofinertia, radiusofgyration, massmomentofinertia-ring, cylinderanddisc.
   TheoremofPappusGuldinus(demonstration only)
   Forcesinspace-vectorial representationof forces, momentsandcouples–resultantandequilibriumequations–concurrentforcesinspace (simpleproblemsonly)

4. **Module4**
   Dynamics–rectilineartranslation-equationsofkinematics (review)
   Kinetics– equationofmotion–D'Alembert'sprinciple.–motion onhorizontalandinclinedsurfaces,
   motionofconnectedbodies.Impulsemomentumequationandworkenergyequation (concepts only).
   Curvilineartranslation-equationsofkinematics–projectilemotion (review), kinetics–equationofmotion. Momentofmomentumandworkenergyequation (conceptsonly).

5. **Module5**
   Rotation–kinematicsofrotation-equationofmotionforarigidbodyrotatingaboutafixedaxis–rotationunderaconstantmoment.
   Planemotionofrigidbody–instantaneouscentreofrotation (concept only).
   Simpleharmonicmotion–freevibration–degreeoffreedom-undampedfreevibrationofspringmasssystem-effectofdamping (conceptonly)

References:

1.TimoshenkoandYoung,EngineeringMechanics,McGrawHillPublishers
2. Shames,I.H.,EngineeringMechanics-StaticsandDynamics,PrenticeHallofIndia.
3..C.HibbelerandAshokGupta,EngineeringMechanics,Vol.Istatics,VolIIDynamics,PearsonEducation.
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.F.P.BeerabdE.R.Johnston(2011),VectorMechanicsforEngineers,Vol.I-Statics,Vol.II-Dynamics,9th Ed,TataMcGrawHill
7.RajasekaranSandSankarasubramanianG,EngineeringMechanics-StaticsandDynamics,VikasPublishingHousePvtLtd.
8.S. S Bhavikatti Engineering Mechanics,7,PB499 New age Publication 2019.

20-215-0106 ENGINEERING GRAPHICS

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

20-215-0106	Engineering Graphics	Category	L	T	P	Credit	Year of Induction
		ESC	4	1	-	4	2020

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 multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test	Test2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Create			

Markdistribution

TotalMarks	CIE(Marks)	ESE(Marks)	ESEDuration
200	100	100	3hours

ContinuousInternalEvaluationPattern:
CIA for section A carries 50marks (30marksfor1st testandClasswork 20marks)CIAforsectionBcarries 50marks(30marksfor 1sttestandClass work 20marks)

End Semester Examination Pattern
ESEwillbeof3hourdurationonA4sizeanswerbookletandwillbefor100marks.ESEquestionpapers hallcontaintwoquestionsfromeachmoduleofSectionAonly.Studenthastoansweranyonequestionf romeachmodule.Eachquestioncarries20marks.

Course Content:

General Instructions:
Firstangleprojectiontobefollowed
- SectionApracticeproblemstobeperformedonA4sizesheets
- SectionBclassestobeconductedonCADlab
- CIAforsectionAcarries25marks(15marksfor1testandClasswork10marks)
- CIAforsectionBcarries15marks(10marksfor1testandClasswork5marks)

SECTION -A

1. **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.

2. **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.

3. **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.

4. **Module IV**

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

5. **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

(TobeconductedinCADLab)

IntroductiontoComputerAidedDrawing:Roleof CADindesignanddevelopmentofnewproducts, 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)

TextBooks

1.Bhatt,N.D.,EngineeringDrawing,CharotarPublishingHousePvt.Ltd.
2.John,K.C.EngineeringGraphics,PrenticeHallIndiaPublishers.
3. Venugopal, K. Engineering Graphics (As Per Anna University),15,PB,475,2018 New age Publication.

References:

1.Agrawal,B.andAgrawal,C.M.,EngineeringDrawing,TataMcGrawHillPublishers.
2.Duff,J.M.andRoss,W.A.,EngineeringDesignandVisualisation,CengageLearning.3.Kulkarni, D.M.,Rastogi,A.P.andSarkar,A.K.,EngineeringGraphicswithAutoCAD,PHI.4.Luzaddff,W.J.and Duff,J.M.,FundamentalsofEngineeringDrawing,PHI.

20-215-0107 WORKSHOP PRACTICE I

Course Description: This lab 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 basic mechanical workshop operations.

20-215-0107		Category	L	T	P	Credit	Year of Induction
	Workshop Practice I	BSC	2	0	3	1	2020

Prerequisite: Nil

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

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

	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											
CO 3	2											1
CO 4	3	2										1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

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) Foundry Shop

4) Sheet Metal Shop

5) Lathe

6) Shaping m/c, Planing m/c, Milling m/c, Drilling and Boring m/c

SEMESTER-II

20-215-0201 MATHEMATICS II

Course Description:

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

20-215-0201	Mathematics II	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	0	3	2020

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 behavior 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	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering
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)

	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						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	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 3 sub-divisions and carry 16 marks.

Course Content:

1. Module I

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

2. Module II

Vector calculus, Cartesian, Cylindrical and Spherical systems of co-ordinates. Expression for ds

Gradient, divergence, curl in all the three systems. Gauss theorem. Stoke's theorem.

3. Module III

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

Simultaneous Linear Equations.

4. Module IV

Fourier series. Full range and half-range series. Maxima and Minima of functions of two variables Saddle points.

5. 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) James McMohan: Hyperbolic functions, Independent publishing platform, 2013.

4) Dexter J Booth, K.A.Stroud: Engineering Mathematics, Industrial press, 2013.

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

6) Luther PfahlerEisenhart: A treatise on the differential geometry of curves and surfaces, Dover Publications,

2013.

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

20-215-0202 COMPUTER PROGRAMMING

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 first principles of computer organization, students will receive a foundation in programming focusing on C. Fundamental programming concepts such as Data types, Operators, Flow control statements, Functions, Arrays and pointers will be covered through relevant programming assignments.

20-215-0202	Computer Programming	Category	L	T	P	Credit	Year of Induction
		ESC	3	-	1	3	2020

Pre-requisites: Mathematical skills.

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 C programming language, to learn the fundamentals of computer programming including how to write, compile and execute programs.

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

CO1	Define the key hardware components in a modern computer system and how software is mapped to the Hardware.
CO2	Use a computer to solve problems by developing simple algorithms and then implement them using a specific programming language
CO3	Write computer programs using conditional and iterative structures, using C programming language
CO4	Analyse and select an appropriate basic data structure (e.g. arrays) for problem solving using C programming
CO5	Implement an appropriate access methods (e.g. pointers) for problem solving using C programming

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	1											
CO 2	1	1	1	1								
CO 3	2	2	2	2	2							
CO 4	2	2	2	1	1							1
CO 5	2	2	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment : 40 marks

Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

   Computer Fundamentals: Basic computer organisation, representation of information, secondary storage devices, systems and applications, software, operating system.

2. **Module II**

   Overview of programming: Introduction to computer based problem solving, programs and algorithms, data organisation or data structures, construction of loops, use of procedures.

3. **Module III**

   Fundamentals of *C Programming*: Data types – *int, float, char, double and void*, etc. Operators and expressions – Arithmetic operators, relational operators, logical operators and their expressions. Control constructs – *if-then, for* and *while*. Arrays – array declaration, one and two-dimensional arrays. Functions and subprograms – general form arguments and return values.

4. **Module IV**

   Advanced Programming techniques: Control constructs – d*o–while, switch* statements, *go to, label.* Functions – parameter passing, call-by-value, call-by-reference, calling functions with arrays, *argc*and *argv.*

5. **Module V**

   Dynamic Data structures: Pointers - & and * operators, pointer expression, pointer assignments. Structures – Basics of structures, referencing structure element, array of structures, passing structures to functions. File handling – file pointer, file accessing functions, *fopen, fclose, putc, getc*and *fprint.*

References:

1) Rajaraman, Introduction to Information technology, 2013.

2) Rajaraman, Fundamentals of Computers, 2014.

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.

20-215-0203 PROFESSIONAL ETHICS

Course Description: The aim of the course is to expose the students toprofessionalethicsand Human Values and also to provide basicfamiliarityabout EngineersasresponsibleExperimenters,ResearchEthics,CodesofEthics and IndustrialStandards.

20-215-0203	Professional ethics	Category	L	T	P	Credit	Year of Induction
		HMC	2	1	-	2	2020

Pre-requisites: Nil

Course Objectives:

1. To create awareness on professional ethics and Human Values.
2. To inculcate knowledge and exposure on Safety and Risk, Risk Benefit Analysis.
3. 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 SafetyandRisk 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)

	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				1
CO 2	2							3				1
CO 3	3	2	2					2				1
CO 4	3	1	1					1				1
CO 5	3	2	2		1			2				2

Assessment Pattern:

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration

200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content

1. **Module I**

   Morals, valuesandEthics –Integrity–Work ethic –Servicelearning–Civicvirtue–Respectforothers–Livingpeacefully–Caring–Sharing–Honesty–Courage–Valuingtime–Cooperation–Commitment–Empathy–Self-confidence–Character–Spirituality–IntroductiontoYogaandmeditationforprofessionalexcellenceandstress

2. **Module II**

   Sensesof'EngineeringEthics'–Varietyofmoralissues–Typesofinquiry–Moraldilemmas–MoralAutonomy–Kohlberg'stheory–Gilligan'stheory–ConsensusandControversy–ProfessionsandProfessionalism–ProfessionalIdealsandVirtues

3. **Module III**

   EngineeringasExperimentation–EngineersasresponsibleExperimenters–ResearchEthics-CodesofEthics–IndustrialStandards-ABalancedOutlookonLaw–TheChallengerCaseStudy

4. **Module IV**

   SafetyandRisk–AssessmentofSafetyandRisk–RiskBenefitAnalysis–ReducingRisk–TheGovernmentRegulator'sApproachtoRisk-ChernobylCaseStudiesandBhopal

5. **Module V**

   CollegialityandLoyalty–RespectforAuthority–CollectiveBargaining –Confidentiality–Conflicts ofInterest– Occupational Crime–ProfessionalRights–EmployeeRights–IntellectualPropertyRights (IPR)–Discrimination
   MultinationalCorporations–BusinessEthics-EnvironmentalEthics–ComputerEthics-RoleinTechnologicalDevelopment–WeaponsDevelopment–EngineersasManagers–ConsultingEngineers–EngineersasExpertWitnessesandAdvisors–Honesty–MoralLeadership–SampleCodeofConduct

Text Books:

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, 2000.
2.Jayasree Suresh and B. S. Raghavan, Human Values and Professional Ethics, 3rd Edition,

S. Chand Publications
3. Mike Martin and Ronald Schinzinger, "Ethics in Engineering", McGraw-Hill, New York, 2005.
4. RR Gaur,R Sangal and G P Bagaria," A foundation course in human values and professional ethics",1st editons,Excel books,2010.

References:

1. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999.
2. David Ermann and Michele S Shauf, Computers, Ethics and Society, Oxford University Press, 2003
3. Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineers, Oxford University Press, Oxford, 2001.
4. Govindarajan M, Natarajan S, Senthil Kumar V S., Engineering Ethics, Prentice Hall of India, New Delhi 2004.
5. John R Boatright, Ethics and the conduct of Business, Pearson education, New Delhi, 2003.
Prof. (Col) P S Bajaj and Dr. Raj Agrawal, Business Ethics – An Indian Perspective, Biztantra, New Delhi, 2004.

20-215-0204 ELECTRICAL ENGINEERING

Course Description: To impart students on the basic knowledge in electrical engineering.

20-215-0204	Electrical Engineering	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2020

Pre-requisites: Nil

Course Objectives:

- To provide the learners a proper understanding of the basic working principles, construction, characteristics and applications of DC and AC machines.
- To impart understanding of the basic principles of three phase circuits and electronic communication.

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

CO 1	Learn the basic working principle, construction, types, vector diagram, equivalent circuit parameter estimation through OC and SC tests, voltage regulation, efficiency and applications of Transformers.
CO 2	Learn the basic working principle, construction, types, performance characteristics, voltage regulation, losses, efficiency and applications of DC Generators, DC motors, Alternators and AC motors.
CO 3	Analyze the generation of three phase electrical power, three phase three wire star connected and delta connected systems, merits and measurement of three phase power.
CO 4	Analyze OC and SC test results to compute the equivalent circuit parameters of a transformer and performance characteristics of DC shunt and series motors from load test observations systems.
CO 5	Learn the basicanalog communications system, waveforms, modulation index and features of Amplitude modulation and Frequency modulation, Super

	heterodyne receiver for AM and FM and fundamentals of satellite communication.
CO 6	Apply learnt concepts to answer numerical problems involving electrical machines and three phase circuit.

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	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						

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	12
Understand	10	20	15
Apply	20	10	13
Analyse	10	10	8
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

   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 transformer.

2. **Module II**
   Basic principles of electrical machines: D.C. generators-construction details-principle of operation-emf equation-methods of excitation-simple problems. 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-simple problems.

3. **Module III**
   Polyphase circuits: Generation of polyphase voltage-phase difference-vector representation-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.

4. **Module IV**
   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 motors-construction details of squirrel cage and slip ring motors-slip speed-single phase induction motors-principle of operation-types.

5. **Module V**
   Basics of Electronic communication: Modulation –need for 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 &HarroonAshfaq, Fourth edition, 2016, Dhanpai Rai & Co.
2. Basic Electrical Engineering, J.B Gupta, 2013 Published by S.K. Kataria& Sons
3. Fitzgerald and Kingsley's Electric Machinery by Stephen Umans, seventh edition, 2013
4. Electrical Machines – I, U.A.Bakshi, M.V.Bakshi,Technical Publications, 2017
5. Electrical Machines – II, U.A.Bakshi, M.V.Bakshi, Technical Publications, 2014
6. Reed's Vol.6: Basic Electro technology for Engineers- Chirstopher Lavers, Edmund G.R. Kraal & Stanley Buyers, Ed.4, 2013.
7. Reed's Vol.7, Advanced Electro technology for marine Engineers - Chirstopher Lavers and Edmund G.R. Kraal, October 2014.
8. A text book of Electrical Technology- Vol-I - B.L.Theraja, A.K. Theraja, 2015
9. A text book of Electrical Technology- Vol-II - B.L.Theraja, A.K. Theraja, 2015
10. Kennedy's Electronic Communication Systems – George Kennedy, Bernard Davis McGraw-Hill, 5th ed., 2011

20-215-0205 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.

20-215-0205	Machine Drawing	Category	L	T	P	Credit	Year of Induction
		ESC	4	1	-	4	2020

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)

	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		
CO 2	3	2								2		
CO 3	3	2								2		
CO 4	3	2			2					2		2
CO 5	3	2			2					2		2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10		10
Understand	15	20	30
Apply	25	30	60
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 question of 4 marks each from each modules 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:

1. **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.

2. **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

3. **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.

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

5. **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 Punlication.

20-215-0206 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 grasp a clear understanding of the underlying principles involved, laying in the process the foundations, for more in depth studies in future.

20-215-0206	Introduction To Naval Architecture	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Prerequisite: Nil

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

CO 1	Discern the role of the Naval Architect in the maritime industry.
CO 2	Explain various types of ships, and of fundamentals of Naval Architecture, that would equip one to define hull forms geometrically, and represent them as line plan drawings.
CO 3	Apply the procedures of numerical integration to calculate hydrostatic properties, and plot sectional area curves, Bonjean curves, and hydrostatic curves.
CO 4	Explain the concept the of weight and buoyancy of a ship, and of the various types of materials used for construction of maritime structures, and identify various major and minor structural components of a ship.
CO 5	Discern the general arrangement of propulsion plants, and of the various auxiliary machinery, required for efficient operation of a ship.
CO 6	Explain the various machineries/ equipment, anchoring, mooring and towing operations.

Mapping of course outcomes with 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
CO1	3		1								1	
CO2	3	1	1		3							
CO3	3	3	1		3							
CO4	2	1	1									
CO5	2		1		1							
CO6	2		1									

Assessment Pattern

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
Continuous Assessment: 40marks
Internal Test : 50marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions, with 3 questions from each module, having 3 marks each. Students should answer all questions. Part B contains 3 questions from each module, of which the student should answer any 2. Each question can have maximum 4 sub-divisions and carry 7 marks.

Course Content

1. **Module I**
   Introduction ships and Naval Architecture discipline
   Historical review - Ancient types of vessels (rafts, boats, and ships), the role of ship in the ages of the great discoveries, Role of a Naval Architect in the Maritime Industry.
   Types of ships: - terms and definitions, cargo ships (general cargo ships, bulk carriers, container ships, Ro-Ro ships, barge carriers, tankers), fishing vessels, factory ships, supply ships, Cable ships, ice breakers, research vessels, warships, hydrofoils, air cushion vehicles, small pleasure crafts (yachts, ketches, etc).
2. **Module II**
   Introduction to ship geometry
   Some physical fundamentals - Archimedes principle, laws of floatation stability and trim.
   The ship's form-main dimensions, lines plan, coefficients and their meaning, Fairing process and table of offsets; Hydrostatic particulars &Bonjean Curves: - (Volume of Displacement/ Displacement, Centre of Buoyancy, Centre of Floatation, KMT And BMT Metacentric Radius, TPC 1cm, MCT 1cm, Form Coefficients (C_B, C_P, C_M and C_W), LCF)

3. **Module III**

   Introduction to Bonjean and hydrostatic curves

   Integration rules: - Trapezoidal rule; Simpson's rules, 6 ordinate rules; Tchebycheff's rule; Areas, volumes and moments Bonjean calculations and curves, sectional area curves. Hydrostatic calculations and curves.

4. **Module IV**

   Introduction to ship structures

   The ship and her structural members - shipbuilding materials (properties, compositions), Bottom structure, shell plating and framing, decks, hatches and hatch covers, Superstructures, bulkheads, tanks, holds, fore and aft structure, stern and rudder.

5. **Module V**

   Introduction to ships Machinery

   Introduction to ships Machinery: Propulsion machinery - development of ship propulsion, general arrangement of propulsion plants, Main engines (Diesel engines, steam engines & turbines, gas turbines, Diesel-electric drive, nuclear power plants) Auxiliary machineries. Bridge, Navigation Lights Communication Equipment, Lifesaving appliances and fire-fighting equipment, Anchoring, mooring and towing equipment, cargo handling equipment.

Text Books

1. E.C. Tupper, *Introduction to Naval Architecture*; 5th Edition; Butterworth-Heinemann, 2013
2. K.J. Rawson and E.C. Tupper, *Basic Ship Theory*, Vol. I & II, 5th Edition; Butterworth-Heinemann, 2001

References:

1. A.B. Biran, *Ship Hydrostatics and Stability*; 2nd Edition; Butterworth-Heinemann Capt D.C. Derret; Ship Stability for Masters and Mates, 2013
2. ApostolosPapanikolaou, *Ship Design Methodologies of Preliminary Design*; Springer, 2014
3. Taggart, Ship Design and Construction; SNAME, 1980
4. D.A Taylor, Introduction to Marine Engineering; 2nd Edition; Butterworth-Heinemann, 1996.

20-215-0207 WORKSHOP PRACTICE II

Course Description: This lab 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.

		Category	L	T	P	Credit	Year of Induction
20-215-0207	Workshop Practice II	ESC	1	-	2	1	2020

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

	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											
CO 3	2											1
CO 4	3	2										1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

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.

2) Welding Practice – Arc welding, Gas welding, Gas cutting.

20-215-0208 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 equipment's.

		Category	L	T	P	Credit	Year of Induction
20-215-0208	Electrical Engineering Lab.	ESC	1	-	2	1	2020

Prerequisite: NIL

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

CO 1	Describe the basics of electrical engineering.
CO 2	Demonstrate the principle of operation of motor.
CO 3	Demonstrate the test carried out in transformers.
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

	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											
CO 3	2											1
CO 4	3	2										1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

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. Conduct the polarity test and ratio transformation of given single-phase transformer.
2. Conduct the open-circuit and short circuit tests on single-phase transformer.
3. Plot the following characteristics of DC series and Shunt motors:
   (a) Efficiency against output (b)Speed against torque (c)Current against torque

SEMESTER-III

20-215-0301 MATHEMATICS III

Course Description:

This course equip 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

20-215-0301	Mathematics III	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	0	3	2020

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)

	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					1
CO 2	1	1										
CO 3	2	2		2	1							
CO 4	2	1	1	1	2							1
CO 5	1	2	2	2		2	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 3 sub-divisions and carry 16 marks.

Course Content:

1. Module I

Eigen values and Eigen vectors of a square matrix. Diagonalisation. Finding the n th power of a square matrix using Eigen values. Orthogonal and Hermitian matrix. Theorems on the eigenvalues of these.

2. Module II

Laplace Transforms. Unit step function- Dirac Delta functions. Periodic functions. Inverse transforms. Laplace transforms methods of solving Ordinary Differential Equation

3. Module III

Analytic functions of a complex variable. Cauchy-Riemann conditions. Harmonic functions. . Euler's formula and its uses in summation of series

4. Module IV

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

5. Module V

Partial Differential Equations of the form F(x, y, z, p, q) = 0. Formation Complete, Singular and General Integrals. Clairaut's form. 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) James McMohan: Hyperbolic functions, Independent publishing platform, 2013.

4) Dexter J Booth, K.A.Stroud: Engineering Mathematics, Industrial press, 2013.

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

6) Luther PfahlerEisenhart: A treatise on the differential geometry of curves and surfaces, Dover Publications,2013.

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

8) Yousef saad, Numerical Methods for Eigen value problems, SIAM, 2011.

9) N.W.McLachlan, Laplace transforms and their applications to differential equations, Dover publications, 2014

20-215-0302 FLUID MECHANICS I

Course Description: The aim of the course is to lay a solid base to comprehend the properties and behaviour of fluid and its influence on the surroundings when they are exposed to varying environments or loading conditions. The underlying theories to analyse the forces that will impart due to the different cases of fluid motion are discussed. The basic knowledge about the working of hydraulic machines like pumps and turbines are also included in the course.

		Category	L	T	P	Credit	Year of Induction
20-215-0302	Fluid Mechanics I	ESC	3	1	-	3	2020

Pre-requisites: Knowledge in basic engineering courses like engineering physics, engineering mathematics 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 some basic ideas about how an object will behave when it moves through a fluid medium.

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

CO 1	Recall the basic terms associated with the fundamentals of fluid mechanics.
CO 2	Learn the basic static, kinematic and dynamic properties of fluids.
CO 3	Apply the fluid properties and laws to study the behaviour of a fluid under different conditions, and the basic working principles of different categories of pumps and turbines.
CO 4	Analyse the influence of different flow parameters and the nature of velocity and pressure distributions for various types of fluid motion.
CO 5	Evaluate the flow characteristics and evolving expressions to study the random and unpredictable nature of fluid motion in real life.

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									1
CO 2	3	1	1	1								1
CO 3	3	2	2	2	2		1					1
CO 4	2	2	2	2	2		1					1
CO 5	2	2	2	2	2		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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: The paper consists of two parts: Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all the questions. Part B contains 5 questions. There will be 2

questions from each module of which a student should answer any one of the two. Each question can have a maximum of 2 subdivisions and carries a total of 16 marks.

Course Content:

1. **Module I**
   Properties of fluid: Ideal fluid-actual fluids-fluid pressure-measurement of fluid pressure.

2. **Module II**
   Statics of fluids-Euler's condition of equilibrium-pressure under the action of gravity-constant velocity rotation around a fixed axis-fluid under pressure neglecting gravity-forces on walls of container-surface tension-atmospheric equilibrium.

3. **Module III**
   Fluids in motion-One dimensional flow-equation of continuity-Euler's equation-Bernoulli's equation- stagnation and total pressure-energy equation for unsteady flow-impulse and equilibrium.

4. **Module IV**
   Influence of viscosity-generalised Bernoulli's equation-Newton's law of fluid friction-laminar flow-Poiseuille's flow-turbulent flow-Reynold's number-Prandtl's mixing length and Karman's suggestion in regard to the relationship between mixing length and wall distance-velocity distribution in turbulent plane flow-friction co-efficient.

5. **Module V**
   Pumps & turbines: -Reciprocating pumps, Air vessels, Rotodyanamic pumps, Velocity diagram. Turbines:-Impulse turbine-Pelton wheel, Reaction turbine, Francis turbine, Kaplan turbine.

References:

1) MeihardSchobeiri, Applied fluid mechanics for Engineers, McGraw Hill professional, 2014.

2) Douglas, Gasiorek, and Swaffield; Fluid Mechanics, PHI, 2011.

3) Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd., 1963.

4) G.S Sawhney, Fundamentals of fluid mechanics, I.K.International, 2013.

5) Bruce R Munson & others, Fundamentals of fluid mechanics, Wiley, 2012.

6) Daugherty &Franzini; Fluid mechanics with engg. Applications, International Students Edition McGraw Hill., 1997.

7) Jagdish Lal; Hydraulic machines, Metropolitan book Co., Delhi-, 2000.

8) N.S.Govind Rao; Fluid flow machines, Tata Mc Graw Hill., 2002

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.

20-215-0303 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.

20-215-0303	Mechanics of solids	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2020

Prerequisite: Nil

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	Calculate the shear stress distribution under 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

	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	3										
CO 3	3	2										1
CO 4	3	3										
CO 5	3	2										
CO 6	3	2	2									

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			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
Continuous Assessment: 40marks
Internal Test : 50marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5questions with 1question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

   Basics in Mechanics of Solids:

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

   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**

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

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

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.

Text books:

1. Bansal R. K; Strength of Materials; Lakshmi Publications; New Delhi, 4th edition, 2007
2. Timoshenko S. P.; Strength of Materials Part 1; 3rd edition, D. Van Nostrand Company Inc .New York, 2002
3. S. Ramamrutham ; Strength of Materials; Dhanpat Rai Publishing Company, 16th edition,2008.

Reference Books:

1. S. S Bavikatti; Strength of Materials; Vikas Publishing House Pvt Ltd., 4th edition, 2014.
2. Shames I. H., James M. Pitarresi; Introduction to Solid Mechanics; Pearson Education India. 3rd edition, 2015
3. V.N. Vazirani, M.M.Ratwani, analysis of structures . Vol 1, Khanna Publishers, 2015
4. Punmia B. C. and A. K. Jain, Mechanics of Materials, Laxmi Publications (P) Ltd, New Delhi.

20-215-0304 INSTRUMENTATION

Course Description: The objective of the course is

1. To provide the learners a proper understanding of the basic working principles, construction and features of various measuring instruments.
2. To impart understanding of the principles of digital instrumentation.

		Category	L	T	P	Credit	Year of Induction
20-215-0304	Instrumentation	ESC	3	1	0	3	2020

Prerequisite: Nil

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	Understand the basic working principle and classification of transducers for measurement of displacement, strain, force and pressure
CO 3	Explain 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	Explain the concepts and terminology of digital instrumentation

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	2	1	1		1						
CO 2	3	2	1	1		1						
CO 3	3	2	1	1		1						
CO 4	3	2	2	1		1						
CO 5	3	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **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.
2. **Module II**
   Displacement measurement: Transducers-classification of transducers- Digital optical shaft encoder-. Strain gauges- gauge factor-unbounded and bonded resistance strain

gauges-resistance strain gauge bridges- temperature compensation- balancing of bridges. Capacitive gauges - L.V.D.T. (Linear variable differential transformer) - Piezo electric transducers.

3. **Module III**
   Temperature measurement: Electrical methods - Electrical resistance thermometer-Semi-conductor 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.

4. **Module IV**
   Measurement of Pressure, Flow, Humidity and Level: Moderate pressure measurement-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 log - 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

5. **Module V**
   Introduction to intelligent Instrumentation: Logic circuits - ADC (Analog to digital converter) and DAC (Digital to analog converter).- Binary weighted resistor ladder network - Successive Approximation ADC-Binary Ramp ADC - Display devices-LED (Light emitting diodes) - LCD (Liquid crystal display) and CRT (Cathode ray tube). Digital instruments (Functional Block diagram) -Advantages & disadvantages of digital instruments – basics of ISA symbols - introduction to microcontroller.

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. B.C. Nakra, K.K.Chaudhary; Instrumentation measurement and Analysis, Tata Mc Graw Hill, 2016.
4. A.K. Sawhney, PuneetSawhney, A Course In Electrical And Electronic Measurements And Instrumentation, Dhanpat Rai Publications, 2015.
5. Ernest O Doebelin; Measurement Systems, 2003.
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. Krishnaswamy, K. Industrial Instrumentation 2 PB 475 2010,New age,Publication

20-215-0305 APPLIED THERMODYNAMICS

Course Description: Covers principles of classical thermodynamics. Develops understanding of mass, energy, heat, work, efficiency, ideal and real thermodynamic cycles and processes. Covers first and second laws of thermodynamics, perfect gas law, properties of real gases, and the general energy equation for closed and open system.

20-215-0305	Applied Thermodynamics	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2020

Pre-requisites: Nil

Course Objectives:

- To impart knowledge on fundamental concepts and laws of thermodynamics
- To introduce the various thermodynamic processes & cycles.
- To impart knowledge on the properties of pure substances.
- To introduce the principle of operation of steam nozzles, turbines and internal combustion engines.

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

CO 1	Demonstrate understanding of the laws governing thermodynamic processes.
CO 2	Demonstrate understanding of the various types of thermodynamic processes and cycles.
CO 3	Demonstrate understanding of the concept of entropy and appreciate its significance.
CO 4	Apply the concepts of refrigeration and air conditioning.
CO 5	Demonstrate understanding of the principle and operation internal combustion engines.

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										1
CO 2	3	3	1									1
CO 3	2	3										
CO 4	2	1	1									
CO 5	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment : 40 marks

Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **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.

2. **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

3. **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 Boltzman 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

4. **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.

5. **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 Conditioning 3 PB 399 2015, New age Publication.

20-215-0306 BASIC SHIP THEORY

Course Description: Aim of this course is to mould students to prepare lines plan, Bonjean and hydrostatic curves. Also to provide general idea on flooding calculation and subdivisions.

	Basic Ship	Category	L	T	P	Credit	Year of Induction

20-215-0306	Theory	PCC	3	1	-	3	2020

Pre-requisites: Nil

Course Objectives:

- To provide thorough knowledge on ship's geometry and Lines plan.
- To explain application of numerical integration methods to hull form
- Calculations.
- To describe parameters of hull form and also Bonjeans and Hydrostatics Calculations and Drawing.
- To illustrate watertight integrity, subdivision and Floodable Length

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

CO 1	Draw a Lines Plan from a given offset table and Stem & Stern profiles.
CO 2	Calculate and draw Bonjeans and Hydrostatic Curves from a given Lines Plan.
CO 3	Grasp the concept of hull form parameters of a ship.
CO 4	Determine trim due to bilging based on Added Weight or Lost Buoyancy methods.
CO 5	Calculate and Plot Floodable and Permissible Length Curves

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	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	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

   Lines Plan: 3D Geometry: -Representing 3D objects in 2D views-Orthographic Projection-Orthogonal Planes .Lines Plan : Purpose, -Orthogonal Planes of Reference, Three views -Body Plan; Half Breadth Plan; Sheer Plan or Profile, LinesButtocks,Stations;Waterlines.How to Draw Offset Table, Types of Stem and Stern profiles, Procedure, Drawing tools, Fairing process.

   Practical: Lines plan drawing from given offset table and generation of final offset table after fairing.
2. **Module II**

   Integration rules; Introduction; Cross sectional Areas- Water plane area, Transverse section area-Volume-First and Second Moments of Area-Need for Numerical Integration 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-Application to ship geometry numerical problems
3. **Module III**

   Bonjeans:-Purpose-Calculation of Sectional Areas and Moments -Procedure for Drawing of Area and Moment curves-Sectional area curve – Significance, Parameters obtained from it.

   Practical:-Bonjeans Calculation and Drawing.

4. **Module IV**

   Hydrostatics : Purpose Concept of Metacentre, KB, BM, KM, Draft, Trim, Change of Trim due to addition / removal of weight, Numerical Problems-Definition and Calculation of Parameters: Volume of Displacement, Displacement, TPC, MCT, LCF, LCB, Form Co-efficients (C_B, C_M C_P C_W), KM_T, BM_L, Wetted Surface Area-Procedure for drawing the curves.

   Practical: -Hydrostatics Calculation and drawing.

5. **Module V**

   Floodable Length: Introduction: Archimedes Principle-Weight and Buoyancy-Reserve of Buoyancy Watertight Integrity :-Concept Bilging, Foundering, Capsizing, Plunging-Sinkage and Trim: Lost Buoyancy and Added Weight Methods, Numerical Problems-Watertight Subdivision – Mandatory Bulkheads-Permeability, Bulkhead Deck, Margin Line, Criterion of service Numeral, Factor of Subdivision-Floodable Length and Permissible Length- Calculation and Drawing. Software overview. (*Not for External Examination*)

   Practical: Hull modelling, Bonjeans and Hydrostatics using Software.

References:

1. Lewis E. U., —Principles of Naval Architecture, SNAME, U.S.A., 2010.
2. K. J. Rawson, E. C. Tupper, —Basic Ship Theory, Butterworth-Heinemann, 2001.
3. E. C. Tupper, —Introduction to Naval Architecture, Butterworth-Heinemann. 2013.
4. Adrian Biran, —Ship Hydrostatics and Stability, Elsevier. 2011.
5. W. Muckle, —Naval Architecture for Marine Engineers, 2004.
6. E. A. Stokoe, Reed's —Naval Architecture for Marine Engineers, 2003.
7. Ship Stability – Notes and Examples – CB Barass
8. R. Munro Smith, —Ships and Naval Architecture, 1977.
9. R. Munro Smith, —Notes and Examples in Naval Architecture, 1965.
10. V. Semyonov-Tyan-Shansky, —Statics and Dynamics of the Ship, Peace publishers, Moscow., 2004.
11. R. Munro-Smith, —Elements of Ship Design, Marine Media Management Ltd., 1975.
12. Thomas C. Gillmer and Bruce Johnson, —Introduction to Naval Architecture.
13. Andrew McCance Robb, —Theory of Naval Architecture, Charles Griffin. 1952.
14. Edward Lewis, Attwood, Text-Book of Theoretical Naval Architecture, 2012,
15. Robert B. Zubaly, Applied Naval Architecture, Cornell Maritime Press Inc.,2010.
16. J. Klinkert, H. W. White, —Nautical Calculations Explained, Routledge & Kegan Paul, London., 1969.
17. Kemp & Young, —Ship Stability, notes and examples, Butterworth-Heinemann., 2000

20-215-0307 FLUID MECHANICS LAB

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

20-215-0307	Fluid Mechanics Lab	Category	L	T	P	Credit	Year of Induction
		ESC	2	-	4	1	2020

Prerequisite: Nil.

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 fluidmechanics.
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 property 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

	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

Assessment Pattern:

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

- Pressure measurements
- Velocity and rate of flow measurements
- Calibration of Venturimeter
- Determination of Friction factor
- Critical velocity and Reynold's number at steady pipe flow
- Calibration of small orifices and mouthpieces
- Determination of metacentric height of a floating model

20-215-0308 INTERNSHIP

Course Description: Impart students the application of theoretical knowledge on practical work related to Naval Architecture.

20-215-0308	Internship	Category	L	T	P	Credit	Year of Induction
		PCC	-	-	-	1	2020

Assessment Pattern: (Mark distribution)

Total Marks	**CIE**	**ESE**	**ESE Duration**
50	50	-	-

IV SEMESTER

20-215-0401 MATHEMATICS IV

Course Description:

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

		Category	L	T	P	Credit	Year of Induction
20-215-0401	Mathematics IV	BSC	3	1	0	3	2020

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)

	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				2	1					2
CO 2	1	1										
CO 3	2	2		2	2							
CO 4	3	2	1	1	2							1

CO 5	3	2	2	2		2	2					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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 3 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

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

2. **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.

3. **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

4. **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, Milno's predictor corrector method.

5. **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, 2011.

3) James McMohan: Hyperbolic functions, Independent publishing platform, 2013.

4) Dexter J Booth, K.A.Stroud: Engineering Mathematics, Industrial press, 2013.

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

6) Luther PfahlerEisenhart: A treatise on the differential geometry of curves and surfaces, Dover Publications,2013.

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

20-215-0402 FLUID MECHANICS II

Course Description: In this course, the fundamental concepts of different types of flow such as potential flow and viscous flow are covered. An introduction to the basic types of vortex flow, with its engineering significance are discussed. The course also helps in a laying a solid background to comprehend the basic concepts of resistance offered to any object during its motion in a fluid.

		Category	L	T	P	Credit	Year of Induction
20-215-0402	Fluid Mechanics II	ESC	3	1	-	3	2020

Pre-requisites: Knowledge in the fundamentals of fluid mechanics and basic engineering courses like engineering physics, engineering mathematics 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, 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

CO 1	Recall the basic properties of ideal flow and various cases of potential flows
CO 2	Understand the fundamental concepts of vortex motion and boundary layer theory.
CO 3	Apply the boundary layer concepts to analyse the behaviour of an object as it moves through a fluid medium.
CO 4	Analyse the nature of forces that are acting on streamlined and bluff bodies.
CO 5	Evaluate the nature of streamlines and potential lines, when different types of flows are superimposed.

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									
CO 2	2	1	1				1					1
CO 3	2	2	2	2	2		1					1
CO 4	2	2	2	2	2		1					2
CO 5	2	2	2	2	2							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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment : 40 marks

Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: The paper consists of two parts: Part A and Part B. Part A contains 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all the questions. Part B contains 5 questions. There will be 2 questions from each module of which a student should answer any one of the two. Each question can have a maximum of 2 subdivisions and carries a total of 16 marks.

Course Content:

1. **Module I**

   General theory of two and three-dimensional flow:-Continuity equation, Euler's equation of motion, 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

2. **Module II**

   Vortex motion-Fundamental concepts, vortex analogy to Biot-Savart's law, straight parallel vortex filaments, vortex sheets.

3. **Module III**

   Viscous flow-Navier-Stoke's equations, Couette flow, Plane poiseuille flow.

4. **Module IV**

   Boundary layer theory-Prandtl's boundary layer equations, criterion for separation, Blasius solution, Skin friction, displacement thickness, momentum thickness, Turbulent boundary layer, Boundary layer control.

5. **Module V**

Airfoils-Lift, drag, circulation, pressure distribution-theory of thin airfoils, wings of infinite and finite span, circulation distribution, Cavitation.

References:

1) Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd., 1963.

2) Schlichting; Boundary Layer Theory, Springer Verlag, 2001.

3) Vallentine; Applied Hydrodynamics, ELBS, 1967.

4) Joseph H Spurk, Fluid Mechanics, Springer, 2008.

5) MeihardSchobeiri, Applied fluid mechanics for Engineers, McGraw Hill professional, 2014.

6) Douglas, Gasiorek, and Swaffield; Fluid Mechanics, PHI, 2011.

7) G.S Sawhney, Fundamentals of fluid mechanics, I.K.International, 2013.

8) Bruce R Munson & others, Fundamentals of fluid mechanics, Wiley, 2016.

9) Hibbeler, R.C., Fluid Mechanics, Pearson, 2017

10) A.K Jain; Fluid Mechanics including hydraulic machines, Khanna Publishers, 1998.

11) Pijush K. Kundu, Ira M.Cohen and David R. Dowling; Fluid Mechanics, AcademicPress,2014.

20-215-0403 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.

20-215-0403	Design Of Machine Elements	Category	L	T	P	Credit	Year of Induction
		ESC	2	2	-	3	2020

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.

4. 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)

	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	2									
CO 2	3	3	2									
CO 3	3	3	2									
CO 4	3	3	2									
CO 5	3	3	2		2		2		2			2

Assessment Pattern:

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 question of 4 marks each from the whole modules and students should answer all questions. Part B contains 5 question of 4 marks each from the whole modules and students should answer all questions.

Course Content:

1. **Module I**
   Fundamentals of machine design:-definitions, design process, design principles, design criteria; Stresses in machine parts-working stress, safe stress, factor of safety, endurance limits, fatigue factors Elastic springs-classification and uses of springs-allowable stresses and deflections-design for fluctuating loads

2. **Module II**
   Joints: - Principles of force transmission; detachable joints (pins, keys, spline and bolted joints), Non detachable joints; welded, soldered and glued joints, riveted joints; strength of welded and riveted joints.

3. **Module III**
   Drive elements: - Shafts - torsion and bending of shafts, design of shafts for strength and deflection, effect of key ways, crank shafts.

4. **Module IV**
   Shaft couplings:- Rigid coupling (flange and compression couplings)-couplings with kinematics flexibility slip couplings, fluid 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.

6. **Module VI**
   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.

20-215-0404 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 continues bodies, matrix method and finite element method for structural analysis.

20-215-0404	Analysis of Structures	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2020

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. It also provides knowledge of different methods for analyzing structures and the introduction to finite element method of structural analysis.

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

CO 1	Apply principles of elasticity and plasticity for statically indeterminate structures
CO 2	Analyse the stability of columns and structural behaviour of beam column
CO 3	Understanding vibration of continues structures with practical applications
CO 4	Analyse one dimensional and two dimensional structures using matrix methods of structural analysis
CO 5	Apply FEM principles to solve elastic bodies subjected to mechanical loadings.

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	1	1	1				1					2
CO 2	1	1	1									
CO 3	2	2	2	2	2							
CO 4	3	2	2	1	1		2					1
CO 5	3	3	2	1	1		2					1

Assessment Pattern:

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration

200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: Divided into two parts; Part A and Part B. Part A contains 5 questions, with1 question from each module, carrying 4 marks for each question. Students are expected to answer all questions. Part B contains 2 questions from each module of which student should answer any one question for 16 marks.

Course Content:

1. **Module I**
   Introduction to elasticity and plasticity, Analysis of continuous beams using three moment equation, moment distribution method.

2. **Module II**
   Stability of columns and beams – Euler buckling of columns, Energy and Equilibrium criteria for beam columns.

3. **Module III**
   Vibrations of continues systems- Vibration of strings, rods, beams and shafts

4. **Module IV**
   Matrix methods- Stiffness and flexibility methods for continuous beams and rigidly joined frames

5. **Module V**
   Introduction to finite element method – Nodes, elements, mesh, and shape functions. Truss, beams, finite elements, assembly of global stiffness matrix, & solution to Eigen value problems.

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.

20-215-0405 MATERIALS SCIENCE

Course Description: The aim of the Materials Science is to offer students a solid background in the fundamentals of materials- conceptual perspective for origin of materials, structure/property/performance interrelationships 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 material science with the core programmes.

20-215-0405	Material Science	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2020

Pre-requisites: Higher Secondary Level physics, Chemistry and Mathematics of materials.
Course Objectives: This is an introductory course, designed to provide the fundamental concepts of Materials Science and Engineering. To describe the structure, properties, and applications of metallic, ceramic, polymeric and composite materials.
Course outcome: After the completion of the course the students will be able to

CO 1	Recognise/recall the various types of materials with structure property correlation.
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	Understand metallic materials based on structure, properties, processing and applications
CO 5	Evaluate non-metallic materials based on structure, properties, processing and applications for designing engineering application

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	1	1	1									2
CO 2	3	1	1									
CO 3	2	2	2									
CO 4	2	2	2									1
CO 5	2	2	2									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	CIE	ESE	ESE

Marks			Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: Divided into two parts; Part A and Part B. Part A contains 5 questions, with1 question from each module, carrying 4 marks for each question. Students are expected to answer all questions. Part B contains 2 questions from each module of which student should answer any one question for 16 marks

Course Content:

1. **Module I**

Crystal Structure: Atomic structure- Atomic bonding in solids, Unit cells and Space lattices, Crystal structures, Concept of amorphous, single and polycrystalline structures, Packing geometry in metallic, Crystal planes- and directions, Miller Indices, Diffraction of X-rays by crystal, Crystal Defects, point, line, surface and volume defects, Diffusion, Fick's 1st and 2nd law equation.

2. **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, Recovery, recrystallization & grain growth. Precipitation hardening, T-T-T diagram, Pearlitic, Martensitic&Bainitic transformation, Annealing, normalizing, hardening& tempering, hardenability.

3. **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, impact strength, creep, fatigue, ductile and brittle fracture.

4. **Module IV**

Metallic Materials: Pure iron, cast iron, mild steel, stainless steels, special alloy steels, heat treatment of plain-carbon steels. Manufacturing methods of steel, aluminium, Nickel, Copper, and Titanium. Composition,Properties and applications of ferrous and nonferrous alloys in Shipbuilding industries.

5. **Module V**

Non Metallic Materials: Classification, polymerization, structure and properties, additives for polymer products, processing and applications. Composites: Classification, Composition, Properties and applications of various composites. Structure, properties, processing and applications of traditional and advanced ceramics.

References:

1) Callister W D, "Materials Science and Engineering:An Introduction", 7thEdition, 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", 6thEdition, 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.

20-215-0406 STABILITY OF SHIPS

Course Description: This course is designed to offer the students an understanding of the concept of stability of ships, which include transverse stability, longitudinal stability and damage stability.

	Stability of Ships	Category	L	T	P	Credit	Year of Induction
20-215-0406		PCC	3	1	-	3	2020

Pre-requisites: Nil

Course Objectives: The objective of the course is to provide the learners an understanding of the theory and calculation of intact and damage stability of shipsand to equip them with a 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 and stability of floating body and the effects on transverse stability due to various external and internal factors.
CO 2	Explain the transverse stability of ships, for small and large angles of inclination.
CO 3	Discern the purpose of an inclining experiment and the procedures involved in it.
CO 4	Compare the cross curves of stability and generate a specific loading condition, perform trim and stability calculation for that loading condition and check with IMO intact stability criteria.
CO 6	Estimate trim of a ship resulting from addition, removal, and shifting of weights and due to change in density of water

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	2	1	1								
CO 3	3	3	1	1	1							1
CO 4	3	3	1	1	1							
CO 5	3	3	1	1	1							

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests	End Semester Examination

	1	2	
Remember	10	10	15
Understand	20	20	35
Apply	20	20	50
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**
   Stability terms. Potential energy. Equilibrium. Weight displacement and Volume displacement; Change of density, FWA, DWA. Equi-volume inclinations, shift of CoB due to inclinations, CoB curve in lateral plane, (*initial*) metacentre, metacentric radius, metacentric height; metacentre at large angles of inclinations, pro-metacentre. CoG, righting moment and lever; Statical, metacentric, residuary, form and weight stabilities. Surface of flotation, curve of flotation. Derivation of BM = I / V.

2. **Module II**
   Initial (*transverse*) stability: GM_0, GZ at small angles of inclinations, Wall sided ships. Sinkage and stability due to addition, removal and shift (transverse and vertical) of weight, suspended weights and free surface of liquids; Inclining Experiment; stability while docking and grounding; Stiff/ Tender ship.

3. **Module III**
   Large angle (*transverse*) stability: Diagram of statical stability (GZ curve), characteristics of GZ curve, effect of form, shift of G and super structure on GZ curve, static equilibrium criteria, Methods of calculating GZ curve (Prohaska, Krylov and from ship form), Cross curves of stability.
   Dynamical stability, diagram of dynamical stability, dynamic stability criteria.
   Moments due to wind, shift of Cargo and passengers, turning and non-symmetric accumulation of ice.
   Intact stability rules, Heel/ Load test.
   Practical: Diagram of statical stability / Cross curves of stability (Krylov's method).

4. **Module IV**
   Longitudinal Stability: Trim, longitudinal metacentre, longitudinal centre of flotation, moment to change trim, trimming moment, change of trim and drafts due to addition,

removal and longitudinal shift of weight, trim and draft change due to change of density. Rules on draft and trim.

5. **Module V**
   Damage stability: Bilging, Surface and volume permeability; Sinkage, heel, change of trim and drafts due to bilging of midship, side and end compartments.

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

References:

1) V. Semyonov-Tyan-Shansky, "Statics and Dynamics of the Ship", Peace publishers, Moscow, 2004.
2) Derret, "Ship Stability for Masters and Mates", Butterworth-Heinemann., 1999.
3) Capt. A. R. Lester, "Merchant Ship Stability", Butterworths, 1985.
4) Adrian Biran, "Ship Hydrostatics and Stability", Elsevier. 2013.
5) Kemp & Young, "Ship Stability, notes and examples", Butterworth-Heinemann., 2001.
6) J. Anthony Hind, "Stability and Trim of Fishing Vessels", Fishing news books Ltd., 1989.
7) . H. Subramanian, "Ship Stability", Nut shell series book, Vijay publications, Mumbai, 2009.
8) J. Klinkert, H. W. White, "Nautical Calculations Explained", Routledge & Kegan Paul, London, 1969.
9) International Maritime Organisation (IMO), "SOLAS", 2017.
10) Colin.S.Moore, J.R. Paulling, Principles of Naval Architecture Series: Intact stability, SNAME,New Jersey, 2010.
11) E. A. Stokoe, Reed's "Naval Architecture for Marine Engineers", 2003.
12) W. Muckle, "Naval Architecture for Marine Engineers", 2004.
13) R. Munro Smith, "Ships and Naval Architecture", Institution of Marine Engineers, 1977.
14) R. Munro Smith, "Notes and Examples in Naval Architecture", E.Arnold, 1965.
15) R. Munro-Smith, "Elements of Ship Design", Marine Media Management Ltd., 1975.
16) K. J. Rawson, E. C. Tupper, "Basic Ship Theory", Butterworth-Heinemann, 2001.
17) E. C. Tupper, "Introduction to Naval Architecture", Butterworth-Heinemann, 2013.
18) Andrew McCance Robb, "Theory of Naval Architecture", Charlse Griffin.1952
19) Thomas C. Gillmer and Bruce Johnson, "Introduction to Naval Architecture".ments, IE& FN 1982.

20-215-0407 LANGUAGE LAB

Course Description: This lab mainly focuses on to develop a platform where the students can enhance their soft skills.

20-215-0407	Language Lab	Category	L	T	P	Credit	Year of Induction
		HMC	-	-	2	1	2020

Prerequisite: Nil

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

CO 1	Test pronunciation skills through stress on word accent, intonation, and rhythm.
CO 2	Use English language effectively for writing business letters, resume, minutes of meeting and reports.

CO 3	Use English language effectively to face interviews, group discussions, and public speaking.
CO 4	Apply the knowledge gained in the class room with the physical world.
CO 5	Improve soft skills.
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

	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
CO 2	3									1		1
CO 3	2									1		1
CO 4	3	2								1		1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	-

Continuous Internal Evaluation Pattern:

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

List of Activities

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Preparing business letters
4. Preparing a resume
5. Conducting a meeting and writing the minutes
6. Writing a report
7. Situational Dialogues / Role Play.
8. Oral Presentations- Prepared and Extempore.
9. 'Just A Minute' Sessions (JAM).
10. Describing Objects / Situations / People.
11. Debate
12. Group discussion

20-215-0408 MATERIAL TESTING LABORATORY

Course Description: This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge in the analysing the strength of materials in domain by applying their theoretical knowledge acquired.

20-215-0408	Material Testing Laboratory	Category	L	T	P	Credit	Year of Induction
		ESC	-	-	4	1	2020

Prerequisite: Nil.

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

CO 1	Identify major equipment's commonly used in the field material testing.
CO 2	Identify and practice different experiments in the material testing domain.
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 with 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

Assessment Pattern:

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) Standard tension test on UTM (Al or MS Rod)
2) Shear strength of MS rod on UTM
3) Deflection characteristic of open and closed springs

4) Determination of 'G' of wires using torsion 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

SEMESTER V

20-215-0501 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 machinery 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.

20-215-0501	Resistance of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

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	Discern the various components of resistance of ships.
CO 2	Estimate resistance of ships and effective power using statistical / methodical series / model tests.
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	Apply standard series data for estimating ship propulsive power of various ship types and size, particularly at the preliminary design stages.
CO 5	Understand the principles of operation of various high speed marine crafts and the developments in their hull forms from conventional displacement hulls.

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
CO 2	3	2	2	2	1							1
CO 3	2	2	2	2	1							1
CO 4	2	2	2	2	1		1					2
CO 5	2	1	1	1			1					1

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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts - Part A and Part B. Students are expected to answer all questions. Part A contains 5 questions; one question from each module, carrying 4 marks each. Part B contains 2 questions from each module of which student should answer any one. Each question carries 16 marks and can have maximum 2 sub-divisions.

Course Content:

1. **Module I**

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

2. **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.

3. **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.

4. **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. Resistance of planning crafts, multi-hull vessels, hovercrafts, hydrofoils, barges and convoy of barges.

5. **Module V**

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

Practicals: - 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) LotharBirk; 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.

20-215-0502 PROPULSION OF SHIPS

CourseDescription: The goal of this course is to expose students to the concept of Propulsion of ships, and to estimate machinery power required to attain the specified speed. Also it is intended to impart knowledge on various types of marine propellers and to familiarize with design methods.

20-215-0502	Propulsion of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Nil

Course Objectives: This course designed to provide the fundamental concepts of 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 cause the causes and characteristics of various components of ship resistance and flow parameters on which they are dependent.
CO 2	Estimate the effective power using statistical / methodical series / model tests.
CO 3	Learn 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	Apply standard series data for estimating ship propulsive power of various

	ship types and size, particularly at the preliminary design stages.
CO 5	Learn the principles of operation of various high speed marine crafts and the developments in their hull forms from conventional displacement hulls.

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
CO 2	3	2	2	2	1							1
CO 3	2	2	2	2	1							1
CO 4	2	2	2	2	1		1					2
CO 5	2	1	1	1			1					1

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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts - Part A and Part B. Students are expected to answer all questions. Part A contains 5 questions; one question from each module, carrying 4 marks each. Part B contains 2 questions from each module of which student should answer any one. Each question carries 16 marks and can have maximum 2 sub-divisions.

Course Content:

1. **Module I**
   Propeller as a thrust producing mechanism; historical development; Screw propeller-screw propeller geometry, sections, propeller drawing, construction details. Propeller theories-Momentum theory, Blade element theory, Circulation theory

2. **Module II**
   Interaction between Hull and propeller- Wake and wake fraction, Resistance augment and thrust deduction factor, propulsive efficiency in open water and behind conditions, hull efficiency, quasi propulsive coefficient, transmission efficiency; Powering.
   Cavitation-Types, Cavitation Number, Effects of cavitation, Prevention of cavitation, Design for minimum cavitation, Cavitation tests.

3. **Module III**
   Design of propellers-Propeller families and series; Open water tests-Presentation of data, Kt-Kq diagrams, Design charts- Bp-δ, T-J, P-J charts, Use of charts in propeller design and performance study; Selection of engines-diesel engine characteristics.

4. **Module IV**
   Propeller strength- Materials and their qualities, strength calculation. Model testing of propellers-Test facilities, Laws of comparison, open water diagram self-propulsion tests-British and continental Methods.

5. **Module V**
   Shrouded propellers-Action of propeller in a nozzle, wake fraction and thrust deduction fraction in nozzles, load factor of nozzles, design of propeller-nozzle system, design charts. Controllable Pitch propellers-Advantages, special features in geometry, design aspects. Super cavitating propellers-application. Other propulsion devices-Vertical axis propellers, Water jet propulsion, Sail, Paddle wheels, Electromagnetic propulsion etc. Ship standardisation trials.

Practical's:Propeller design using series diagrams, screw propeller drawing.

References:

1. D.W. Taylor ; The Speed and Power of Ships ; A Manual of Marine Propulsion, Maritime Press, 2013
2. Anthony F. Molland ; Ship Resistance and Propulsion, Cambridge University Prss; 2011

20-215-0503 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.

20-215-0503	Controllability of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Nil

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 the completion of the course the students will be able to:

CO 1	Understand and differentiate between various types of motion stability with controls fixed and controls working and understand the principles and working of closed-loop control system for ship manoeuvring.

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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

   Manoeuvring Fundamentals – the control loop, path keeping, equations of motion, linearised equations and control fixed stability indexes, model tests.

2. **Module II**

Stability and control in the horizontal and vertical planes – definitive manoeuvres, turning trials.

3. **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.

4. **Module IV**

Influence of ship features on controls fixed stability - fixed fin, propeller, hull configuration

5. **Module V**

Experimental determination of hydrodynamic derivatives (rotating arm technique, planar motion mechanism).Non-linear Manoeuvres, Simulation, IMO Regulations and Recommendations.

Practicals:- Calculation of free stream characteristics of rudder, Rudder design, Zigzag manoeuvre.

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."

20-215-0504 SHIP MOTIONS IN SEAWAY

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

20-215-0504	Ship Motions in Seaway	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Nil

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

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

CO 1	Understand the equation of motion for coupled and uncoupled motions in vertical plan and the various forces, moments acting on ship i.e, inertia ,damping, restoring and exciting .Understand the solution of equations for deterministic regular waves and for the irregular sea waves
CO 2	Understand the physics of progressive and standing water waves and various theories that leads to mathematical expression for the velocity potential, particle velocity, pressure and wave energy.
CO 3	Determine the added mass/added moment of inertia, damping coefficient

	,amplitude of exciting forces/moment for heave, roll, pitch motion using 2-D strip theory
CO 4	Discern various methods of ship-motion control
CO 5	Explain the sea keeping performance of ships and sea keeping-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										
CO 2	3	1										
CO 3	2	2										
CO 4	2	1										
CO 5	1	1										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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **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.

2. **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.

3. **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 Broading, Added Resistance, Powering in waves, Wave Loads.

4. **Module IV**

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

5. **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).

Practicals:- Estimation of Hydrodynamic coefficients, Heave, roll and pitch test in waves

References:

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

20-215-0505 ELECTRICAL SYSTEMS ON SHIPS AND SHIPYARDS

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

20-215-0505	Electrical Systems On Ships And Shipyards	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Electrical Engineering

Course Objectives:
To impart basic knowledge in Electrical Systems in Ships and Shipyards and impart understanding of the electrical power generation, distribution, electric propulsion and governing rules of installation of electrical system on board ships

Course outcome: After the 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 protections given to the main generator, types of emergency power plants and their installation in ships.
CO 3	Describe the components of Distribution system and regulations governing their installation on-board ships.
CO 4	Understand electric propulsion and control of propulsion motors
CO 5	Understand the navigational lights and communication equipment 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 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	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						

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	12
Understand	10	20	15
Apply	20	10	13
Analyse	10	10	8
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5questions with 1question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**

Components of electrical system on board ships - Merits and demerits of AC and DC on board. Standard voltages - difference between marine and industrial circumstances. Safety and quality of supply. Standard IEC symbols. Electrical power generation on board ships- comparison of diesel, thermal and Nuclear power plants as prime movers-shaft driven generators - Brushless generators, specification of generators. Specification of motors-speed based and torque based motors.

2. **Module II**

Introduction to MV and HV generation in ships. Capacity calculation of main power plant - Diversity factor - single line layout of the DA set. Switch gear for electrical system - Fuses-Switches-relays- contactors- circuit breakers- protection for generators of main power plant - preferential tripping -Installation rules for main power plant-emergency plant-layout of IC engine- driven & battery driven E.P.P- Location of emergency power source- Different emergency loads.

3. **Module III**

Distribution systems:- Ring and radial system. AC single phase & 3-phase system- DC systems-Components of distribution system. MSB, SSB and DB -single line layout. Rules governing the distribution system. Regulations governing the installation of MSB. Special rules for tankers and fighting crafts – Special regulation for installation of electrical system in steering system - earthed and insulated AC systems. DOL starter.

Transformers for power and lighting-. 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.

4. **Module IV**

Electric propulsion – advantages - applications - power flow schematic- single line layout – Control of propulsion motors. Frequency drives, soft starters.

5. **Module V**

Light fittings- different sources of light - lighting arrangements in engine room, accommodation place, weather deck etc. Navigation lights. Communication equipment's- Internal and external communication equipment's

Electrical system in shipyards - power factor improvement- power tariff - essential regulations - main loads.

Practical: Preparation of Ship electrical system diagrams.

References:

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.

20-215-0506 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 of 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.

20-215-0506	Joining Techniques in Shipbuilding Technology	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	3	2020

Pre-requisites: Basics Science and Engineering Sciences.

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

Course outcome: After the 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	Understand 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 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	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Content:

1. **Module I**

Welding Definition, Historical Background, Materials for Ship Building, Science of Welding, Electric arc welding, Welding Metallurgy- Structure of metals, Crystallisation of a pure metal, Phase transformation in Iron - Carbon diagram, Weldability of steel, Presence of alloy elements, Effect of welding process & nature of base metal on weld, Preheating, Heat Affected Zone (HAZ).

2. **Module II**

Welding Processes for Ship Building, different metal transfers, power source, electrodes, shielding gas, uses of Gas in metal arc welding, Mechanised system in shipbuilding - philosophy of automation in welding, Welding in production shop – SAW, Gravity welding, Auto contact, Co2 Welding, Robotic Welding.

3. **Module III**

Welding in Ship Building – Unit and Block method of ship Construction, SAW, MIG welding, welding of stiffeners, Electro-slag welding, Electro-gas welding, One-sided welding, different types of backing Materials, Comparison of European, Japanese & Indian Welding Process.

4. **Module IV**

Welding problems - Weld defects, Distortion, Welding Sequence, Welding quality control, Non-destructive tests, Welding standards, Welding procedure qualification, Effect of variables on qualification of tests, Performance qualification of Welders & operators, Test reports, Acceptance standards, Quality assurance and audit, Consumable classification & coding.

5. **Module V**

Structural Adhesive Bonding as a joining technique – Adhesives and adhesive bonding methods and joint design, analysis of joints for strength, surface preparation for steel, aluminium and other materials used for marine structures.

References:

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, Dhanpat Rai &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.
10) Khan, M.I. Welding Science and Technology 1 PB 280 2007 New age Publication.
11) Radhakrishnan, V.M. Welding Technology and Design 3 HB 895 2019 New age Publication.

20-215-0507 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.

20-215-0507	Model Making Techniques Lab	Category	L	T	P	Credit	Year of Induction
		PCC	2		4	1	2020

Prerequisite: Nil

Course Objective:

- To impart knowledge of various types of modelling materials and methods used in ship model making
- 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, steps and techniques used in ship model making.
CO 3	Develop 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

	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

CO 2	3									1		1
CO 3	2									1		1
CO 4	3	2								1		1
CO 5	2	1								1		1
CO 6	1								1	1		1

Assessment Pattern:

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

20-215-0508 INTERNSHIP

Course Description: Impart students the application of theoretical knowledge on practical work related to Naval Architecture.

20-215-0508	Internship	Category	L	T	P	Credit	Year of Induction
		PCC	-	-	-	1	2020

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
50	50	-	-

SEMESTER VI

20-215-0601 COMPUTER AIDED DESIGN AND DRAFTING

Course Description: To give a fundamental understanding to computer aided design process and mathematical representation of curves and surfaces.

20-215-0601	Computer Aided Design and Drafting	Category	L	T	P	Credit	Year of Induction
		ESC	3	1	-	3	2020

Prerequisite: Matrix Algebra, Basics of Computers and Computer Programming

Course Outcome: After the Completion of the course the student will be able to:

CO 1	Have an overall understanding of CAD concepts and CAD system developments
CO 2	Demonstrate the geometry transformation of 2D and 3 D models and its application in CAD systems
CO 3	Apply mathematical representation of parallel and non-parallel projections and their application in CAD systems
CO4	Have an understanding of mathematical representation of computational geometry by planar and space curves
CO 5	Have a understanding of mathematical representation of computation geometry by surface models defined by different forms of curves as boundary curves
CO 6	Have knowledge of object oriented programming and its application in CAD systems

	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
CO4	3	2	1	2	1							2
CO 5	3	1	1	2	1							2
CO 6	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Content:

1. **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, programming language for CAD.

2. **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:

3. **Module III**

   Introduction: 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.

4. **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.

5. **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.

20-215-0602 SHIP STRUCTURAL ANALYSIS – I

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

20-215-0602	Ship Structural Analysis I	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Nil

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 the 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	Explain the procedure to determine wave loads.
CO 6	Explain 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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. 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
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.
Dynamic loads: Springing, slamming, whipping, shipment of green water.

2.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: Shear stress in open section due to shear load, shear stress in multi cell sections, shear lag, effective breadth, hull – super structure interaction.

3.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.

4.**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.

5.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

ocean structures, SNAME, New Jersey, 2008.
2) Owen. F. Hughes andJeomKee Paik – Ship Structural Analysis and Design, SNAME, New York., 2008.
3) Mohammed Shama – Torsion and Shear Stresses in Ships, Springer - Verlag, 2010.
4) Mohammed Shama – Buckling of Ship Structures, Springer - Verlag, 2013.
5) Yasuhisa Okumoto – Design of Ship Hull Structures- A practical guide for Engineers, Springer – Verlag, 2009.
6) Yasuhisa Okumoto, Yu Takeda, Masaki Mano, Tetsuo Okada; Design of Ship Hull Structures, Springer, 2010
7) Chandrasekaran Srinivasan; Advanced Marine Structures, Springer, 2010.

20-215-0603 STRUCTURAL DESIGN OF SHIPS

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

20-215-0603	Structural Design of Ships	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

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 on board and to develop design and drawings of mid-ship section of ships and boats.

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

CO 1	Discern various kinds of materials used on-board 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 on-board highlighting the importance of compatibility with other aspects of ship design.
CO 5	Develop a model mid-ship and other structural system 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	1	2	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Studentsshould answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **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)

2. **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.

3. **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.

4. **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.

5. **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

References:

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) Chandrasekaran Srinivasan; Advanced Marine Structures, Springer, 2010.

20-215-0604 SHIP DESIGN

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

20-215-0604	Ship Design	Category	L	T	P	Credit	Year of Induction
		PCC	3	1		3	2020

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 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

Mapp

ing 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	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. Module I

   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; Owners requirements

2. 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).Ship parameters – displacement, displacement coefficient, displacement equation, volume equation, solution of the cubic equation

3. **Module III**

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

4. **Module IV**

Design of hull form – conventional method of lines, distortion of existing forms; stem and stern contours, Bulbous Bow.

5. **Module V**

Effect of form on Ship's performance: Freeboard and load line regulation; Stability – stability booklet, IMO Regulations, Checks on stability, trim.Watertight integrity; damage stability, Tonnage measurement – international, Suez, Panama. Behaviour of ships in sea. Resistance, Powering, Propulsion

Practicals:-Development of Lines plan.

References:

1) Lewis, E.U; 'Principles of Naval Architecture' (2nd Rev.) Vol. III, 1989, SNAME New York
2) Schneekluth, H; Ship Design for Efficiency and Economy, Butterworths, 1987
3) Taggart; Ship Design and Construction, SNAME, 1980.
4) Thomas Lamb, Ship Design and construction, SNAME, 2003.
5) ApostolosPapanikolaou, Ship Design: Methodologies of Preliminary Design, , SNAME, 2014.
6) Antony F Molland, A Guide to ship design, construction and operation, SNAME, 2008
7) Misra S.C.; Design Principles of Ships and Marine Structures, CRC Press, 2016
8) DGM Watson, Practical Ship Design, Elsevier Ocean Engineering Book Series 2002
9) Myung-II Roh, Kyu-Yeul Lee; Computational Ship Design, Springer, 2018.

20-215-0605 SHIP PRODUCTION TECHNOLOGY

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

20-215-0605	Ship Production Technology	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

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 the 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 pre-fabrication 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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5questions with 1 question from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**
   History of Indian Ship building, 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 handlingand storage, transport system insteel stockyard, material preparation (straightening of plates and rolled sections, shot blasting, pre-painting
2. **Module II**
   Fabricationofcomponentparts:–thecuttingprocess–tools, physicalchemicalbackgroundofthecuttingprocess, mechanical cutting, devices for thermal cutting, general description of the various machines, photoelectric and NC control devices, edge preparation, problems of accuracy; Bending of rolledand built up sections general description of bending, control of the bending process, automation of bending; Plate bending, uniaxial bending, biaxial bending
3. **Module III**

AssemblyofShip'sStructures: Prefabrication–generalremarks, basic problemsof prefabrication, 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, and Insulation.

4. **Module IV**

   Erectionofship'shull–Generalassembly methods, handling ofpreassembledunitsintheerectionarea–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.

5. **Module V**

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

Practicals–Shell Expansion Drawing and Docking Plan

References:

1) Taggart; Ship Design and Construction,SNAME, 1980.
2) Storch R. Lee,Hammon C.P. & Bunch H.M.; Ship Production, CornellMaritimePress,Maryland,USA, 1988
3) DormidontovV.K. &et.al.,ShipbuildingTechnology, MirPublishers, Moscow, 1990.
4) Eyres D.J.; Ship Construction William HeinemannLtd, London, 2011
5) A W Carmichael , Practical Ship Production , Salzwasser-VerlagGmbh, 2004.
6) Andrew Williams Carmichae, Practical Ship Production, BiblioBazaar, 2009.
7) Thomas Lamb, Ship Design and construction, SNAME, 2003
8) Journal of ship production London SNAME

20-215-0606 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.

20-215-0606	Marine Engineering	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Nil

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

CO 1	Apply the knowledge on various marine machineries and marine systems.
CO 2	Understand the importance and functions of various machineries on board ships.
CO 3	Understand the problems faced by marine engineers and rectify them by efficient design & construction.
CO 4	Understand significance of vibration in main engine installation and working.
CO 5	Make an efficient engine room plan.

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											1
CO 3	3	2	2									1
CO 4	3	1	1									1
CO 5	3	2	2		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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **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)

2. **Module II**

   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,

3. **Module III**

   Marine and special duty pumps, General pumping system characteristics, Classification of Pumps- Displacement, Axial-flow, Centrifugal Pumps, Screw pumps, Ejectors. Piping – various types of piping system fitted in ships, Expansion arrangements for pipes, valves, types used in Marine Practice. Materials and corrosion in pipes, colour codes for pipes.

4. **Module IV**

   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.

5. **Module V**

   Engine dynamics, torsional vibration of engine and shafting, axial shaft vibration, critical speeds, engine rating, rating corrections, trial tests etc. Relationship of engine to the propeller classification society rules on engine construction, Engine room arrangement. Automation of ship propulsion plants, Maintenance requirements and reliability of propulsion plants.

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

6) H. D. McGeorge; General Engineering Knowledge Routledge; 3rd edition 2012

7) Taylor, D.A.; Introduction to Marine Engineering, Butterworth-Heinemann, 2003.

8) IMO, MARPOL Consolidated edition, 2011

9) IMO, SOLAS Consolidated Edition, 2014

10) A. J. Wharton, Anthony John Wharton ; Diesel Engines 3rd edition Butterworth-Heinemann 2013

20-215-0607 MARINE HYDRODYNAMICS LAB

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

20-215-0607	Marine Hydrodynamics Lab	Category	L	T	P	Credit	Year of Induction
		PCC	1	-	2	1	2020

Prerequisite: Knowledge on Resistance and Propulsion of ships.

Course Outcomes: After the completion of the course the student 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 with 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

Assessment Pattern:

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) Model test to predict ship resistance, flow line test, shallow water resistance test.
2) Open water test, self-propulsion test, bollard pull test.
3) Seakeeping tests

20-215-0608 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.

20-215-0608	Marine Engineering Lab	Category	L	T	P	Credit	Year of Induction
		PCC	1	-	2	1	2020

Prerequisite: Nil

Course Outcomes: After the completion of the course the student 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 class room 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 with 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

Assessment Pattern:

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) 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

20-215-0701 SHIP PRODUCTIONMANAGEMENT

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.

20-215-0701	Ship Production Management	Category	L	T	P	Credit	Year of Induction
		PCC	4	-	-	3	2020

Pre-requisites: Nil

Course Objectives:

- To provide an overview on layout of shipyard & various activities.
- To impart knowledge on shipbuilding practices and sequence of ship production

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	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	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

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**
   Production system: The systems approach, subsystems, comprehensive system model– the firm as system. 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).
2. **Module II**
   Process planning in shipbuilding: Planning for operations – interconnection between production design and process planning, production and process analysis, assembly charts operation process charts flow process charts; Process election. Application of models for process planning, scheduling and control Gantt charts, CPM & PERT.; Special aspects of application of these in shipbuilding process
3. **Module III**
   Introduction to operation research. Operation planning and control production planning scheduling network models (PERT, CPM) quality control maintenance analysis. Production Standards– production standards in several parts of the ship production process, work measurement systems, methods of man- hour determination.
4. **Module IV**
   Quality Assurance and quality control activities in shipyards; Problems of accuracy – tolerances, standards, measuring techniques (Theodolite laser).
5. **Module V**
   General Shipbuilding and Shipyard Activities; Business Development, Safety, Security, Housekeeping, Training, Enterprise resource Planning-Data Management Systems.

   Practical: Application of network models with critical path scheduling in shipbuilding.

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

20-215-0702 SHIP STRUCTURAL ANALYSIS II

Course Description: To provide overview on the analysis of ship structural members.

20-215-0702	Ship Structural Analysis II	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	-	3	2020

Pre-requisites: Structural Analysis I

Course Objectives:

- To impart knowledge on plated structures used in ship design
- To provide knowledge on analysis of submarine
- To impart knowledge on torsional behaviour of ship structures
- To impart knowledge of ultimate strength of ship structures
-

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

CO 1	Understand the principles of torsion.
CO 2	Understand and demonstrate knowledge in analysis of submarine structures
CO 3	Assess ultimate strength of plates, beams and structures.
CO 4	Characterise the vibrational features of plated structures.
CO 5	Understand Reliability analysis and ultimate strength of hull girder

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
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

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content

1. **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

2. **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.

3. **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

4. **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.Crack growth and linear elastic fracture mechanics (LEFM), Fracture toughness method of improving fatigue strength in ship structure

5. **Module V**

Reliability analysis and ultimate strength of hull girder

Reliability based analysis of ship structures, 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 ocean structures, SNAME, New Jersey, 2008.
3. Owen. F. Hughes and JeomKee Paik – Ship Structural Analysis and Design, SNAME, New York, 2010
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, 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.), ASM international, 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 of welded structures, Woodhead publishing, 2014
14. Roy Burcher, Louis.J.Rydill, Concepts in Submarine Design, Cambridge University Press, 2014.
15. Ansel.C.Ugural, Stresses in Beams, plates and Shells, CRC, Press, 2010.

20-215-0703 PRACTICAL SHIP DESIGN

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.

20-215-0703	Practical Ship Design	Category	L	T	P	Credit	Year of Induction
		PCC	3	1	2	3	2020

Prerequisite: ST20 1604 Ship Design I

Course Outcome: After the Completion of the course the student 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
CO4	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 these knowledge for presentation by preparing standard ship drawings.

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
CO 2	2	2										2
CO 3	2	2										2
CO4	2	3										2
CO 5	2	1										2
CO 6	1	1										1
CO 7	2	1										2

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	200	-	-

Course Content:

(Students are to do the respective design calculations and drawings as Classroom Assignments.)

1) 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.
2) 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.
3) Cargo handling equipment, lifting devices; Design of swinging derrick system.
4) Cargo Access: Design of hatch coamings, Design of Lifting type Container Hatch covers
5) Determination of number and type of Life saving appliances (LSA) and Fire Fighting Appliances (FFA) as per statutory regulations.
6) Structural design of rudder and rudder stock using class rules.

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.

20-215-E7n Elective I

20-215-E7n Elective II

Elective subjects shall be selected from the list of electives given for 7th Semester as shown below the Course Content.

20-215-0704 PROJECT WORK

Course Description: Students shall do independent Ship Design Project work. The ship design work up to the main dimension fixing shall done in the 7th Semester and the remaining work shall be continued in 8th Semester

20-215-0704	Project Work	Category	L	T	P	Credit	Year of Induction
		PCC	2	2	3	4	2020

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	100	-	-

20-215-0705 INTERNSHIP

Course Description: Impart students the application of theoretical knowledge on practical work related to Naval Architecture.

20-215-0705	Internship	Category	L	T	P	Credit	Year of Induction
		PCC	-	-	-	1	2020

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	50	-	-

SEMESTER VIII

20-215-0801 SPECIAL PROBLEM AND SEMINAR

Course Description: Students can be given small projects that are relevant to Naval Architecture, Marine Engineering and other Engineering fields and accordingly a seminar can be conducted.

20-215-0801	Special Problem And Seminar	Category	L	T	P	Credit	Year of Induction
		PCC	-	2	-	2	2020

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	100	-	-

20-215-E8n ELECTIVE III

20-215-E8n ELECTIVE IV

Elective subjects shall be selected from the list of electives given for 8th Semester as shown below the Course Content.

20-215-0802 PROJECT WORK& VIVA VOCE

Course Description: After completing the project, a project report along with necessary drawings shall to be prepared and submitted by each student.

20-215-0802	Project Work& Viva Voce	Category	L	T	P	Credit	Year of Induction
		PCC	12	-	8	12	2020

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
500	300	200	-

Continuous Internal Evaluation Pattern:

Attendance : 30 marks
Continuous Assessment :270 marks

ELECTIVE SUBJECTS – 7TH SEMESTER

List of Electives for 7th Semester)

20-215- E701 Marine corrosion and prevention
20-215- E702 Design of Fishing Vessels
20-215- E703 Refrigeration & Air conditioning of Ships
20-215- E704 Offshore Structure Design
20-215- E705 Ship Recycling
20-215- E706 Computer Aided Ship Design
20-215- E707 Experimental Stress Analysis
20-215- E708 Cargo Handling
20-215- E709 Inland Water Transport
20-215- E7010 Design of small crafts
20-215- E7011 Marine Pollution, Control and Recovery Systems
20-215- E7012 Maritime Law and Shipping Management.
20-215- E7013 Maritime EngineeringContracts and CommercialManagement
20-215- E7014 Composite Boat Design
20-215- E7015 Computational Fluid Dynamics in Marine Technology

Note: Students shall have the choice of taking upto 20% of credits from the industry based electives offered in this department subject to availability of teachers in the core areas. Accordingly the teachers in the core area have to prepare the syllabus and offer the industry based elective course after approval from the committee consisting of academician and industry.

20-215- E701 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.

20-215-E701	Marine corrosion and Prevention	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	3	2020

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)

	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	3	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	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
200	100	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Content:

1. **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.
2. **Module II**
   Corrosion control by design, selection of Ship building materials, corrosion inhibitors, corrosion monitoring-corrosion management in ships-Marine Corrosion Testing.
3. **Module III**
   Surface preparation and treatments-Degreasing-weathering-mechanical surface cleaning-pickling-blast cleaning-flame cleaning-rust converters-chemical pre-treatment-comparison

of pre-treatment methods- Anodic protection, Powder coating, Electroplating, thermal spraying, hot dipping.

4. **Module IV**
   Marine paints-Role of constituents of paints-classification of paints-mechanism of anticorrosive paint-paint types-selection of paint-paint scheme-antifouling paints-principles of antifouling paints -coating failure.
5. **Module V**
   Cathodic protection-Mechanism of cathodic protection, sacrificial anode, design of sacrificial anode system for ship, impressed current system, 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.

20-215-E702 DESIGN OF FISHING VESSELS

Course Description: To provide an overview on types and design features of fishing vessel, materials and preservation.

20-215-E702	Design of Fishing Vessels	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	3	2020

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 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	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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content

1. **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

2. **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

3. **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.

4. **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.

5. **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

20-215-E703 : REFRIGERATION AND AIR CONDITIONING OF SHIPS

1) Introduction- Marine Applications of Mechanical Refrigeration; Refrigerated Ship's Stores Refrigeration at Sea; Cargoes and carrying conditions, Thermodynamical principles vapour, compression cycles (CARNOT, superheating, subcooling, multistage operation) Absorption cycles

2) Refrigerating machinery- principal components, compressors, condensers, evaporators, regulators. Refrigerant Properties- Demands; Choice; Safety; Lubricants; Refrigerant Numbering System; Refrigerant Blends; Ozone Depletion and the Montreal Protocols; Alternative Refrigerants; Secondary Refrigerants

3) Methods of cooling- cargo chamber cooling in conventional refers, Methods of cooling containers, Insulations, Heat Leakage Estimation, Total load on the refrigeration plant

4) Air Conditioning- Fundamentals, definitions, psychrometric chart, Air conditioning (Heating), heat sources, heat exchangers, heat pump, Air conditioning (Cooling), principal arrangement and equipment.

5) Standards for marine air conditioning systems- Air flow & air conditioning capacity calculations, Air conditioning Systems

HVAC Systems and Components- Single Zone System; Multiple Zone Systems; Terminal Reheat system; Dual Duct System; Variable Air Volume Systems; Water Systems; Unitary Systems; Cargo Hold Dehumidification Systems.

Reference:

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) R.S. Khurmi, J. K. Gupta; Textbook of Refrigeration and Air Conditioning; S. Chand 2016

6) P.I. Ballaney ;Refrigeration and Air Conditioning ;Khanna PublishersKhanna, 1985

20-215-E704 OFFSHORE STRUCTURE DESIGN

1) 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.

2) Loads .Description of environmental loads, dead loads and operational load, calculation of wave, wind, current loads.

3) Steel structural design of members subjected to axial compression and bending, Design of deck structures. Design of mooring lines, Design of offshore pipelines

4) Design of Jacket structures, Combined axial compression and bending, Design of Joints-Punching shear load and determination of stress concentration, Design for fatigue strength.

5) Design of Jackup structures, Description of the structural components, Design of hull structures, leg, lifting components.

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

20-215-E705 : SHIP RECYCLING

1) 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.

2) 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

3) 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

4) Operation in Ship Recycling Ship dismantling process,Access, Cleaning, Marking, cutting, handling, lifting, sorting, stacking, storing, marshall Concept of recycling

Reuse and Land-filling 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.

5) 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) PurnenduMisra, AnjanaMukharjee, Ship Recycling , A Hand book for mariners, Narosa Publication, House, New Delhi, 2009.
2) A guide for ship scrappers, tips for regulatory compliance, United StatesEnvironmental 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 recyling 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.

20-215-E706: COMPUTER AIDED SHIP DESIGN

1) Numerical Techniques in Computer Aided Ship Design:

Numerical Interpolation: Differences, Newton's Forward Difference interpolation formula, Lagrangian Interpolation formula. Numerical Integration: Integration formulas.

Curve Fitting: Fitting of Polynomials, Least Square curve fitting technique, choosing the degree of the polynomial, Ill-conditioning difficulties, Orthogonal Polynomial fitting

2) Lines Design and Fairing: Manual Graphical method, Computer Aided Curve fitting Techniques Fairing Principles, Spline Fitting: Cubic Spline curve, Bezier Curve, B-Spline Curve.

3) Preliminary Ship Design Design Stages and methods, Preliminary Parameter Estimation: Displacement, Length, Breadth, Depth, Draught, Block Coefficient; Check on Transverse & longitudinal Stability, Freeboard, etc., Estimation of Power, Capacity; Basic Ship Method, Computer Aided Preliminary Ship Design: Preliminary Parameter Selection, Ship Lines fairing

4) Database Systems-Introduction-Architecture of a Database system-Data Models: Relational, Hierarchical, Network-Application to Ship Design

5) Optimisation Methods in Ship Design Introduction-Modelling of Design as Optimisation Different Optimisation Methods; Linear and Non-liner optimisation Application to Ship Design

Practical: Development of relevant Computer Programs based on the Course Content

Reference:

1. L.R Reheja, et.al.; Computer Aided Ship Design, Code No. 77, Update for Working Professionals, AICTE, Continuing Education Programme

2. ChengiKuo; Computer Methods for Ship Surface Design, Longman, 1971

3. ChengiKuo; Computer Applications in Ship Technology, Heyden& Son Ltd. 1977

4. H. Nowacki, et.al.;Computational Geometry for Ships, World Scientific Publishing Co. Pvt. Ltd., 1995

5. David F. Rogers & J Alan Adams; Mathematical Elements for Computer Graphics, McGraw-Hill International Editions, 1990.

6. Myung-II Roh, Kyu-Yeul Lee; Computational Ship Design, Springer, 2018.

20-215-E709 INLAND WATER TRANSPORT

1) Introduction – Characteristics of Inland Water Transport - Inland water transport in India Classification of Inland Waterways.

2) 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

3) 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

4) General Arrangement – Cargo handling & equipment on board systems – piping systems – FFA - LSA-super structure arrangements, mooring and anchoring.

5) Structural design - materials of construction – methods of construction and production technologies

Reference:

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) 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) SulaimanOladokunOlanrewaju Safety and Environmental Risk Model for Inland Water Transportation 2012 .

20-705-E7013 MARITIME ENGINEERINGCONTRACTS AND COMMERCIALMANAGEMENT

1) Introduction, Basic Divisions of Shipyard Activities, Introduction to Activity based costing (ABC) – cost categories (Material costs, labour costs, overhead costs), activity based budgeting, support costs. Importance of costing in competitive shipbuilding, Cost and Price, Approximate or budget prices, Approximate or budget costs, Subdivision of costs - merchant shipbuilding practice, Subdivision of costs - warship practice

2) Principles and Definitions - Elements of Cost, Materials. Labour and Expenses, demarcations and subdivisions of costs (separate for merchant ships and warships), structural costs (Structural material, Structural labour*), Outfit Cost, Machinery costs,* Considerations in Devising Standard Methods, Classification and Methods for Production Orders, Ship Product Units, Ship Works Departments, Materials and Supplies, Labour etc

3) Unit production and first of class costs,Derivation of price fromcost, Costing Methods for Production Control and Estimating, Summary Cost Reports and Statistical Statements, Life cycle costing, Cost management methods and instruments, cost indices, cost planning, cost minimization.

4) 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.

5) 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. Safety management concept in ships and ports and ISO certifications. Management practices in maritime projects. Commercial, marketing, legal and financial aspects of shipbuilding and shipping.

Practical: Cost estimation of Tugs/Inland Vessels

References:

1) Management of Marine Design, Erichsen. Stian, Butterworth & Co. (Publishers) Ltd, 1989, The Law ofShipbuilding 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

20-215-E7014 COMPOSITE BOAT DESIGN

1) 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.

2) 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.

3) 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)

4) 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.

5) 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

20-215-E7015 COMPUTATIONAL FLUID DYNAMICS IN MARINE TECHNOLOGY

1) Introduction to Computational Fluid Dynamics and Principles of Conservation
CFD Applications, Numerical vs Analytical vs Experimental, Modelling vs Experimentation; Fundamental principles of conservation, Reynolds transport theorem, Conservation equations: mass; momentum and energy equations; convective forms of the equations and general description.

2) Numerical Methods for Solving CFD Problems

Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic
elliptic and hyperbolic; boundary and initial conditions; overview of numerical methods: Finite Difference Method, Finite Element Method and Finite Volume Method.

3) Implementing a CFD Code

The basic structure of a CFD code: Pre-processor, Solver and Postprocessor, User-defined subroutines;
Grid generation: Numerical grid generation, basic ideas, transformation and mapping; Solution to some basic problems in fluid flow – free surface flows and N-S equations around a body in water; Numerical flow simulation.

4) Turbulence Modelling
Important features of turbulent flow, Vorticity transport equation, General Properties of turbulent quantities, Reynolds Average Navier Stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling, Different types of turbulence model: Eddy viscosity models, Mixing length model,
Turbulent kinetic energy and dissipation, The κ-ε model, Advantages and disadvantages of κ -ε model, More two-equation models: RNG κ-ε model and κ-ω model, Reynolds Stress Model (RSM), Large Eddy
Simulation (LES), Direct Numerical Simulation (DNS)

5) Minor Project
A minor project in computational fluid dynamics using any commercial or open-source CFD package. May include programming exercise to solve problems and analyze the results.

References

1. John D.Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company.2012
2. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press. 2014
3. H.K.Versteeg& W. Malalasekera,An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical. 2016
4. J.Blazek, Computational Fluid Dynamics:Principles and Applications,Elsevier.2001
5. Ferziger, J. H., Peric, M., Computational Methods for Fluid Dynamics, 3rd ed., Springer, 2002.
6. Computational Fluid Dynamics: An Introduction,Springer Publisher,2012
7. Walker Gregg ,Advances In Computational Fluid Dynamics,Auris Reference Limited,2014

ELECTIVE SUBJECTS – 8TH SEMESTER

List of Electives for 8th Semester)

20-215- E801 Experimental Techniques on ships and models

20-215- E802 Finite element method

20-215- E803 Ship Repairing and Surveying

20-215- E804 Advanced Computer Techniques

20-215- E805 Computer Application in Shipbuilding Technology

20-215- E806 Design of fishing systems

20-215- E807 Design of Submarines and Deep Submersibles

20-215- E808 Design of High speed crafts

20-215- E809 Quality Assurance and Management in Shipbuilding

20-215- E8010 Numerical techniques in Marine Hydrodynamics

20-215- E8011 Probabilistic Theory applied to ship in seaway

20-215- E8012 Remote sensing Applications in Ocean Wave Data Analysis

20-215- E8013 Underwater Explosions and Acoustics

20-215- E8014 Design of warships

20-215- E8015 Fracture Mechanics

20-215- E8016 Marine Pollution Prevention and Management

Note: Students shall have the choice of taking upto 20% of credits from the industry based electives offered in this department subject to availability of teachers in the core areas. Accordingly the teachers in the core area have to prepare the syllabus and offer the industry based elective course after approval from the committee consisting of academician and industry.

20-215-E801 EXPERIMENTAL TECHNIQUES ON SHIPS AND MODELS

1) Ship Resistance tests, Total resistance, Resistance diagrams, Resistance Coefficients, Ship Models, Laws of comparisons and Similarity, Extension of Model results to Ships, Towing Tank, Instrumentation, Method of measurements.

2) Open water tests, Objectives, Facilities, Test set up, principles, procedure, Analysis and conclusions. Self-Propulsion experiments, Objectives, Instruments and equipments, Test arrangements, basic principles, experiment, Results.

3) Cavitation, Cause of Cavitation, Cavitation number, Classification of Cavitation, Law of similarities, Cavitation tests, facilities, prevention of Cavitation.

4) Sea trials, Shop tests, various sea trials, manoeuvring trials, Dock trials, Speed Trials, Observations, Data presentation and uses.

5) Shallow water resistance tests
Wake measurements, Sea keeping tests

Model Tests for Determination of Hydro dynamic derivatives of Ships and submerged vehicles. Paint erosion tests, Smoke disposal tests, Rudder tests, Tuft tests

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 Manoeuvrability – Captive Model Test Procedures. Proceedings of 23rd ITTC, 2002.
6) ITTC RECOMMENDED PROCEDURES Resistance Tests. Proceedings of 23rd ITTC, 2002.
7) ITTC RECOMMENDED PROCEDURES Propulsion, Propulsor Open Water Tests. Proceedings of 23rd 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

20-215- E802 FINITE ELEMENT METHOD

1) 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.

2) 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.

3) Computer Implementation of FEM- organization of computer program, Numerical methods for various property matrix calculations, fundamentals of stability and Dynamic analysis.

4) 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.

5) Analysis of offshore jacket structures usingFEM – static and free vibration analysis – including foundation.Analysis of Jackup structures using stick model. Numerical examples of simplified structures.

Reference:

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) Ivo Babuska Finite Elements: An Introduction to the Method and Error EstimationOxford University press 2011
9) Klaus-Jürgen Bathe; Finite Element Procedures; Klaus-Jürgen Bathe; second edition 2014

20-215-E803 SHIP REPAIRING AND SURVEYING

Course Description: This course provides students 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.

20-215-E803	Ship Repairing and Surveying	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	3	2020

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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment : 40 marks
Internal Tests : 50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **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.

2. **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.

3. **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.

4. **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.

5. **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.

20-215-E809 : QUALITY ASSURANCE AND MANAGEMENT IN SHIPBUILDING

1) Introduction to Quality & Quality Control: Concept of quality, quality characteristics, quality standards, quality cost, concept of quality control, quality control methodology, quality philosophy and management strategies, Major Quality Problems, Difference between QA and QC.

2) Statistical methods of quality control, Statistical Description of Quality: Population and sample, techniques of sampling, analysis of sample data, representation of sample data.

Statistical Inferences on Quality: Population and sample distributions, estimation of population parameters, statistical hypothetical test, Quality Control Charts, Concept and methods of six sigma, six sigma control chart.

3) Quality Management Principles:- Customer focus, Leadership, Involvement of people, Process approach, System approach to management, Continual improvement, Factual approach to decision making, Mutually beneficial supplier relationships.

4) Fundamentals of a Quality Management System: - Definition, Description and Use, Integrated Quality Management System, Advanced QMS Software, Fundamentals of Total Quality Management in Ship Building, Strategic Quality Management and Human Factors in Quality.

5) Fundamentals of Quality Assurance in Shipbuilding, Steel process Quality Assurance (Hull and Painting) and Outfit process Quality Assurance, Various Quality Standards and Auditing in shipyards, Overview on ISO standard in Ship Building, Qualification Standards, Training and Certification, Quality Manual and Document Management, Quality in Planning, Design and Operation, Quality Policy of Shipyards.

References:

1) Ship Production, Richard Lee Storch, Richard C. Moore, Colin P. Hammon, Howard M. Bunch, Cornell Maritime Press, Inc.Publication, 2nd Edition, 1995

2) Introduction to Statistical Quality Control, 7th Edition, Douglas C. Montgomery, John Wiley & Sons, Inc., 2009

3) Statistical Quality Control, Grant E.L, Leavenworth R.S, Tata McGraw Hill Education Private Limited.

4) Applied Reliability and Quality: Fundamentals, methods and Procedures, Dhillon, Balbir S, Springer, London, 2007

20-215-E8016 MARINE POLLUTION PREVENTION AND MANAGEMENT

Course Description: Provides students a general idea about various types of marine pollution and their mitigation measures.

20-215-E8016	Marine Pollution Prevention And Management	Category	L	T	P	Credit	Year of Induction
		PEC	3	1	-	3	2020

Pre-requisites: Nil

Course Objectives:

- 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	Explain marine pollution mitigation measures.
CO 3	Apply safe design consideration for ships.
CO 4	Understand impact of pollution risk from ships.
CO 5	Describe 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					
CO 2	3	2					2					
CO 3	2	3	2									2
CO 4	2	1										1
CO 5	1						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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment	:	40 marks
Internal Tests	:	50 marks

End Semester Examination Pattern:

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 5 questions with 1 questions from each module, having 4 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 16 marks.

Course Content:

1. **Module I**
   Marine pollution- definition- classification of pollutants- environmental impacts - Oil pollution and consequence of oil pollution on coastal environment- thermal, radioactive- port and 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: Primary, Secondary and Tertiary treatment processes.
2. **Module II**
   Marine Pollution Prevention and containment: Prevention and mitigation of pollution by port and Harbor-safe tankers design and operation-safe navigation channels-offshore resources exploitation and pollution prevention-oil pollution containment- treatment of oil spills and recovery- radioactive pollution containment and recovery-operational tankers pollution prevention -Oil spill response plans-dredging induced pollution and its prevention- Pollution due to Protection methods against corrosion and fouling.
3. **Module III**
   Ballast Water and Other Marine Pollutants- Environmental threats from ballast water-International maritime dangerous goods (IMDG)-Dumping of ship wastes and other materials-Bilge water / waste oil operational management- ballast water treatment- ship breaking and associated issues and ship recycling-Waste management operations
4. **Module IV**
   Environmental Management Systems -Environmental management function-Monitoring Ocean environmental effects-Performance of Ocean environmental management- Ocean environmental management process-role of international, national and local authorities: IMO, MEPC, MARPOL-Managing ocean pollution by ships-Environmental auditing-EIA for ocean development projects-strategies or Ocean environmental management-ISO 14000 - standards in water quality: Assessment of pollution damage. Energy Efficient Design Index (EEDI)-Energy Efficient Operational Indicator (EEOI).

5. **Module V**
   Legal Issues, Liability and Insurance- Marine pollution preparedness and response - Methods of intervention and clean-up technologies- shipboard monitoring, contingency planning, port reception facilities (IMO, EU and national level), the human element, accident investigation and surveys- 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

2. Ernst Frankel; Ocean Environmental Management,Edn.1995; Prentice Hall ,Inc., New Jersey, USA
3. AradhanaSalpekar; Marine Pollution; New Delhi JnanadaPrakashan, 2008
4. Clark, R.B; Marine Pollution; New York, Oxford University,1997
5. Johnston R.; Marine Pollution; London Academic Press, 1976.
6. MARPOL Consolidated Edition, 2017
7. Michael G Faure, Han Lixin and Shan Hongjun; Maritime Pollution Liability and Policy China, Europe and the US; Austin Wolters Kluwer 2010

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