

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
NAAC ACCREDITED WITH 'A' GRADE
Marching Beyond 25 Years Successfully

B. Tech.
Naval Architecture and Offshore Engineering

Curriculum and Syllabus
(Based on Choice Based Credit System)
Effective from the Academic year
2021-2022

Department of
Naval Architecture and
Offshore Engineering

DEPARTMENT OF NAVAL ARCHITECTURE AND OFFSHORE ENGINEERING

VISION

The Department of Naval Architecture and Offshore Engineering of VELS Institute of Science Technology and Advanced Studies (VISTAS) has a vision to establish itself as a centre of excellence in Naval Architecture and Offshore Engineering Programme for producing well qualified graduate engineers capable of meeting the challenging and ever-expanding needs of development and management of world class shipbuilding/ Offshore Industry.

MISSION

1. Educate, motivate and prepare the students to know the fundamental and technical skills in Naval Architecture and Offshore Engineering through effective teaching learning Methodologies.

2. To imbibe professional and ethical standards in the minds of the young engineers by continuous learning and professional activities.

3. To impart the employability skills to the students as industry ready by implant training and industrial visits.

4. To create entrepreneurship skills by industrial collaborations and mentoring.

5. To encourage students to undertake R&D activities for the societal needs with high ethical standards.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Build their career as a successful and distinguished Naval Architect or Offshore Engineer

PEO2: Pursue higher education and research in Marine sector, other engineering streams and specializations

PEO3: Acquire innovative and creative thinking skills to augment their professional growth

PEO4: Nurture in design, analysis and implementation skills to innovation technology in Naval Engineering with global context.

PEO5: Develop the awareness among the students about the various social responsibilities related to Engineering ethics and human values with ecological.

PROGRAM OUTCOME (PO)

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **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.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and

modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1: Be able to acquire core Naval Engineering knowledge and able to solve industrial as well as societal problems with ethical and environmental consciousness.

PSO2: Be well versed in the various Offshore structures and Subsea systems with specific areas like Risers, Mooring Lines, Pipelines, etc.

PSO3: Be competent in the fundamentals of ship design, ship production, seakeeping and maneuvering and Demonstrate knowledge on the decommissioning of ships and offshore structures

PSO4: Discuss the advancements in the Offshore Structural Engineering, like operation in ultra-deep waters, Arctic Sea conditions.

PSO5: Be able to build the nation, by imparting technological concepts and tools on emerging fields through the Managerial and entrepreneurs' skills.

BOARD OF STUDIES MEMBERS

1	Mr. T S Arvind Kishor	HOD i/c, Naval Architecture and Offshore Engineering, VISTAS	Chairperson
2	Mr. S Mathivanan	Assistant Manager & Lead, Pioneer Smith Engineering Solutions, Kandigai, Chennai – 600048	External Expert
3	Capt. N. Kumar	Director, School of Maritime Studies, VISTAS	Member
4	Mr G Muralidharan	Course Coordinator – GME, School of Maritime Studies, VISTAS	Member
5	Dr P Murali	Assistant Professor - Electrical, School of Maritime Studies, VISTAS	Member
6	Mr. K Saravana Kumar	Assistant Professor, Dept of Naval Architecture and Offshore Engineering, VISTAS	Member
7	Mr S Sravan Kumar	Assistant Professor – Naval Architecture School of Maritime Studies, VISTAS	Member
8	Mr M.S. Hariharan	Assistant Professor – Naval Architecture School of Maritime Studies, VISTAS	Member
9	Mr K Rajiv Kumar	Technical Lead, Navcraft, Chennai	Alumni Member

REGULATIONS

DEPARTMENT OF NAVAL ARCHITECTURE AND OFFSHORE ENGINEERING

NAME OF THE COURSE: B.Tech Naval Architecture & Offshore Engineering

(Choice Based Credit System – Semester Pattern)

REGULATIONS

Effective From Academic Year 2021 -22

1. DURATION OF THE PROGRAMME

1.1. Four years (Eight semesters)

1.2. Each academic year shall be divided into two semesters. The odd semesters shall consist of the period from July to November of each year and the even semesters from January to May of each year.

1.3 There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION:

- A candidate with a pass in (10+2) with 45% aggregate marks in Maths, Physics and Chemistry & 45% in English is eligible for admission as per AICTE norms. The candidate qualified in CBSE or state board of any state is eligible.
- Lateral entry is permissible to those who qualified Diploma in Mechanical, Civil, Metallurgy, Marine, Naval Architecture, Offshore Engineering, Petroleum Engineering, Harbour Engineering, Industrial Engineering and Production Engineering.
- Boys and Girls are eligible to join the course.

3. MEDIUM OF INSTRUCTION

The medium of instruction for the programme is English

4. ELIGIBILITY FOR AWARD OF THE DEGREE:

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed course of study in the department of Naval Architecture & Offshore Engineering of this university for a period of not less than four academic years, passed the examinations of all the eight semesters and earning a minimum of 160 credits

5. COURSE:

Each course / subject is to be designed under lectures / tutorials / laboratory or field work / seminar / practical training / Assignments / Term paper or Report writing etc., to meet effective teaching and learning needs.

6. COURSE OF STUDY:

The subjects of study for this Bachelor Degree shall consist of,

- **i.** General Subjects (English, Mathematics, Physics, Chemistry, Computer basics)
- **ii.** Foundation Subjects (Engineering Graphics, Strength of Materials, Fluid Mechanics, Electrical Engineering)
- **iii.** Core Subjects on Naval Architecture and Offshore Engineering as given in the curricula.
- **iv.** Laboratory practical, Ship Design calculation and drawing practical, Ship Design, Offshore Structure Design, Software Lab practical and Workshop Practical.
- **v.** Internship for a period of one month in anyone of Shipyard / Design Office.
- **vi.** Minor and Major Design Projects.
- **vii.** Elective subjects related to core subjects.

For each course, credit is assigned based on the following:

Contact hour per week		CREDITS
1 Lecture hour	-	1 Credit
1 Tutorial hour	-	1 Credit
2 Practical hours	-	1 Credit
(Laboratory / Seminar / Project Work / etc.)		

7. SCHEME OF EXAMINATION:

There shall be eight semester examinations for first /third /fifth /seventh in November/December and second /fourth /sixth /eight in May/June every year.

The following procedures to be followed for Continuous Assessment (CA)

Theory Papers	Internal Marks (40)
1. Continuous Assessment Test – I, II, III	15 marks
2. Assignments / Seminars	5 marks
3. Model Examinations	5 marks
4. Attendance	5 marks
5. Aptitude of the student	5 marks
6. Student Assessment by Faculty	5 marks

Practical: Internal Marks 40
Project & Internship: Internal Marks 40
External Examination: (for theory, practical, project & internship): 60

8. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

8.1 **Eligibility:** Students shall be eligible to go to subsequent semester only if they earn sufficient attendance as prescribed therefor by the Board of Management from time to time.

8.2 **Attendance:** All Students must earn 75% and above of attendance for appearing for the University Examination. (Theory/Practical)

8.3 **Condonation of shortage of attendance:** If a Student fails to earn the minimum attendance (Percentage stipulated), the HODs shall condone the shortage of attendance on medical grounds up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) after paying the prescribed fee towards the condonation of shortage of attendance. The students with attendance of less than 65 and more than 50% shall be condoned by VC on the recommendation of HODs on genuine grounds, will be permitted to appear for the regular examination on payment of the prescribed condonation fee.

8.4 **Detained students for want of attendance:** Students who have earned less than 50% of attendance shall be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion of final semester of the course, by paying the fee for the break of study as prescribed by the University from time to time.

8.5 **Transfer of Students and Credits:** The strength of the credits system is that it permits inter Institutional transfer of students. By providing mobility, it enables individual students to develop their capabilities fully by permitting them to move from one Institution to another in accordance with their aptitude and abilities.

8.5.1. Transfer of Students is permitted from one Institution to another Institution for the same program with same nomenclature, provided, there is a vacancy in the respective program of Study in the Institution where the transfer is requested.

8.5.2. The marks obtained in the courses will be converted into appropriate grades as per the University norms

8.5.3. The transfer students are not eligible for Ranking, Prizes and Medals.

8.5.4. Students who want to go to foreign Universities up to two semesters or Project Work with the prior approval of the Departmental / University Committee are allowed to transfer of their credits. Marks obtain in the courses will be converted into Grades as per the University norms and the students are eligible to get CGPA and Classification.

9. EXAMINATION AND EVALUATION

9.1. EXAMINATION:

i) There shall be examinations at the end of each semester, for odd semesters in the month of October / November, for even semesters in April / May. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed courses in the subsequent examinations to be held in October / November or April / May.

ii) A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit / regulations prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.

iii) The results of all the examinations will be published through University Website. In the case of passed out candidates, their arrear results, will be published through University Website.

9.2 To Register for all subjects: Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination, except for the shortage of attendance programs. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

9.3. Marks for Continuous Internal Assessment (CIA) Examinations and End Semester Examinations (ESE) for theory subjects

9.3.1 There shall be no passing minimum for Continuous Internal Assessment (CIA) Examinations.

9.3.2 For End Semester examination, passing minimum shall be 40% (Forty Percentage) of the maximum marks prescribed for the Course/Practical/Project and Viva-Voce.

9.3.3 In the aggregate (CIA and ESE) the passing minimum shall be of 40%.

9.3.4. He / She shall be declared to have passed the whole examination, if he/she passes in all the courses wherever prescribed in the curriculum by earning 160 CREDITS

10. QUESTION PAPER PATTERN FOR END SEMESTER EXAMINATION

SECTION – A	10 questions 10 X 2 = 20 Marks
SECTION – B	5 questions either or pattern X 16 = 80 Marks
	Total 100 Marks

11. SUPPLEMENTARY EXAMINATION: Supplementary Examinations are conducted for the students who appeared in the final semester examinations. Eligible criteria for appearing in the Supplementary Examinations are as follows:

11.1. Eligibility: A Student who is having a maximum of two arrear papers is eligible to appear for the Supplementary Examination.

11.2. Non-eligibility for those completed the program: Students who have completed their Program duration but having arrears are not eligible to appear for Supplementary Examinations.

12. RETOTALLING, REVALUATION AND PHOTOCOPY OF THE ANSWER SCRIPTS:

12.1. Re-totaling: All UG Students who appeared for their Semester Examinations are eligible for applying for re-totaling of their answer scripts.

12.2. Revaluation: All current batch Students who have appeared for their Semester Examinations are eligible for Revaluation of their answer scripts. Passed out candidates are not eligible for Revaluation.

12.3. Photocopy of the answer scripts: Students who have applied for revaluation can download their answer scripts from the University Website after fifteen days from the date of publication of the results.

13. THE EXAMINATION AND EVALUATION FOR MOOCS will be as per the requirements of the regulatory bodies and will be specified at the beginning of the Semester and notified by the university NPTEL-SWAYAM Coordinator (SPOC).

14. CLASSIFICATION OF SUCCESSFUL STUDENTS

General, Foundation, Core Subjects, Humanities Science Courses, Electives Courses, Practical, Internship and Project: Successful Students passing the Examinations and securing the marks

a) CGPA 9.00 to 10.00 shall be declared to have passed the examination in **First class with Outstanding**.

b) CGPA 7.50 to 8.99 shall be declared to have passed the examination in **First class with distinction**.

c) CGPA 6.00 to 7.49 shall be declared to have passed the examination in **First Class**.

d) CGPA 5.00 to 5.99 in the aggregate shall be declared to have passed the examination in the **SECOND** Class.

e) CGPA 4.00 to 4.99 shall be declared to have passed the examination in the **THIRD** Class.

15. MARKS AND GRADES: The following table shows the marks, grade points, letter grades and classification to indicate the performance of the student:

15.1 Computation of Grade Point Average (GPA) in a Semester, Cumulative Grade Point Average (CGPA) and Classification

GPA for a Semester: = ∑iCiGi ÷ ∑iCi That is, GPA is the sum of the multiplication of grade points by the credits of the courses divided by the sum of the credits of the courses in a semester.

Where, Ci= Credits earned for course i in any semester,

Gi = Grade Points obtained for course i in any semester

n = Semester in which such courses were credited.

CGPA for the entire programme: = ∑n∑iCniGni ÷∑n∑iCni That is, CGPA is the sum of the multiplication of grade points by the credits of the entire programme divided by the sum of the credits of the courses of the entire programme

Grade Conversion Table - UG			
Range of Marks	**Grade Points**	**Letter Grade**	**Description**
90 - 100	10	O	Outstanding
82 - 89	9	A+	Excellent
75 - 81	8	A	Very Good
67 - 74	7	B+	Good
60 - 66	6	B	Above Average
50 - 59	5	C	Average
40 - 49	4	D	Minimum for pass
0 - 39	0	RA	Reappear
		AAA	Absent

15.2. Letter Grade and Class CGPA

Overall Performance - UG		
CGPA	**GRADE**	**CLASS**
4.00 - 4.99	D	Third Class
5.00 - 5.99	C	Second Class
6.00 - 6.69	B	First Class

6.70 - 7.49	B+	
7.50 - 8.19	A	First Class with Distinction*
8.20 - 8.99	A+	
9.00 - 10.00	O	First Class - Outstanding*

- The students who have passed in the first appearance and within the prescribed semester of the UG Programme (Major, Allied and Elective courses only) are eligible.

16. RANKING

- Students who pass all the examinations prescribed for the Program in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking / Distinction.
- In the case of Students who pass all the examinations prescribed for the Program with a break in the First Appearance are only eligible for Classification.
- Students qualifying during the extended period shall not be eligible for RANKING.

17. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMS TO QUALIFY FOR A DEGREE

17.1. A Student who for whatever reasons is not able to complete the programs within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span = N + 2 years for the completion of programme)

17.2. In exceptional cases like major accidents and child birth an extension of one year considered beyond maximum span of time (Time Span= N + 2 + 1 years for the completion of programme).

18. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Academic Council with the approval of the Board of Management.

CURRICULUM

VELS INSTITUTE OF SCIENCE TECHNOLOGY & ADVANCED STUDIES, CHENNAI

B. TECH - NAVAL ARCHITECTURE & OFFSHORE ENGINEERING

Curriculum 2021-2022

Total Number of Credits: 160

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 1						
HSMC	21CBNA11	English for Engineers	3	0	0	3
BSC	21CBNA12	Engineering Physics – Mechanics of Solids	3	1	0	4
BSC	21CBNA13	Engineering Mathematics – 1	3	1	0	4
ESC	21CBNA14	Programming for Problem Solving	3	1	0	4
ESC	21PBNA11	Engineering Graphics & Design - Lab	2	0	3	3
BSC	21PBNA12	Physics Lab	0	0	3	1
ESC	21PBNA13	Programming for Problem Solving Lab	0	0	3	1
HSMC	21PBNA14	Communication Skills - Lab	0	0	3	1
MC	21MCNA11	Induction Program	-	-	-	-
Total			14	3	12	21

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 2						
BSC	21CBNA21	Engineering Chemistry	3	1	0	4
BSC	21CBNA22	Engineering Mathematics – II	3	1	0	4
ESC	21CBNA23	Marine Electrical Technology	3	1	0	4
MC	21MCNA21	Environmental Science and Engineering	2	0	0	2
BSC	21PBNA21	Chemistry Lab	0	0	3	1
ESC	21PBNA22	Marine Electrical Lab	0	0	3	1
ESC	21PBNA23	Marine Workshop Practices	0	0	6	2
HSMC	21SBNA21	Gender Sensitivity	2	-	-	-
Total			13	3	12	18

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 3						
BSC	21CBNA31	Engineering Mathematics – III	3	1	0	4
ESC	21CBNA32	Fluid Mechanics	3	0	0	3
ESC	21CBNA33	Strength of Materials	3	0	0	3
PCC	21CBNA34	Basic Ship Theory	3	0	0	3
PCC	21CBNA35	Thermodynamics and Marine Machinery	3	0	0	3
PCC	21PBNA31	Basics of CADD Software - Lab	0	0	3	1
ESC	21PBNA32	Strength of Materials - Lab	0	0	3	1
PCC	21PBNA33	Ship Design Calculation Drawing & Drafting I	0	0	3	1
HSMC	21SBNA31	Personality Development - I	2	0	0	2
HSMC	21SBNA32	Ethics and Human Values	2	0	0	2
Total			19	1	9	23

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 4						
ESC	21CBNA41	Theory of Structures	3	0	0	3
PCC	21CBNA42	Hydrodynamics, Resistance & Propulsion of Ships	3	0	0	3
PCC	21CBNA43	Strength of Ships	3	0	0	3
PCC	21CBNA44	Fundamentals of Offshore Structures	3	0	0	3
PCC	21PBNA41	Ship Design Software - Modelling & Analysis	0	0	3	1
PCC	21PBNA42	Ship Design Calculation Drawing & Drafting - II	0	0	3	1
PCC	21PBNA43	Marine Engineering Lab	0	0	3	1
PCC	21PBNA44	Ship In Campus - VISIT	0	0	3	1
HSMC	21SBNA41	Personality Development - II	2	0	0	2
MC	21MCNA41	Industrial Safety	2	0	0	2
Total			16	0	12	20

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 5						
PCC	21CBNA51	Ship Design	3	0	0	3
PCC	21CBNA52	Ship Production I	3	0	0	3
PCC	21CBNA53	Advanced Offshore Engineering	3	0	0	3
PCC	21CBNA54	Marine Materials and Metal Joining Techniques	3	0	0	3
PEC	21EBNA__	Professional Elective I	3	0	0	3
GEC	21GBNA__	Generic Elective I	2	0	0	2
PCC	21PBNA51	Seamanship and Fire Fighting Lab	0	0	3	1
PCC	21PBNA52	Ship Design Calculation Drawing & Drafting – III	0	0	3	1
PCC	21PBNA53	Ship Design Software - Structural Strength	0	0	3	1
EEC	21RBNA51	Ship Design Project - Phase - I	0	0	4	2
Total			17	0	13	22

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 6						
PCC	21CBNA61	Sea Keeping and Maneuvering	3	0	0	3
PCC	21CBNA62	Ship Structural Design and Vibration	3	0	0	3
PCC	21CBNA63	Offshore Structural Design	3	0	0	3
PCC	21CBNA64	Ship Production II	3	0	0	3
PEC	21EBNA__	Professional Elective II	3	0	0	3
GEC	21GBNA__	Generic Elective II	2	0	0	2
PCC	21PBNA61	Offshore Design Software	0	0	3	1
PCC	21PBNA62	Ship Design Calculation Drawing & Drafting – IV	0	0	3	1
EEC	21RBNA61	Ship Design Project - Phase - II	0	0	6	2
Total			17	0	12	21

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 7						
PCC	21CBNA71	Ship Conversion Technology	3	0	0	3
PCC	21CBNA72	Construction of Offshore Structures	3	0	0	3
PCC	21CBNA73	Finite Element Analysis	3	0	0	3
PCC	21CBNA74	Standards and Recommended Practices	3	0	0	3
PEC	21EBNA__	Professional Elective III	3	0	0	3
GEC	21GBNA__	Generic Elective III	2	0	0	2
EEC	21PBNA71	Shipyard Training	0	0	3	1
EEC	21RBNA71	Mini Project	0	0	6	2
Total			17	0	9	20

Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
SEMESTER 8						
PCC	21CBNA81	Port Design and Infrastructure	3	0	0	3
PEC	21EBNA__	Professional Elective IV	3	0	0	3
GEC	21GBNA__	Generic Elective IV	2	0	0	2
EEC	21RBNA81	Major Project / Industry Internship Project	0	0	*14	7
Total			8	0	14	15
*Students will be working on the project during non-class hours.						

LIST OF BASIC SCIENCE COURSES						
BSC	21CBNA12	Engineering Physics - Mechanics of Solids	3	1	0	4
BSC	21CBNA13	Engineering Mathematics – 1	3	1	0	4
BSC	21PBNA12	Physics Lab	0	0	3	1
BSC	21CBNA21	Engineering Chemistry	3	1	0	4
BSC	21CBNA22	Engineering Mathematics – II	3	1	0	4
BSC	21PBNA11	Chemistry Lab	0	0	3	1
BSC	21CBNA31	Engineering Mathematics – III	3	1	0	4

LIST OF ENGINEERING SCIENCE COURSES						
ESC	21CBNA14	Programming for Problem Solving	3	1	0	4
ESC	21PBNA11	Engineering Graphics & Design - Lab	2	0	3	3
ESC	21PBNA13	Programming for Problem Solving Lab	0	0	3	1
ESC	21CBNA23	Marine Electrical Technology	3	1	0	4
ESC	21PBNA12	Marine Electrical Lab	0	0	3	1
ESC	21PBNA13	Marine Workshop Practices	0	0	6	2
ESC	21CBNA32	Fluid Mechanics	3	0	0	3
ESC	21CBNA33	Strength of Materials	3	0	0	3
ESC	21PBNA32	Strength of Materials - Lab	0	0	3	1
ESC	21CBNA41	Theory of Structures	3	0	0	3

LIST OF PROFESSIONAL CORE COURSES						
PCC	21CBNA34	Basic Ship Theory	3	0	0	3
PCC	21CBNA35	Thermodynamics and Marine Machinery	3	0	0	3
PCC	21PBNA31	Basics of CADD Software - Lab	0	0	3	1
PCC	21PBNA33	Ship Design Calculation Drawing & Drafting I	0	0	3	1
PCC	21CBNA42	Hydrodynamics, Resistance & Propulsion of Ships	3	0	0	3
PCC	21CBNA43	Strength of Ships	3	0	0	3
PCC	21CBNA44	Fundamentals of Offshore Structures	3	0	0	3
PCC	21PBNA41	Ship Design Software - Modelling & Analysis	0	0	3	1
PCC	21PBNA42	Ship Design Calculation Drawing & Drafting - II	0	0	3	1
PCC	21PBNA43	Marine Engineering Lab	0	0	3	1
PCC	21PBNA44	Ship In Campus - VISIT	0	0	3	1
PCC	21CBNA51	Ship Design	3	0	0	3
PCC	21CBNA52	Ship Production I	3	0	0	3
PCC	21CBNA53	Advanced Offshore	3	0	0	3
PCC	21CBNA54	Marine Materials and Metal Joining Techniques	3	0	0	3
PCC	21PBNA51	Seamanship and Fire Fighting Lab	0	0	3	1
PCC	21PBNA52	Ship Design Calculation Drawing & Drafting – III	0	0	3	1
PCC	21PBNA53	Ship Design Software - Structural Strength	0	0	3	1
PCC	21CBNA61	Sea Keeping and Maneuvering	3	0	0	3
PCC	21CBNA62	Ship Structural Design and Vibration	3	0	0	3
PCC	21CBNA63	Offshore Structural Design	3	0	0	3
PCC	21CBNA64	Ship Production II	3	0	0	3
PCC	21PBNA61	Offshore Design Software	0	0	3	1
PCC	21PBNA62	Ship Design Calculation Drawing & Drafting – IV	0	0	3	1
PCC	21CBNA71	Ship Conversion Technology	3	0	0	3
PCC	21CBNA72	Construction of Offshore Structures	3	0	0	3
PCC	21CBNA73	Finite Element Analysis	3	0	0	3
PCC	21CBNA74	Standards and Recommended Practices	3	0	0	3
PCC	21CBNA81	Port Design and Infrastructure	3	0	0	3

LIST OF PROFESSIONAL ELECTIVE COURSES						
Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
PEC	21EBNA51	Marine Corrosion and Coating Engineering	3	0	0	3
PEC	21EBNA52	Subsea Engineering	3	0	0	3
PEC	21EBNA61	Marine Refrigeration and Air-conditioning	3	0	0	3
PEC	21EBNA62	High Performance Marine Vehicles	3	0	0	3
PEC	21EBNA71	Ship Trails	3	0	0	3
PEC	21EBNA72	Computational Fluid Dynamics	3	0	0	3
PEC	21EBNA81	Design of floating offshore structures	3	0	0	3
PEC	21EBNA82	Underwater Acoustics	3	0	0	3

LIST OF GENERAL ELECTIVE COURSES						
Category	Code	Title of Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
GEC	21GBNA51	Engineering Economics and Management	2	0	0	2
GEC	21GBNA52	Production and Project Management	2	0	0	2
GEC	21GBNA61	Total Quality Management	2	0	0	2
GEC	21GBNA62	Quality Control and Quality Assurance	2	0	0	2
GEC	21GBNA71	Health Safety and Environment Management	2	0	0	2
GEC	21GBNA81	Marine Pollution	2	0	0	2

LIST OF HUMANITARIAN SCIENCE AND MANAGEMENT COURSES						
HSMC	21CBNA11	English for Engineers	3	0	0	3
HSMC	21PBNA14	Communication Skills - Lab	0	0	3	1
HSMC	21SBNA21	Gender Sensitivity	2	-	-	-
HSMC	21SBNA31	Personality Development - I	2	0	0	2
HSMC	21SBNA32	Ethics and Human Values	2	0	0	2
HSMC	21SBNA41	Personality Development - II	2	0	0	2

LIST OF EMPLOYABILITY ENHANCEMENT COURSES						
EEC	21RBNA51	Ship Design Project - Phase - I	0	0	4	2
EEC	21RBNA61	Ship Design Project - Phase - II	0	0	6	2
EEC	21PBNA71	Shipyard Training	0	0	3	1
EEC	21RBNA71	Mini Project	0	0	6	2
EEC	21RBNA81	Major Project / Industry Internship Project	0	0	*14	7

LIST OF MANDATORY COURSES						
MC	21MCNA11	Induction Program	-	-	-	-
MC	21MCNA21	Environmental Science and Engineering	2	0	0	2
MC	21MCNA41	Industrial Safety	2	0	0	2

SYLLABUS

21CBNA11	English for Engineers	L- 3	T - 0	P- 0	C- 3

Course Objectives:
The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

- To acquire ability to speak effectively in real life situations.
- To write letters and reports effectively in formal and business situations.
- To develop listening skills for academic and professional purposes.
- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their career.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

Unit I: Vocabulary Building **9**
General Vocabulary – Nouns - Compound nouns, Word borrowing & Word making, foreign machinery in English, Dictionary and Thesaurus usages, Synonyms, Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.

Unit II Basic Writing **9**
Sentences structures – Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Word Links and Connectives, Summarizing, Precise writing, Paragraph Writing.

Unit III Identifying Common Errors in English **9**
Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives& Gerund

Unit IV Nature and Style of Sensible Writing **9**
Describing people, place and situations, Process description, Definitions, Numerical Expressions, Information Transfer- Flow chart Bar chart and Pie chart, Checklists, Writing introduction and conclusion.

Unit V Writing Practices **9**
Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Comprehension Passages.

Total Hours: 45

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

CO1	List out a wide range of technical vocabulary to interpret the professional texts with attention to ambiguity, complexity, and aesthetic value
CO2	Infer implied meanings of different genres of texts and critically analyze and evaluate them for ideas as well as for method of presentation.
CO3	Assess and write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO4	Infer meanings of different flow charts and bar charts and develop constructive paragraphs deriving possible information to be obtained from them.
CO5	Prepare letters to officials and to the editor in formal and official context

Textbooks:

1. ’English for Scientists, Prof.K.R. Lakshminarayanan, Former Head, Department of Humanities and Social sciences, Sri Venkateshwara College of Engineering, Pennalur, Sriperumbudur, Tamilnadu SCITECH PUBLICATIONS (INDIA PVT.LTD)2014
2. Department of English, Anna University, Mindscapes, ‘English for Technologists and Engineers’, Orient Longman Pvt. Ltd, Chennai: 2012.
3. Department of Humanities and Social Sciences, Anna University, ‘English for Engineers and Technologists’ Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
4. Department of English, Anna University, Mindscapes, ‘English for Technologists and Engineers’, Orient Longman Pvt. Ltd, Chennai: 2012.
5. Department of Humanities and Social Sciences, Anna University, ‘‘English for Engineers and Technologists’’ Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
6. M.Ashraf Rizvi, “Effective Technical Communication”, Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

Suggested Readings:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

21CBNA12	Engineering Physics – Mechanics of Solids	L- 3	T - 1	P - 0	C - 4

Course Objectives:
The objective of this course is to familiarize the prospective engineers with the fundamental concepts of kinematics of Solid Objects.

Unit I: Vector mechanics of particles **12**
Transformation of scalars and vectors under Rotation transformation- Forces in Nature - Newton's laws of motion - Euler's laws of motion -work-energy theorem- Conservative and non-conservative Forces- Elastic collision in one dimension and inelastic collision- Conservation of angular momentum – non-inertial frames of reference - Five-term acceleration formula -Foucault pendulum- Harmonic oscillator- Damped harmonic motion- Forced oscillations and resonance

Unit-II Kinematics **12**
Definition and motion of a rigid body in the plane- - law of conservation of linear momentum and its applications - Equilibrium of concurrent forces – triangle law, parallelogram law and Lami's theorem – experimental proof - Uniform circular motion – angular velocity – angular acceleration – relation between linear and angular velocities- Work done by a constant force and a variable force

Unit-III: Planar rigid body mechanics **12**
Rotational motion of rigid bodies- Equations of rotational motion - Rotational kinetic energy and moment of inertia of a rigid body - radius of gyration – Theorems of moment of inertia: parallel axes theorem and perpendicular axes theorem- Moment of force- angular momentum of a rigid body- Relation between torque and angular momentum

Unit IV: Statics **12**
Free body diagrams with examples on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions-moment of a force-clockwise and anti-clockwise moments-Principle of moments- couple Torque acting due to a couple–experimental determination of mass of the given body using principle of moments.

Unit V: Mechanics of solids **12**
Concepts of elasticity and plasticity- Stress-strain curve - Hooke's law- Experimental verification of Hooke's law- Poisson's ratio - modulus of elasticity and the relation between them – Expression for bending moment – Experiment to find Young's modulus uniform and non-uniform bending - Application of normal stress and strains: Homogeneous and composite bars having uniform and stepped sections subjected to axial loads and thermal loads

Total Hours: 60

Course Outcomes:
After successful completion of the course, the student will be able to
CO 1: Demonstrate the fundamental concepts of kinematics.
CO 2: Identify the vector mechanics of particles in five-term acceleration equation.
CO 3: Apply the rotational equations of motion in rigid bodies.
CO 4: Analyze the free body diagram and their applications.
CO 5: Examine the stress-strain curve of the solid materials.

Reference books:

1. Engineering Mechanics, 2nd ed. — MK Harbola
2. Introduction to Mechanics — MK Verma
3. An Introduction to Mechanics — D Kleppner & R Kolenkow
4. Principles of Mechanics — JL Synge & BA Gri_ths
5. Mechanics — JP Den Hartog
6. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
7. Theory of Vibrations with Applications — WT Thomson
8. An Introduction to the Mechanics of Solids, 2nd ed — SH Crandall, NC Dahl & TJ Lardner
9. Engineering Mechanics: Statics, 7th ed. — JL Meriam
10. Engineering Mechanics of Solids — EP Popov

21CBNA13	Engineering Mathematics – I	L - 3	T- 1	P - 0	C- 4

Course Objectives:
The objective of this course is to familiarize the prospective engineers with techniques in calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

UNIT I: Calculus: **12**
Evolutes and involutes--Evaluation of definite and improper integrals- Beta and Gamma functions and their properties

UNIT II: Calculus: **12**
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders-indeterminate forms and L'Hospital's rule.

UNIT III: Sequences and series: **12**
Convergence of sequence and series, tests for convergence- Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT IV: Multivariable Calculus (Differentiation): **12**
Limit, continuity and partial derivatives, directional derivatives, total derivative- Tangent plane and normal line- Maxima, minima and saddle points- Method of Lagrange multipliers.

UNIT V: Matrices **12**
Introduction to matrix and rank of a matrix-System of linear equations- Symmetric, skew- symmetric andorthogonal matrices-Eigenvalues and eigenvectors- Diagonalization of matrices-Cayley-Hamilton Theorem and Orthogonal transformation.

Total Hours: 60

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

CO1 Introduce the idea of applying differential and integral calculus to notions of curvature and to improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.
CO2 Introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO3 Develop the tool of power series for learning advanced Engineering Mathematics.
CO4 Familiarize the student with functions of several variables that is essential in most branches of engineering.
CO5 Develop the essential tool of matrices in engineering.

Textbooks:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002
2. Ramana B . V ., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11

Reference Books:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

21CBNA14	Programming for Problem Solving	L - 3	T - 1	P - 0	C - 4

Course Objectives:

- To understand the basic concepts of programming – Flow chart, Pseudo code.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.
- To understand the concepts of arrays, basic sorting and searching algorithms**.**
- To find the order of time complexity of basic algorithms

Unit 1: Introduction to Programming **12**

Introduction to Programming (Flow chart / pseudo code, compilation etc.), Variables (including data types) -Arithmetic expressions and precedence, Conditional Branching and Loops - Writing and evaluation of conditionals and consequent branching Iteration and loops

Unit 2: Arrays and Basic Algorithms **12**

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

Unit 3: Function and Pointers **12**

Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers - Defining pointers, Use of Pointers in self-referential structures

Unit 4: Structures and Unions **12**

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation

Unit 5: String Functions and Files **12**

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Preprocessor directives, use of typedef, Command line arguments, Enumerated data types.

Total: 60 hrs

Course Outcomes:

After successful completion of the Programming for Problem Solving course, the student will be able to

CO1	Understand the principles of algorithm, flowchart and pseudo code
CO2	Find the order of time complexity of algorithms
CO3	Understand programs involving control instructions, arrays, structures and unions.
CO4	Utilize the string manipulations, and to write functions for various applications using C programming constructs.
CO5	Apply the file operations in ‘C’ programming

Textbooks:

1. Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill
2. E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill

References:

1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall of India
2. Yashavant Kanetkar, “Let Us C”, BPB Publications
3. Ashok.N.Kamthane, “Computer Programming”, Pearson Education (India)

21PBNA11	Engineering Graphics and Design	L - 2	T - 0	P - 3	C - 3

Course Objectives:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products
- To expose them to existing national standards related to technical drawings.

Concepts And Conventions (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

Unit I Introduction to Engineering Drawing and Plane Curves 9

Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. Scales – Plain, Diagonal and Vernier Scales.

Unit Ii Projection of Points, Lines and Plane Surfaces 9

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes - Auxiliary Planes

UNIT III Projection of Solids 9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method - Auxiliary Views

UNIT IV Section of Solids and Development of Surfaces 9

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section - Auxiliary Views. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V Orthographic Projection and Isometric Projection 9

Free hand sketching: Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones

Total Hours: 45

Course Outcomes

After successful completion of the course, the student will be able to

CO1 Develop special curves and sketch by free hand orthographic views

CO2 Understand and draw the projections of points, straight lines and planes

CO3 Sketch the projections of simple solids like prisms, pyramids, cylinder and cone

CO4 Develop lateral surfaces of the uncut and cut solids

CO5 Develop the perspective projection of simple solids, truncated prisms, pyramids, cone and cylinders and sketch the isometric projection

Textbooks:

1. N.D. Bhatt, “Engineering Drawing” Charotar Publishing House, 46th Edition, (2003).

References:

1. K. V. Natrajan, “A textbook of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, “Engineering Graphics”, D.D. Publications, (2007).
3. K. Venugopal & V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education (2005).
5. K. R. Gopalakrishnana, “Engineering Drawing” (Vol.I&II), Subhas Publications (1998). 6. Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited (2008).

21PBNA12	Physics Lab	L- 0	T- 0	P - 3	C- 1

Course Objectives:

The Physics laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering.

List of Experiments:

1. Spectrometer –Dispersive Power of prism
2. Spectrometer – Grating
3. Semiconductor Laser – To find Wavelength and particle size.
4. Ultrasonic Interferometer
5. Torsional Pendulum
6. Hooke's Law
7. Compound pendulum- To determine 'g'
8. Newtons' Ring
9. Air wedge
10. Bifilar Pendulum

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Examine the dispersive power of the prism using spectrometer.
CO2	Estimate the formation of Newton's rings in the air-film in between a plano-convex lens.
CO3	Calculate the wavelength and particle size of semiconductor diode laser.
CO4	Measure the velocity of ultrasonic waves and compressibility of the liquid using ultrasonic interferometer.
CO5	Calculate the gravity g at that place and the radius of gyration.

21PBNA12	Programming for Problem Solving Lab	L - 0	T - 0	P - 3	C - 1

Course Objectives:
To design and develop C Programs for various applications

List of Experiments:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. Recursive functions
11. Pointers and structures
12. File operations

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Understand the Programming Environment
CO2	Develop programs using various control instructions and operator precedence in C Programming.
CO3	Apply the string manipulations, arrays and functions for various applications in C.
CO4	Analyze the use of structures, unions and pointers in C
CO5	Utilize the various file operations in C

21PBNA13	Communication Skills	L- 0	T - 0	P - 3	C - 1

Course Objectives:

- This course is to subject the students to practice the diverse components of skill development in various units.
- To make students ready for placement interviews
- To infuse confidence and to assimilate social skills for the workplace betterment.

List Of Exercise

1. Listening comprehensions
2. Pronunciation,
3. Phonology, Intonation,
4. Stress and Rhythm,
5. Situational Dialogues,
6. Communication in workplace,
7. Interviews,
8. Seminar,
9. Formal Presentations,
10. Group Discussions,
11. Debates,
12. JAM sessions

Total hours: 30

Course of Outcomes:

After successful completion of the course, the student will be able to

CO1 Use appropriate communication strategies for enhancing interpersonal relationship.
CO2 Apply soft skills in personal, social and corporate life
CO3 Articulate knowledge of chosen profession and corporate skills effectively in interviews with appropriate body language
CO4 Demonstrate active group discussion and presentation skills such as initiating a conversation, exchanging ideas, expressing dissent or agreement and giving persuasive presentation.
CO5 Prepare job applications, various letters, abstract and summary for technical articles.

Suggested Readings:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

21CBNA21	Engineering Chemistry	L - 3	T - 1	P - 0	C - 4

Course Objectives

- To learn about the molecular orbitals, ionic interactions and periodic properties.
- Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

UNIT Atomic molecular structure, Intermolecular forces and potential energy surfaces 12

Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN.

UNIT II Spectroscopic techniques and applications 12

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Diffraction and scattering

UNIT III Use of free energy in chemical equilibria 12

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

UNIT IV Periodic properties 12

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT V Organic reactions and synthesis of a drug molecule 12

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Total Hours: 60

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Explain the relation between the intermolecular forces, present within a substance and the temperatures associated with changes in its physical state.
CO2	Apply formalisms based on molecular symmetry to predict spectroscopic properties.
CO3	Determine and understand the operation of electrochemical systems for the production of electric energy, i.e., batteries and fuel cells.
CO4	Explain general corrosion in terms of electrochemistry
CO5	Explain the arrangement of elements in the periodic table and relate the arrangement to electronic configuration, bonding and properties.
CO6	Prove various types of reaction and its mechanism in drug development

Text Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

Reference Books

1. Physical Chemistry, by P. W. Atkins.
2. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp.

21CBNA22	Engineering Mathematics – II	L - 3	T - 1	P - 0	C - 4

Course Objectives:
The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

UNIT 1: Basic Probability: 12
Probability spaces- conditional probability- Independence- Bayes'rule- Discrete random variables- Continuous random variables- Expectation of Discrete Random Variables-Continuous Random variables.

UNIT 2: Continuous Probability Distributions: 12
Discrete Distributions-Binomial, Poisson, Geometric-Continuous Distribution-Normal, Uniform, Exponential and gamma densities.

UNIT 3: Bivariate Distributions: 12
Bivariate distributions and their properties-Covariance- Correlation and Regression Analysis

UNIT 4: Basic Statistics: 12
Measures of Central tendency: Mean, Median and Mode- Measure of Dispersion- Range, Standard Deviation and coefficient of variation- Moments Skewness and Kurtosis (Simple Problems)

UNIT 5: Applied Statistics: 12
Introduction to Large and small sample – t-test-Single mean, difference of means, and Paired t-test. Small samples: Test for single mean, difference of means-F-test- Chi-square test for goodness of fit and independence of attributes.

Total Hours: 60

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

CO1	The students will have a fundamental knowledge of the concepts of probability.
CO2	Knowledge of standard distributions which can describe real life phenomenon.
CO3	The notion of sampling distributions and statistical techniques used in engineering
CO4	Use appropriate statistical methods in the analysis of simple datasets
CO5	Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries

Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
5. N.P. Bali and Manish
6. Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
8. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

21CBNA23	Marine Electrical Technology	L - 3	T - 1	P - 0	C- 4

Course Objectives:
To develop student's ability to understand electrical motors, starters, switch boards, electrical installations and safety devices, ac generator active and reactive load sharing, generator synchronizing procedure, understand principle of 3 phase alternating voltage generation on board the ship.

UNIT I DC Circuits and AC Circuits: 12
DC Circuits - Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, AC Circuits - Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT II AC Motors, Starters and Generators 12
Understand the Principle of operation of a direct on-line starter (DOL) starter, Star delta starter, autotransformer starter, Understand the need and means for motor protection. AC Motors Understand the construction and characteristics of a squirrel cage induction motor Understand the principle of operation of a single-phase motor. Understand the construction and principle of operation of a three-phase ac generator, ac regulation on ac generator, ac generator active and reactive load sharing, generator synchronizing procedure (SIMULATOR).

UNIT III DC Generator 12
Understand the construction and principle of operation of a dc generator. Dc Motor-Understand the construction and operation of dc motor. Ship Lightning-Understand different types of lightings installed onboard ships. 3 Phase Ac System-Understand principle of 3 phase alternating voltage generation.

UNIT IV Transformers and Switch Board 12
Transformers - Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Autotransformer and three-phase transformer connections. Switch Board - Understand the function of the main switchboard, need and methods ac system protection. Neutral System Understand the types of neutral systems and earth fault. Emergency Supplies-The operation and maintenance of commonly used batteries on board ship. The operation of the emergency generator. Insulation Resistance-Understand insulation resistance measurement.

UNIT V Electrical Installations and Safety 12
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup**, U**nderstand hazards of live electrical systems and safe electrical practice. Fuse protection, general maintenance. Instrumentation -Temperature, Pressure, Torque, Rpm measuring devices – methods working principles.

Total hours: 60

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

CO1	Know the basics of DC and AC Circuits
CO2	Demonstrate the principles and operations of AC motors and starters. List out the functions of AC generator operators & procedure
CO3	Demonstrate the construction of DC generator & 3 Phase Alternate Voltage. Classify the different types of lightings installed onboard
CO4	Understand the working principle of Transformers. Explain the concept of switch boards operation and maintenance principle
CO5	Explain the installation procedure and its safety on board

Textbooks / Reference Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
6. Elstan A. Fernandez, Marine Electrical Technology, SPD Publishers, 4th Edition, 2008.
7. John C. Payne, "The Marine Electrical and Electronics Bible" Sheridon House Inc. 2001

21CBNA24	Environmental Science and Engineering	L - 2	T - 0	P - 0	C - 2

Course Objectives:

- To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
- The student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.
- The role of government and non – governmental organization in environmental managements.

UNIT I Environment, Ecosystem and Biodiversity **6**

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.

UNIT IIEnvironmental Pollution **6**

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management: - Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides.

UNIT III Natural Resources **6**

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.

UNIT IV Social Issues and The Environment **6**

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V Human Population and The Environment **6**

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Understand the concept of ecosystem, biodiversity, constitutes the environment and the precious resources available and how to conserve natural resources and the relationship between living and non-living things and ethics

CO2 Analyze the different types of pollution and their causes, effect and control measures and the role of a human being in maintaining a clean environment exposure.

CO3 Analyze the uses of available natural resources and the effect of over exploitation and deforestation, equitable use of resources for sustainable development and role of individual for conservation of resources.

CO4 Create awareness; understand the role of non-governmental organization for sustainable development and their importance, effects and the different laws for environmental protection.

CO5 Create awareness about human population in worldwide and their causes effect and role of information technology on control measures for sustainable lifestyle.

Text Books

1. De AK, Environmental Chemistry, Wiley Eastern Ltd.
2. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.
3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

Reference Books

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
2. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
3. Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs.
4. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs.

21PBNA21	Chemistry Lab	L - 0	T - 0	P - 3	C -1

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

Choice of 10-12 experiments from the following

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of Minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Total Hours: 30

Course Outcome

After successful completion of the course, the student will be able to

CO1 Estimate the rate constants of reactions, freezing point depression and partial coefficient of immiscible liquids.

CO2 Develop a small drug molecule and analyze a salt sample.

CO3 Find the viscosity and partition coefficient of a substance.

CO4 Determine the saponification value of an oil

CO5 Determine the cell constant and conductance of solutions

Textbooks

1. S. Sundaram and K. Raghavan “Practical Chemistry”, S. Viswanathan. Co. 3rd edition 2011.
2. Gnanaprakasam, Ramamurthy, “Organic Chemistry Lab Manual” S. Viswanathan Pvt. Ltd. 3rd edition 2011

Reference Books

1. Vogel’s – “Textbook of qualitative organic Analysis”, Longmann, 12th edition, 2011
2. J. N. Gurtu and R. Kapoor “Advanced experimental Chemistry”, S. Chand and Co. 6th edition, 2010

21PBNA22	Marine Electrical Lab	L - 0	T - 0	P - 3	C - 1

Course Objectives:

To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.

List of Laboratory Experiments/Demonstrations:

1. Testing of continuity, insulation and grouping of coils of AC and DC Motors.
2. Speed control of DC motors by armature and field control.
3. Connecting a three phase Induction Motor with DOL starter and measurement of power and speed.
4. Study of constant current and voltage source and current source.
5. Measurement single phase power using wattmeter.
6. Wiring of TPN switch, fuse units for circuits of three phase four wire system load.
7. Energy measurement by single phase Energy meter.
8. Load test on DC shunt generator.
9. Study of single phase and three phase transformers.
10. Open circuit characteristics of DC generator.

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Study different meters and instruments for measurement of electrical quantities
CO2	Understand the Dc motor connection, source and power
CO3	Study the single phase and three phase transformers
CO4	Study the circuit of DC generator
CO5	Understand the Characteristics of DC motor and AC motor

21PBNA23	Marine Workshop Practices	L - 0	T - 0	P - 6	C - 2

Course Objectives:

- To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
- To study Arc welding drawings for making common weld joints as per the given dimensions.
- To study Gas Welding for making common metal parts/components as per the given dimensions.

UNIT I Grinding and Lathe Work **9**

Grinding tools familiarization – Checking of angles with tool angle gauge – Grinding of cutting tools - Grinding of welded joints. Straight Turning – Step Turning -Taper Turning – Thread cutting on Lathe

UNIT II Shaping and Drilling **9**

Familiarization of shaping machine – Tools employed in shaping – Shaping a specimen – Machine Drilling – Hand Tapping of threads

UNIT III Fitting 9

Round bar by chipping and filing, Male-Female V- fitting, T-Fitting, dove tail fitting, square fitting, H fitting, outside calipers of given dimensions.

UNIT IV Arc Welding **9**

Bead building – Closed Butt joint – Square Butt Joint – Single Vee Butt Joint – Single Bevel Butt Joint – T Joint – Lap Joint – Outside corner joint – Fillet joint (Flat) – Horizontal Butt Joint – Horizontal Filet joint – Vertical Butt Joint – Vertical Fillet joint

UNIT V Gas Welding & Gas Cutting **9**

Gas Welding: Butt joint, Fillet joint – Vertical up Fillet
Gas Cutting: Round cutting, Beveling

Total Hours: 45

Course Outcomes:

After successful completion of the Engineering Practices Laboratory course, the student will be able to

CO1 Understand the different types of woods used and tools used in Grinding and Lathe machine

CO2 Develop knowledge of basic concepts of shaping and drilling

CO3 Experiment with different types of tools used in fitting technology.

CO4 Utilize the hands-on experience in various Arc Welding

CO5 Demonstrate with the various Gas Welding and Gas cutting

21SBNA21	Gender Sensitivity	L - 2	T - 0	P - 0	C - 0

Course Objectives:

- To provide an overview of gender sensitivity
- To provide basic understanding about contemporary gender related perspectives

Unit 1: Fundamentals of gender sensitivity **6**

Gender: definition, nature, evolution, cultural, traditional and historical perspective

Unit 2: Gender Spectrum **6**

Gender: An overview of Biological, sociological and psychological conditioning

Unit 3: Division of labour **6**

Gender based division of labour-domestic work and use value;

Unit 4: Gender-Contemporary perspective **6**

Gender justice and human rights, international perspective, constitutional and legal perspectives, Gender, Human Rights and Parity (parallel progress of both genders)

Unit 5 Media and emerging issues in gender **6**

Print and Electronic Media and Gender Inequalities; Gender-Emerging issues and challenges; Case study on real life gender issues

Total Hours: 30

Course Outcomes:

At the end of the course the student will be able to:

CO1 Identify the fundamental principles of gender sensitivity
CO2 Explain the about the various general spectrum
CO3 Discuss about the division of labor
CO4 Explain the contemporary perspectives of gender sensitivity
CO5 Evaluate the knowledge on justice, human rights and legal perspectives

Text Book

1. Raja Lakshmi Kalyani et al. 2017. Gender Sensitization. Himalaya Publishing House

Reference Book

1. Gender, school and society - b. Ed 2nd year book (English, paperback, dr. S.c. Oberoi), Laxmi Publishers

21CBNA31	Engineering Mathematics – III	L - 3	T - 1	P - 0	C - 4

Course Objectives:
To develop students' ability to solve problems using Fourier series, Laplace transform, partial differential equations, numeric methods, numerical differentiation and integration, Trapezoidal and Simpsons rule and their engineering applications in ship design calculations.

UNIT I Fourier Series **12**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT II Fourier Transform **12**
Fourier integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III Partial Differential Equations **12**
Formation of partial differential equations - singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous functions.

UNIT IV Application of Partial Differential Equations **12**
Classification PDE-Method of separation of variables – One dimensional wave and heat equation – Steady state solution of two-dimensional heat equation (square plate only)

UNIT V Z -TRANSFORM AND DIFFERENCE Equations **12**
Z-transform –Introduction- properties – Inverse Z-transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

Total Hours: 60

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

CO1 Develop Fourier series for different types of functions.
CO2 Define and determine Fourier Transform.
CO3 Derive and obtain the solution of wave, heat equation
CO4 Solve problems of Fourier series and Fourier transforms used in engineering applications.
CO5 Know the z-transforms and its properties

Text Books:

1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi,43rd Edition, 2013.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th reprint,2008.
3. Sivaramakrishna Das.P & Vijayakumari.C , A Text book of Engineering Mathematics-III

Reference Books:

1. Bali.N.P. and Manish Goyal 'A Textbook of Engineering Mathematics', Laxmi Publications, 9th edition,2011.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition, 2011.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education ,3rd Edition, 2012.
4. Transforms and partial differential equations- A.Singravelu

21CBNA32	Fluid Mechanics	L - 3	T - 0	P - 0	C - 3

Course Objectives:
To develop student's ability to understand fundamentals of fluid mechanics, fluid motion, equation of motion, Newton's law of fluid friction, laminar and turbulent flow, various types of pumps, friction coefficient, continuity equation etc.

UNIT I Properties of Fluids **9**
Properties of fluids – ideal fluid – actual fluid – fluid pressure, **s**tates of fluids – Euler's equilibrium conditions – constant velocity rotation around a fixed axis – forces on walls of container – surface tension – atmospheric equilibrium

UNIT II Fluid motion **9**
Fluid in motion – one dimensional flow – continuity equation – Euler's equation – Bernoulli's equation – energy equation for unsteady flow, Generalized Bernoulli's equation – Newton's law of fluid friction – laminar flow – Poiseuille's flow – turbulent flow – Reynold's number – Prandtl's mixing length – friction coefficient

UNIT III Types of Pumps and Turbines **9**
Pumps & Turbines – Positive Displacement Pump - centrifugal pump – rotary pump - reciprocating pump – air vessels – roto dynamic pumps – velocity diagram - Impulse turbine – Pelton wheel – reaction turbine – Francis turbine – Kaplan turbine

UNIT IV Two- and Three-dimensional flow **9**
General theory of two- and three-dimensional flow – continuity equation – circulation – Stoke's integral theorem – sources – sinks – dipole – flow with circulation – potential flow – hydro dynamical lift – Kutta – Joukowski theorem

UNIT V Viscous Flow **9**
Pattaks motion - Balance of Momentum - Navier-Stokes Equation – Biot - Savart's law - cortex sheets - viscous flow - boundary theory - criterion for separation - turbulent boundary layer - airofoils - lift - drag - circulation - pressure distribution - cavitation.

Total hours: 45

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

CO1	Understand and analyze the properties of fluids for various equilibrium conditions
CO2	Applying the concepts and solving Bernoulli's equation for various flow
CO3	Examine the functioning of pumps and turbines
CO4	Understand the dimension flow fluids
CO5	Formulate various equation for viscous flow

Textbooks

1. K.L Kumar: Engineering Fluid Mechanics, Eurasia Publishing house, New Delhi
2. Dr. Jagdishlal: Hydraulic machines, Metropolitan book Co, Delhi.
3. Vallentine: Applied hydrodynamics, Butterworths, London.

Reference Books

1. Walther Kaufmanns: Fluid Mechanics, Tata McGraw – Hill publishing company Ltd.
2. Daugherty & Franzini – Fluid Mechanics with Engg. Application, International Student's edition McGraw Hill.

21CBNA33	Strength of Materials	L - 3	T - 0	P - 0	C - 3

Course Objectives: To develop student's ability to understand fundamentals of various types of loads and stresses on structure, bending of beams, principal stresses, triaxial state of stresses, strain energy, strain deformation, shear stresses, boundary conditions, etc.,

UNIT I Introduction **9**

Introduction-type of loads and stresses-definition of uni-axial, bi-axial and tri-axial state of stresses-displacements and deformations. Tension, Compression and Shear-uniaxial stresses-Hooke's law of material behaviors deformation, in stress direction -lateral deformation, Poisson's ratio-differential equation of displacement, boundary conditions-strain energy for uniaxial loading.

UNIT II Type of Stresses **9**

Biaxial tension and compression-stresses in thin-walled pressure vessels (cylindrical and spherical)-analysis of biaxial stresses-Mohr's circle for biaxial stresses, principal stresses for triaxial state of stress.

UNIT III Strain Energy **9**

Torsion of circular shafts-shear stresses, shear deformation, differential equation of the rotational displacement, strain energy.

UNIT IV Bending of Beams **9**

Symmetrical Bending of beams- shear force and bending moment diagrams assumption of the technical theory of bending, strain and stress distribution, linearized moment - curvature - relation, differential equation of deflection (2nd & 4th order). Boundary conditions, strain energy, oblique bending.

UNIT V Shear Stresses and Combined Loads **9**

Transverse shear-shear stress-simplified deformations due to shear stresses- differential equation of the additional deflection caused by transverse shear-strain energy. Combined loads-failures (fracture, yielding, loss of stability)-hypothesis of failure Stability of beams - types of equilibrium, Euler's theory of buckling, approx. Determination of Critical 1oad.

Total hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Understand the stresses acting on a object and its deformations
CO2	Applying the concepts and understand the different types of stresses acting on different objects
CO3	Examine the Strain energy using differential methods
CO4	Understand the bending principles of beams
CO5	Formulate various equation and solve combined load problems

Text Books

1. RS Khurmi, Strength of materials, S Chand & Company Ltd, New Delhi-110055.
2. Dr. H. J. Shah, S. B. Junnarkar, Mechanics of structures Vol.I, Charotar Publishing house, India.
3. Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Company (P) Ltd, New Delhi,2009

Reference Books

1. Timoshenko; Strength of Materials, East-West Publications 2004.
2. Popov, Engineering Mechanics of Solids, Prentice-Hall Publications.
3. Krishna Raju & Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications.

21CBNA34	Basic Ship Theory	L- 3	T - 0	P - 0	C - 3

Course Objectives:

To perceive knowledge about the basic ship structures, fundamental principle of the ship's theories and calculations about the hydrostatics, floating curves, static stability of ships and dynamic stability of ships.

UNIT -1: Introduction **9**

Historical review - ancient types of vessels (rafts, boats, and ships), the role of the ship in the ages of the great discoveries. 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.) , Some physical fundamentals-Archimedes principle, laws of floatation stability and trim, forces acting on a ship (static condition in waves and during launching) The ship's form-main dimensions.

UNIT – 2: Lines Plan and Hydrostatics **9**

Lines Plan – fairing process – table of offsets, Integration rules – Trapezoidal rule; Simpson's rules (1-4-1, 1-3-3-1 and 5-8-1 rule); 6 ordinate rules; Tchebycheff's rule; Areas, volumes and moments, Bonjean calculations and curves, sectional area curves, Hydrostatic calculations and curves. Buoyancy and weight of the ship

UNIT – 3: Basics of Ship Stability **9**

Introduction :- Potential energy and equilibrium; Stability of ships - stable and unstable conditions (including submerged vessels); Stability terms; Equi volume inclinations - shift of C.O.B. due to inclinations, C.O.B curve in lateral plane, metacenter, pro-meta center and metacentric radius, metacentric height, metacentric curve, surface of flotation, curve of flotation, righting moment and lever; Moments due to wind, shift of cargo, passengers, turning and non-symmetrical accumulation of ice; Effect of superstructure on stability.

UNIT – 4: Transverse Stability **9**

Transverse stability: - Form and weight stability – stability functions

Initial stability – GM0, GZ at small angles of inclinations, wall sided ships; Stability due to addition, removal and transference (horizontal, lateral and vertical) of weight, suspended weight and free surface of liquids; Stability while docking and grounding; Inclining experiment.

Large angle stability -Diagram of statical stability (GZ-curve), characteristic of GZ-curve, static equilibrium criteria; Methods for calculating the GZ-curve (Krylov, Prohaska, etc.); Cross curves of stability; Dynamical stability – diagram of dynamical stability, dynamical stability criteria.

UNIT – 5: Longitudinal and Damage Stability **9**

Longitudinal stability – trim, longitudinal metacentre, longitudinal centre of flotation, moment to change trim, trimming moment; trim calculations – addition, removal and transference of weight, change of density of water

Damage stability – deterministic and probabilistic approach. Stability in waves. Recommendations of classification societies and governmental authorities – Intact and damage stability rules.

Total Hours 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define about various types of ships, fundamentals of principles and ship's form
CO2	Demonstrate the fairing processes of lines plan, Simpson's rule and hydrostatic calculations
CO3	Evaluate the various conditions of ship stability, equilibrium, curves of floatation
CO4	Explain the statical and dynamic stability of the vessel
CO5	Develop the data of the longitudinal stability and damage stability

Textbooks:

1. Capt. H.Subramaniam, Ship Stability Vol- I, II and III, Vijaya Publications
2. Tupper, E.C.;Introduction to Naval Architecture, Butterworth-Heinemann, UK, 1998.

Reference Books:

1. Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
2. Rawson & Tupper; Basic Ship Theory

21CBNA35	Thermodynamics and Marine Machinery	L- 3	T - 0	P - 0	C - 3

Course Objectives:

The objective of this course is

- To provides basic knowledge about thermodynamics.
- To understand about concepts of heat transfer.
- To understand the heat flow direction. Provide the knowledge about marine engines.
- To classify the machineries in a ship
- To compare the various starting techniques of machineries
- To illustrate the cross-sectional views of the machineries and machineries room arrangement

Unit I: Basic Concepts **9**

Concept of Continuum, Comparison of microscopic and macroscopic approach, Path and point functions; intensive and extensive properties, specific quantities, Systems, Quasi static Process, reversible and irreversible Processes; Heat and work transfer; Zeroth law of thermodynamics – concept of temperature and thermal equilibrium.

Unit II: Law of Thermodynamics **9**

Concept of energy and various forms of energy; specific heats; first law applied to elementary processes, closed systems and control volumes, steady and unsteady flow processes, internal energy, enthalpy.
Heat reservoir, Source and Sink; Heat Engine, Refrigerator and Heat Pump; Statement of second laws, Carnot cycle and Reversed Carnot cycle, Clausius inequality, concept of entropy, entropy change for - pure substance, ideal gases, T-s diagrams; third law of thermodynamics, Available and non-available energy of a source Unit IV: Thermodynamics cycles
Air-standard Brayton cycle, Carnot vapor cycle, Rankine reheat cycle, ideal Rankine cycle, air standard Otto cycle, air-standard Diesel cycle, vapor-compression refrigeration cycle.

Unit III: Main Propulsion Machinery – 1 **9**

Marine diesel engines -general engine principles, Low speed and medium speed diesel engines, Fuels, fuel oil system, Scavenging and turbo charging. Starting and revising systems, controls and safety devices, Lubrication, Lubricants and lub oil systems, cooling systems torque and power measurement. Marine boilers types, fire tube and water, tube boilers, boiler arrangements, steam to steam boilers, double evaporation boilers, exhaust gas heat exchangers, auxiliary steam plant systems, exhaust gas boilers, composite boilers

Unit IV: Main Propulsion Machinery – 2 **9**

Marine Steam turbines -Types of turbines, compounding - reheat turbines, turbine construction, rotors, blades, casing, gland scaling, diagrams, nozzles, bearings etc. Lubrication systems, expansion arrangements, control, gearing operating procedure. Marine gas turbines - fundamentals of G.T, Structure of gas turbines, gearing, operational features, controls, gearing, combined cycles.

Unit V: Marine Auxiliary Machineries **9**

Marine Auxiliary machineries and controls, Air compressors, boilers, heat exchangers, cooling, evaporators, distillers, waste heat recovery systems, hot water, drinking water, cooling water and sea water systems. Fuel systems, lubricating oil system filters, coolers, centrifuges, purifiers and clarifiers. Bilge and Ballast systems - Sewage disposal, Oily water separator, incinerator, galley equipment, RO plant. Introduction to Marine pumps and piping - types, materials, colour coding etc. Rudder and steering gear, anti-roll devices.

Total :45 Hours

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Categorize the machineries and their functions
CO2	Compile the records of the machineries commissioning data and performance
CO3	Develop the machineries room arrangement
CO4	Explain the Lube Oil, Fuel Oil systems
CO5	Design the layout of an engine room

Text Books

1. Nag.P.K., “Engineering Thermodynamics”, 5thEdition, Tata McGraw-Hill, New Delhi, 2008
2. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010
3. Dr Savithri, Mukesh, Sakthivel, “Engineering Thermodynamics”, 1st Edition, ARS Publications, 2017
4. McGeorge,”MarineAuxiliary Machinery"7thedition, Butter Worths, London, 2001.
5. Harrington; Marine Engineering, SNAME Publications
6. Pounder,C.C.; Marine Diesel Engines, Newnen-Butterworths, London.
7. Khetagurov, M.; Marine Auxiliary Machinery and Systems, Peace Publishers, Moscow.

References:

1. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill
3. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, PrenticeHall of India Pvt. Ltd
4. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010
5. Taylor, D.A.; Introduction to Marine Engineering
6. Reed's Marine Engineering for Naval Architect
7. Marine Pumps and Piping Systems

21PBNA31	Basics of CADD Software	L - 0	T - 0	P - 3	C - 1

Course Objectives: To develop student's ability to understand and develop knowledge in CADD Software

List of Experiments

1. Introduction to CAD Software's
2. Basic AutoCAD Commands
3. Creating Sheet Size, Title Block and Scaling of drawing.
4. Working with different types of layers, line types.
5. Dimensioning, Text
6. Creating simple 2D objects
7. Creating simple Isometric drawings
8. 2D drawings Universal Coupling
9. 2D drawings Plumber block
10. Assembly of Universal Coupling

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define basic concepts of CADD software and their applications in naval industries
CO2	Explain about the drawing procedures, presentation and creation
CO3	Develop a sheet, block and scaling of 2D drawings
CO4	Create simple 2D objects and simple Isometric drawings
CO5	Design Assembly drawing of any shapes with 2D drawings images

Reference:

1. AutoCAD Manual 2010, Autodesk, Inc

21PBNA32	Strength of Materials Lab	L- 0	T - 0	P - 3	C - 1

Course Objectives:
The objective of this course is to have a practical knowledge of estimating the stresses and Strains under different loading

List of Experiments

1. Rockwell Hardness test
2. Brinell Hardness Test
3. Universal Testing Machine – Stress – Strain Curve
4. Torsion Test on Mild Steel rod
5. Impact Test – Izod and Charpy Test
6. Compression test on a coil spring

Total hours: 30

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

CO1	Analyze the hardness of materials through Rockwell Hardness
CO2	Compare the hardness of materials through Brinell Hardness Test
CO3	Examine the Universal Testing Machine
CO4	Inspect the torsion test
CO5	Determine the deformation using Izod and Charpy Test

Text Books

1. RS Khurmi, Strength of materials, S Chand & Company Ltd, New Delhi-110055.
2. Dr. H. J. Shah, S. B. Junnarkar, Mechanics of structures Vol.I, Charotar Publishing house, India.
3. Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Company (P) Ltd, New Delhi,2009

Reference Books

1. Timoshenko; Strength of Materials, East-West Publications 2004.
2. Popov, Engineering Mechanics of Solids, Prentice-Hall Publications.
3. Krishna Raju & Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications.

21PBNA33	Ship Design Calculation Drawing & Drafting – I (SDCADD-I)	L - 0	T - 0	P - 3	C -1

Course Objectives:

- To develop offset table from BSRA series
- To design lines plan and hydrostatic curves
- To make use of the offset table to find the hydrostatic properties

List of Exercises:

1. Ship Lines plan (Manual & Autocad)
2. Fairing of Lines
3. Generating Offset table
4. Bonjean Calculation
5. Calculation of Hydrostatic Parameters (Excel)
6. Hydrostatic Curves (Excel & Autocad)

Total Hours 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Define the significance of BSRA series, Offset tables and Lines plan

CO2 Interpret the BSRA series into an Offset table

CO3 Construct the Lines plan, hydrostatic curves by Manually and also using Software

CO4 Evaluate the hydrostatic parameters and Bonjean values

CO5 Compare the values of all the hydrostatic properties like volume, displacement etc.

Reference Books:

1. Lewis,E.U.; “Principles of Naval Architecture”, (2nd Rev.), SNAME, New Jersey, U.S.A.
2. Rawson & Tupper; Basic Ship Theory

18SBNA31	Personality Development I	L - 2	T - 0	P - 0	C - 2

Course Objectives

- To improve the interpersonal skills, soft skills, effective team player and analyze strength and weakness to meet their professional career.

UNIT I: Soft Skills I **6**

Introduction to Personality Development – Meaning-Features of personality=Dimensions of Personality=Determinants of Personality-Features and Traits- Components of self-concept-Barriers-Self analysis

UNIT II: Soft Skills II **6**

Importance of Soft Skills – First Impression-Work Place Requirements-Discipline-Cleanliness-Hygiene-general Appearance--Building Confidence—Concept of Thinking and Usage-Value of Time-Focus & Commitment.

UNIT III Soft Skills in Action **6**

Grooming – Attire – Understanding others- – Stability & Maturity Development – Strengths – Weakness –Opportunities-threats -Merits of SWOT Analysis-Components-how to convert weakness into strengths-Goal settings

UNIT IV Self Awareness and Self Esteem **6**

Definitions-Components of self-awareness-Developing Self-Awareness-Self-esteem-meaning-Steps to improve self esteem

UNIT V Self-Motivation **6**

Motivation –Meaning-Techniques of self-motivation-Motivation & goal setting – Motivation and emotion – Motivation at work.

Total: 30 Hours

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Develop the soft skills through personality features and get rid of barriers.
CO2	Build the basic characters such as cleanliness, hygiene and appearance.
CO3	Creating the soft skills in disciplinary actions.
CO4	Understand the concept of self-awareness and self esteem
CO5	Adapt Familiar with the self-motivation

References:

1. Personality Development and Soft Skills---Barun K Mitra, Oxford Publication
2. Seven habits of Higly Effective people – Stephen R. covey
3. Emotion, motivation and Self-regulation - Nathan C. Hall , McGill University, Canada, Thomas Goetz, University of Konstanz, Germany
4. http://www.emeraldgrouppublishing.com/
5. Psychology of Selfesteem – Nathaniel Branden, Nash (1st edition), Jossey-Bass (32nd anniversary edition

21SBNA32	Ethics and Human Values	L - 2	T - 0	P - 0	C - 2

Course Objectives:

- To understand the importance of engineering ethics
- To learn the various steps and ways to resolve the ethical issues in engineering design and practice
- To inculcate the importance of human values and practice them in personal and professional life

UNIT I–Introduction to professional ethics **6**

Definition of profession, engineering and professionalism, dimension of engineering, definition of ethics and moral values, types of ethics – business, personal and professional ethics. Engineering ethics – preventive ethics and aspirational ethics, aspirational ethics and professional characters of a good engineer-Case study: Space shuttle challenger and Columbia accidents

UNIT II –Moral reasoning and code of ethics **6**

Moral choices and ethical dilemmas, steps in resolving ethical dilemmas, right-wrong or better worse, moral decision making as design Code of ethics–engineering standards, importance of codes, abuse of codes, limitations of codes, ethical relativism, justification of codes

UNIT III –Moral frameworks and workplace responsibilities **6**

Determining the facts - known and unknown facts, weighing the importance of facts, rights ethics, duty ethics and utilitarianism. Utilitarian thinking–the cost-benefit approach, the act-utilitarian approach, the rule- utilitarian approach, virtue ethics, self-realization ethics, ethical egoism, Professional responsibilities and rights, confidentiality and conflicts of interests, whistle blowing, honesty and research integrity

UNIT IV –Ethical issues in engineering practice **6**

Analysis of issues in ethical problems - line drawing, flow charting, conflict problems, environmental ethics – engineering, ecology and economics, environmental moral frameworks, computer ethics – the internet and free speech, property, privacy and additional issues-An application of problem-solving methods; Bribery/Acceptance of gifts

UNITV – Human values **6**

Human Life: Concept of a successful life, happy life and a meaningful life. Harmony in Personal and Social Life, Creating a value-based work culture, Human values: Character, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, and Sense of responsibility, Empathy, Love, Compassion, Cooperation and Tolerance. New dimension of lobal Harmony: Democracy, Equality and Social Justice

Total: 30 Hours

Course Outcome

After the completion of the course, the students will be able to

CO1: Define ethics, its types and importance in engineering course

CO2: Explain ethical dilemmas, code of ethics of professional engineering societies

CO3: Identify various ethical theories and know the applications to engineering situations

CO4: Examine issues surrounding the engineer's duty and understand how computers have been used unethically

CO5: Classify dimensions of human values and its practice in personal and professional life.

TEXT BOOKS

1. Mike W Martin, Introduction to engineering ethics, 2nd edition, McGraw Hill Higher Education, New York, 2010
2. Charles B Fleddermann, Engineering ethics, 4th edition, Prentice Hall, NJ, 2012
3. Charles E Harris, Michael S Pritchard, Michael J Rabins, Engineering ethics – Concepts and Cases, 4th edition, Wadsworth, USA, 2009
4. R.R Gaur, R Sangal, G P Bagaria, A foundation course in human values and professional ethics, Excel books, New Delhi, 2010

21CBNA41	Theory of Structures	L - 3	T - 0	P - 0	C - 3

Course Objectives: To develop student's ability to understand structural calculation theories, analysis of stiffened plates, Pure bending plates, flexibility and stiffness matrices, ultimate strength concepts, design of Tubular members, design for dynamic loads, vibration of beams and shafts etc.

UNIT I Continuous beams and strain energy method **9**

Continuous beams - Chaperon's three-moment equation, Moment distribution method, Torsion of non-circular sections, shear center of simple cross sections. Strain energy method-principle of virtual work, flexibility method, stiffness method, strain energy and complementary energy, Castiglione's theorems. Introduction of theory of plasticity.

UNIT II Matrix methods **9**

The Matrix displacement approach, Introduction, Stiffness matrix of a bar, element subjected to Axial Force, Co-ordinate transformations, Global stiffness matrix, application to Pin-jointed frames, stiffness matrix of a beam element, application to continuous beams.

UNIT III Theory of thin plates **9**

Introduction to theory of thin plates, Pure bending of plates, small deflection analysis of laterally loaded plates, Boundary conditions, Naview solution, Lavy's` solution. Analysis of stiffened plates - orthotropic plate model and other methods. Design of plates for large deflections and permanent set - design of lifting structures such as cranes.

UNIT IV Design of tubular members **9**

Design of tubular members for pure and combined stress resultants - brief introduction to optimal member design. Design principles of tubular joints - punching shear and ultimate strength concepts fracture mechanics and fatigue.

UNIT V Design for dynamic loads **9**

Design for dynamic loads Vibrations of continuous systems - vibration of strings and rods - vibration of beams - vibration of shafts.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Define the shear force and bending moment diagram for Indeterminate structures
- CO2 Explain stiffness matrix for various problems
- CO3 Evaluate dynamic response for various systems
- CO4 Design the bending stress of the structures
- CO5 Develop the loads calculation and plot in the graph using software

TEXT BOOKS

1. Timoshenko & Young; Theory of structures, McGraw Hill Publications.
2. Ramamirutham, "Strength of materials", Dhanpat Rai publishing company (p) limited, new delhi, 17th edition, 2008.
3. Krishna Raju & Gururaja; Advanced Mechanics of solids and structures, Narosa Publications.

REFERENCE BOOKS

1. Reddy, C.S; Basic Structural Analysis, Tata-McGraw Hill Publications. Timoshenko & Young; Theory of plates, McGraw Hill Publications.
2. RD Blevins; Flow induced Vibrations, Van Nostrand Reinhold, 1990.
3. BC Gerwick, Jr. Construction of marine and offshore structures, CRC Press, 2000.
4. N Barltrop, Floating Structures, A Guide for Design and Analysis, OPL , 1998

21CBNA42	Hydrodynamic, Resistance & Propulsion of Ships	L - 3	T - 0	P - 0	C - 3

Course Objectives:

- To classify the functions of wave characteristics and kinematics
- To determine the value of resistance and types of resistance acting on ship
- To Interpret and assess the BSRA series and proving various types of resistance for ships
- To understand and design the propellers and its qualities

Unit-1 Marine Hydrodynamics 9

Classification of water waves, Wave Characteristics, Wave theories, Water particle kinematics, Wave deformation, Wave analysis, Wave forecasting methods, Wave forces – Morison equation, Wave currents and its classification, Scour and other effects of currents.

Unit-2 Components of ship resistance **9**

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

Unit-3 Determination of resistance **9**

Model testing and exploration, 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 multihull vessels, hovercrafts, hydrofoils, barges and convoy of barges. Air and wind resistance, Resistance of appendages, Added resistance in waves; Resistance in restricted waterways – resistance in shallow water, resistance in canals

Unit-4 Propeller as a thrust producing mechanism **9**

Historical development; Screw propeller – screw propeller geometry, sections, propeller drawing, construction details. Types of propellers and other propulsion devices, Propeller theories – Momentum theory, Blade element theory, Circulation theory. 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 and its effects and prevention.

Unit-5 Design of propellers **9**

Propeller families and series; Open water tests, Presentation of data, Kt-Kq diagrams, Design charts -Bp-δ, TJ PJ charts, Use of charts in propeller design and performance study; Selection of engines, diesel engine characteristics. Propeller strength Materials and their qualities, strength calculation. Model testing for resistance and propulsion – 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 Laws of comparison, open water diagram, self-propulsion tests.

Total Hours: 45

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

CO1 Classify the functions of wave characteristics and kinematics
CO2 Make use of model of ship determine the value of resistance and types of resistance acting on ship
CO3 Interpret and assess the BSRA series and proving various types of resistance for ships
CO4 Develop the design of propellers and its qualities
CO5 Develop the efficient design of ships by predicting the resistance and propulsion

Textbooks

1. Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
2. Barnaby K.; Basic Naval Architecture, Marine Propellers and Propulsion 2007, Second Edition, J S Carlton, Butterworth-Heinemann, ISBN: 978-07506-8150-6
3. Marine Powering Prediction and Propulsors by Neil Bose (2008), The Society of Naval Architects and Marine Engineers, ISBN: 0-939773-65-1.

Reference Books

1. Basic Ship Theory Vol II, Rawson and Tupper, Butterworth-Heinemann, 2001, ISBN0750653965
2. Principles of Naval Architecture: Ship Resistance & Flow by Lars Larsson & Hoyte C. Raven (2010), The Society of Naval Architects and Marine Engineers ISBN 978-0-939773-76-3
3. Practical Ship Design, DGM Watson, Elsevier Ocean Engineering Book Series 2002, ISBN: 0-08-042999-8
4. Practical Ship Hydrodynamics 2000, Volker Bertram, Butterworth-Heinemann, ISBN 0 7506 4851 1
5. Hydrodynamics in Ship Design 1957 Vol I, II, III, H E Saunders, The Society of Naval Architects and Marine Engineers
6. Hydrodynamics of High-Speed Vehicles 2005, OM Faltinsen, Cambridge University Press, ISBN-13 978-0-521-84568-7
7. Marine Hydrodynamics, Office of Naval Research Fluid Mechanics Program, MIT

21CBNA43	Strength of Ships	L - 3	T - 0	P - 0	C - 3

Course Objectives:

- To determine the various loads and framing arrangement of ship
- To determine the section modulus and scantling calculations
- To illustrate the basics of ship vibration and methods to determine the dynamic response
- To illustrate the basic understanding of transfer function and frequency domain analysis
- To evaluate the structural analysis and stiffening of plates

Unit-1 Introduction to functions and analysis of ship structures: 9

Functions of ship structure, the forces acting up on a ship at sea, static forces, dynamic forces. The distortion of ship's structure. Application of theory and experience. Limitations of the theory. Distinction between strength and stiffness of hull girder. Forces and moments acting on ship's structures in regular waves in head seas, and oblique seas. Nature of stresses in ship's hull when ship is floating in still water and on a wave. Modelling of ship's' structures including general remarks on structural strength. Three-dimensional analysis of a ship structures (elementary treatment only). Assumptions and simplification of longitudinal strength calculations. Introduction to the use of probability theory in the assessment of longitudinal strength.

Unit – 2: Longitudinal strength of hull girder and ultimate strength 9

Modelling of ship hull Girder as a beam. Assumed form of wave systems. Conditions of Hogging and Sagging. The buoyancy curves. The weight curves. Distributions of dead weight items. The Load, shearing force and bending moment curves. Characteristics of shear force and bending moment curves. Still water bending moment, wave bending moment and total bending moment. Bending theory applied to ship structures and its limitations. Calculations of hull girder section modulus and hull deflection. Dynamic effects on loads acting on the hull due to ship motions and wave action such as slamming. Thermal effects on hull girder. Stresses in the inclined condition. Application of plastic theory to ship structures, stress-strain diagram, calculation of plastic neutral axis and plastic moment. Ultimate strength of a simply supported beam and a fixed ended beam. Ultimate longitudinal strength of a ship.

Unit – 3: Transverse strength of hull girder and ship hull material 9

Transverse loads on ship's hull such as hydrostatic loads, weights, wave loads, racking, and torsion. Effect of hatches and other openings. Strain energy method, moment distribution method and comparison of the two methods, Influence of bracketed connections. Manufacture of steel. Requirement of ship building quality steels, high strength steels, Aluminum alloys and glass reinforced plastics, Mechanical properties and chemical composition of structural materials, Testing of steels such as tensile test bend test and impact test. Brittle fracture. Steels for very low temperature applications

Unit – 4: Strength of bulk heads, decks and tank tops, foundations, super structure, deck houses and structural discontinuities and local strength problem 9

Types of bulkheads and loads on bulkheads, Strength analysis of bulkheads. Types of foundations- loads on foundations and Strength analysis. Generation of loads on superstructure. Factors affecting superstructure efficiency. Effective superstructure. Strength of Aluminum alloy superstructure. Strength analysis of decks and tank tops. Determination of scantlings of superstructure decks based on simple bending theory. Strength of deckhouses, structural discontinuities such as holes in plates, notches in beams and girders, deck openings, ends of superstructure, ends of girders and other structural members. Stress concentration due to various structural discontinuities mentioned above. Applications of three-moment theorem to Ship structures. Use of strain energy method for solution of bending moment problems and redundant structural problems.

Unit – 5: Theory of thin plates, buckling of structures, composite construction, grillage analysis, calculation of scantlings as per rules 9

Thin plate theory and solution for different boundary conditions. Application of plain stress theory to ship structural problems. Case of a plate acted upon by a concentrated load; Buckling of plates. Influence of stiffeners (longitudinal and \ or transverse) on the buckling stress of ship's plating. Bending and membrane stresses in plates (application to bulkheads, shell plates etc.) Composite construction- Two materials with same elastic modulus. Two materials of different elastic Moduli. Bending of composite beam. Introduction to Grillage. Analysis of simple Grillage., Scantling calculations according to the rules of classification societies.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define various loads acting on ship under various conditions
CO2	Illustrate shear force and bending Moment diagram for ship in still water and wave loading conditions
CO3	Evaluate the section modulus and scantling calculations for ship.
CO4	Evaluate the basic calculations for Transfer function and Frequency domain and basic Statistical analysis
CO5	Determine natural frequencies of SDOF and MDOF system and methods to obtain response analytically.

Textbooks

1. Lewis,E.U.; Principles of Naval Architecture, (2nd Rev.), SNAME, New Jersey, U.S.A.
2. Owen Hughes; Ship Structural Design
3. Muckle,W.; Strength of Ships.

Reference Books

1. Ship Structural Design - A Rationally Based, Computer-Aided, Optimization Approach, 1995, Hughes OF John Wiley and Sons
2. Ship Structural Analysis and Design 2010, OF Hughes and JK Paik, The Society of Naval Architects and Marine Engineers, ISBN 978-0-939773-78-3
3. Structural Design of Seagoing Ships, Barabanov, MIR Publishers
4. Basic Ship Theory Vol II, Rawson and Tupper, Butterworth-Heinemann, 2001, ISBN 0 7506 5396 5
5. Principles of Naval Architecture Series: Strength of Ships and Ocean Structures by Alaa Mansour and Don Liu, Edited by J. Randolph Paulling (2008), The Society of Naval Architects and Marine Engineers ISBN 0-939773-66-x
6. Principles of Naval Architecture Series: Vibration by William S. Vorus Edited by J. Randolph Paulling (2010), The Society of Naval Architects and Marine Engineers, The Society of Naval Architects and Marine Engineers, ISBN: ISBN 978-0-939773-75-6
7. Practical Ship Design, DGM Watson, Elsevier Ocean Engineering Book Series 2002, ISBN: 0-08-042999-8
8. Marine Structural Design, 2003, Y Bai, Elsevier, ISBN: 0-08-043921-7
9. Design of Ship Hull Structures - A Practical Guide for Engineers, Yasuhisa Okumoto et al, Springer, ISBN: 978-3-540-88444-6
10. Sea loads on ships and offshore structures 1998, OM Faltinsen, Cambridge Univeristy Press, ISBN 0521458706
11. Design of Ship's Structures 1993, DW Chalmers, UK MoD Publications, ISBN 0 11 772717 2
12. Elementary Beam Theory and the Ship Girder, 1979, Stanford Maritime London, ISBN 0 540 07352 0
13. Ship-shaped Offshore Installations Design Building and Operation, 2007, Jeom Kee Paik and Anil Kumar Thayamballi, Cambridge University Press, ISBN-13 978-0-521-85921-9
14. Torsion and Shear Stresses in Ships, Mohamed Shama, 2011, Springer, ISBN-13: 978-3642146329

21CBNA44	Fundamentals of Offshore Structures	L- 3	T - 0	P - 0	C - 3

Course Objectives: To develop student's ability to understand various loads to which the offshore structure is subjected to, types of offshore structures and various equipment's on the offshore structure loading mechanisms, mooring hardware components etc.

UNIT I Historical Development of Offshore Structures **9**

Introduction – Definition of Offshore Structures – Historical Developments - Deepwater challenges, Functions of Offshore Structures, selection of Offshore Structure and its Configurations, Bottom Supported Fixed Structures, Complaint Structures, Floating Structures – Novel offshore design – Field development concepts

UNIT II Load and Responses **9**

Introduction, Gravity Load, Hydrostatic Loads, Resistance Loads, Current loads on Structures, Current Drag and Lift Force, Steady and Dynamic Wind Loads on Structures, Wave Loads on Structures, Varying Wind Load, Impulse loads and Introduction to design

UNIT III Topside Facilities and Layout **9**

Introduction - General layout Considerations - Areas and Equipment - Deck Impact Loads - Deck Placement and Configuration - Float over Deck Installation - Helipad - Platform Crane - Living quarters - Oil and gas treatment - Oil and gas storage, offloading and export - Utility and process support systems - Drilling facilities

UNIT IV Offshore Installation **9**

Introduction – Installation of Fixed Platform Substructures - Floating Structures – Foundations - Subsea Templates – loadouts - transportation - Platform Installation Methods and installation criteria – Installation of Pipelines and Risers

UNIT V: Materials for Offshore Applications **9**

Material for Construction-Structural Steel, Topside Materials, Advanced Composite materials, Corrosion Control, Material Reliability and Monitoring and Fracture Control

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Summarize and classify the concepts types and knowledge in basics of offshore structures
- CO2 Interpret the loading conditions and apply the formula to analyze the loads acting on offshore structures
- CO3 List the types of equipment and its machinery which are functioning in offshore structures
- CO4 Summarize the various offshore installation methods
- CO5 Explain the various materials used on the constriction of offshore structures

Textbooks

1. Dawson, T.H., "Offshore Structural Engineering", Prentice Hall, 1983
2. B.C Gerwick, Jr. "Construction of Marine and Offshore Structures", CRC Press, Florida, 2000.
3. Subrata K Chakrabarti, "Handbook of Offshore Engineering", Vol 1, Vol 2, Elsevier Publishers, 1st edition, 2005.

Reference Books

4. API RP 2A., "Planning Designing and Constructing Fixed Offshore Platforms", API
5. McClelland, B & Reifel, M.D., "Planning & Design of fixed Offshore Platforms", VanNostrand, 1986
6. Graff, W.J., "Introduction to Offshore Structures", Gulf Publ. Co. 1981.
7. Reddy, D.V & Arockiasamy, M., "Offshore Structure" Vol.1 & 2, Kreiger Publ. Co 1991
8. Morgan, N., "Marine Technology Reference Book", Butterworths, 1990.

21CBNA41	Ship Design Software – Modelling and Analysis	L - 0	T - 0	P - 3	C - 1

Course Objectives: To develop students' ability to understand and carry out practice in Ship modelling and Analysis, so that the student is capable of using the software in ship/offshore engineering. This module will include the offshore vessel modeling, surface preparation, Vessel hydrostatic calculation, tanks calibration, large angle stability, waveform, probabilistic damage, longitudinal strength calculation.

Introduction Basic Principles, creating your first Design, adding a Surface, setting up Units, Modeling Edges, setting your Frame of Reference showing the Net, Inserting Control Points, Setting Surface Stiffness Removing Control Points

Modelling: Working with Surfaces, Surface Properties, Surface Materials and Skin Thickness, Modeling Developable Surfaces, Developable Surfaces Example.

Calculations: Hydrostatics, Calculate Girth, Calculate Areas, Using Parametric Transformation, Scaling factors, Hull Shape Comparison, Parametric Transformation Restrictions, Input of Data, Importing DXF background, Importing Rhino .3dm files, Output of Data, Exporting Design

Analysis: Stability Analysis Input Model, Analysis Settings, Environment Options, Stability Criteria, Output, Upright Hydrostatics, Large Angle Stability, Equilibrium Condition, Specified Condition KN Values, Limiting KG, Floodable Length, Longitudinal Strength, Tank Calibrations, Probabilistic Damage, Setting Initial Conditions, Working with Load cases, Compartment Types, Heel, Trim, Draft, Displacement, Specified Conditions, Hog and Sag, Waveform, Grounding, Criteria Results, Criteria Results Table

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define basics of the software and their significance
CO2	Classify the surface properties, Materials and skin thickness
CO3	Apply Simpson's rules for finding areas of the curves
CO4	Compare the Hull shape, input data and stability criteria
CO5	Analyze stability, floodable length and longitudinal strength

21PBNA43	Ship Design Calculation Drawing & Drafting – II (SDCADD-II)	L - 0	T - 0	P - 3	C - 1

Course Objectives:

- To illustrate the resistance and tank capacities of the ship
- To evaluate the scantling, tank capacities and resistance of ship
- To design shell expansion and midship section by using software

List of Exercises:

1. Shell Expansion drawing (Manual & Autocad)
2. Midship section Calculation (Excel)
3. Midship section drawing (Manual & Autocad)
4. Scantling Calculation
5. Resistance calculation (Excel)
6. Tank Capacities calculation and Tank Plan (Excel & Autocad)

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define the significance of shell expansion drawing and midship section drawing
CO2	Develop shell expansion and midship section drawing by using manually and software
CO3	Make use of the values of particulars to do the scantling calculation and material requirement of the ship
CO4	Define the resistance and tank capacity of the ship
CO5	Evaluate the total resistance and tank capacities of the ship

21PBNA43	Marine Engineering Lab	L - 0	T - 0	P - 3	C - 1

Course Objectives: To develop student's ability to understand practically identification of construction details of main engine, generator, compressors, air bottles, pumps, firefighting systems, etc. installation details, starting and stopping checks, operation, compressed air system on board the ship, etc.

Main Engine Identification /Construction Details of Various Parts of Main Engine –Cylinders, Cylinder Heads, Pistons, Turbo Charger, Governors, Base Plate, Foundation and Fitment, Foundation Bolts, Chalk Fasts/Steel Chalks, Crank Shafts, Fly wheels, L O Sump, L O Pump, S W Pump, F W pump, S W Pump, F W Pump, S V Mounts, Injectors etc

Starting and Stopping Checks of Main Engine, Parameters to be observed during the operation of Main engine, Start Main engine after Starting Checks, Run Main Engine for 15 Mins, Observe all parameters, and readings of

(a) L O Pressure

(b) S W Temperature

(c) F W Temperature

(d) Exhaust Temperature

(e) Engine Room

(f) L O temperature

Starting Air System Identify Various Components, Air bottles, Tracing of air system valves, Valves, Main engine Starting Air valve, Various components of air bottles, Securing arrangements of air bottles

Study/identify lifting arrangement of Main Engine
Identification of Construction Details ship generator, Installation details of Prime mover, and alternator, M SB parts, Power distribution system, Starting and stopping checks of generator

Run the generator and take it in load. Note down various parameters. Stop generator after observing stopping checks of generator

Identification of construction details of starting air compressor. Tracing the air system line from air compressor to air bottle. Note down the material of system pipes and valve details

Start the compressor after observing pre – start checks, Charge the starting air bottles and record the time taken to reach the engine starting air pressure, Stop the compressor. Carry out after stop routines on compressor and system.

Total hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Understand the working principles of Main Engine
CO2	Know the starting of various components in engine room
CO3	Identify various parts in Engine room and its components
CO4	Study the compressor system
CO5	Evaluate the load requirements for the generator

21PBNA44	Ship In Campus - Visit	L - 0	T - 0	P - 3	C – 1

Course Objectives: The visit will familiarize the student various parts of the ship including decks, compartments, equipment fitted on boards, anchoring system, Access arrangements, mooring system, Accommodation area, Location of various tanks and their usage, etc.

The student shall be taken to visit a ship and they have to visit various compartments and decks as follows:

1. Upper deck, second deck and lower decks.
2. All the equipment fitted on the decks (like windlass, capstan, winches, cranes, bitts, Bollards etc.
3. Engine room (the main engine and auxiliary engine, compressors, feed pumps, fuel oil pumps, exhaust system, and other accessories)
4. Location of various tanks and their usage.
5. Access arrangements (ladders, gang ways)
6. Accommodation areas
7. Equipment's used for anchoring and mooring (Ground tackle equipment like anchor, anchor chain, wire rope, shackles, chain stoppers) chain lockers etc.
8. Bulwark and guard rails
9. Communication equipment
10. Fendering
11. Cargo holds
12. Doors, hatches and man holes.
13. Bulk heads.
14. Wheel house and wheel house equipment.
15. Mast and navigation lights.
16. Steering gear compartment.
17. AC & Refrigeration equipment.
18. Propeller shaft system.
19. Piping and valves.
20. Electrical equipment, like generators, motors, control panel etc.

After the visit the students shall submit a report for evaluation.

Total Hours: 40

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Visit the various decks in the ship
CO2	Identify various parts in each deck
CO3	Understand the operations of navigational equipment
CO4	Study the engine propulsion system and its components
CO5	Know the general arrangement of a ship

21SBNA41	Personality Development II	L - 2	T - 0	P - 0	C - 2

Course Objectives:
To improve the leadership quality, team management, quantitative analyzing knowledge, ordering, sequencing and logical thinking knowledge to meet their professional career.

UNIT I Quantitative Aptitude I **6**
Percentage – Profit Loss -Discount – Ratio Proportion – Time & Work – Time, Speed & Distance. Problems relating to ages- Permutation &Combination-Probability, Mensuration Clocks and Calendars-Boats-Simple Interest –Compound Interest- Fractions and Decimals – Square roots – Functions.

UNIT II Analytical Problems **6**
Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

UNIT III Logical Problems **6**
Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

UNIT IV Time Management **6**
Definition –Meaning-Importance, Value of time as an important resource- comparison of Time and Money-Circle of influence and circle of control—Definition of URGENT and IMPORTANT—Time Wasters and how to reduce—Procrastination—meaning and impact- 4 Quadrants.

UNIT V Team Building **6**
Meaning—Aspects of team building—Process of team building—Types of Teams-Team ethics and Understanding-Team trust and commitment

TOTAL: 30 Hours

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

CO1	Develop the soft skills and basic etiquette
CO2	Develop the quantitative aptitude skills
CO3	Build the advanced aptitude skills
CO4	Adapt Familiar with the analytical problem-solving skills
CO5	Build the knowledge on logical problem-solving skills

References:

1. Personality Enrichment--K R Dhana Lakshmi and N S Raghunathan, Margham Publications
2. Personality Development --Dr V M Selvaraj Bhavani Publications
3. Quantitative Aptitude – R. S Aggarwal
4. Logical and Analytical Reasoning (English) 30th Edition – A.K Gupta

21MCNA41	Industrial Safety	L - 2	T - 0	P - 0	C - 2

Course Objectives:

- Effectively communicate information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
- Competent safety Engineer rendering expertise to the industrial and societal needs at national and global level.
- Provide knowledge on safety in various maintenance situations, personal protective equipment and fire safety.

UNIT-I: Safety in Metal Working Machinery and Wood Working Machine 6

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines.

UNIT II Principles of Machine Guarding 6

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction-guard opening., Selection and suitability: lathe-drilling-boring-milling -grinding-shaping

UNIT III Safety in Welding and Gas Cutting 6

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT IV Safety in Cold Farming and Hot Working of Metals 6

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills Safety in gas furnace operation.

UNIT V Safety in Finishing, Inspection and Testing 6

Heat treatment operations, electro plating, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing. Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

Total Hours: 30

Course Outcomes:

After successful completion of the Industrial Safety course, the student will be able to

CO1	Discuss the safety rules, Maintenance, Inspection of various equipment's in machine shop.
CO2	Discuss the importance of protective devices and various machine guarding components.
CO3	Recommend the safety precautions of various welding processes such as arc, gas, resistance welding, brazing and soldering
CO4	Elaborate the functions of the safety in cold forming and hot working of metals.
CO5	Apply the safety measures during heat treatment operations. Learn the measures of pollution control and waste disposal.

References:

1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.
3. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. "Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.
5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing

21CBNA51	Ship Design	L - 3	T - 0	P - 0	C - 3

Course Objectives:

- To Evaluate the ship parameters like coefficient of forms, displacement, etc.
- To Analyze the ship stability
- To define the marine auxiliary systems like ballast, bilge systems

Unit-1 Introduction **9**

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

Unit-2 Methods of ship design **9**

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

Unit-3 Ship dimension **9**

Length, breadth, depth, draught, form coefficients; Shape of the hull. Mass estimation - lightship mass – steel mass, outfit mass, engine plant mass; dead weight. Design of hull form – conventional method of lines, distortion of existing forms; stem and stern contours, Bulbous Bow.

Unit-4 General arrangement and Stability Booklet **9**

Subdivision of the ship's hull and erections, arrangement of spaces, arrangement of tanks, superstructure and deckhouses, arrangement of engine plants, Cargo handling capacity, hold capacity and stowage factor, Stability – stability booklet, IMO Regulations, Checks on stability, trim. Tonnage measurement – international, Suez, Panama. Influence of stability, resistance and propulsion and ship hydrodynamics factors on ship design

Unit-5 Auxiliary systems **9**

Marine system and Offshore Platform Equipment design: Bilge and Ballast system, Ventilation system, Air Conditioning and Refrigeration system, Berth and Mooring systems, Anchor handling system for ships and shore structures, Storage and Offloading, Firefighting systems, Stern gear, Steering gear, Lifesaving equipment.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Design ship using basic type ships, coefficient, iteration methods
CO2	Estimate the mass, material requirements, deadweight, etc.
CO3	Design of hull form, stem and stern and bulbous bow
CO4	Solve the tonnages, stability, resistance and propulsion
CO5	Select the mooring systems, anchors, firefighting systems

Textbooks

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

Reference Books

1. Practical Ship Design, DGM Watson, Elsevier Ocean Engineering Book Series 2002, ISBN: 0-08-042999-8
2. Risk-Based Ship Design - Methods, Tools and Applications, Apostolos Papanikolaou et al, Springer-Verlag Berlin Heidelberg 2009, ISBN: 978-3-540-89041-6,
3. Ship Design for Efficiency and Economy 2nd Ed, H. Schneekluth and V. Bertram, Butterworth-Heinemann, ISBN 0 7506 4133 9

4. Ship Design & Construction, Vol I and II (2003, 2004), The Society of Naval Architects and Marine Engineers, ISBN 0-939773-40-6, ISBN 0-939773-41 -4
5. Basic Ship Theory Vol I and II, Rawson and Tupper, Butterworth-Heinemann, 2001, ISBN 0 7506 5396 5
6. Engineering for Ship Production, Thomas Lamb,1986, The University of Michigan
7. PNA Series, SNAME 2010.
8. Management of Marine Design, Stian Erichsen, Butterworths, ISBN 0-408-03237-5
9. Marine Vehicle Weight Engineering, Society of Allied Weight Engineers 2005, ISBN 9-9999-9999-9
10. Maritime Economics, 2nd ed, Martin Stopford, 2003, Routledge, ISBN 0-415-15309-3
11. MARPOL Consolidated edition 2006, IMO Sales number: IC520E
12. Rickmers standard for stowage and securing of project cargo, 2003, Rickmers Linie GmBH and Cie, Hamburg

21CBNA52	Ship Production I	L – 3	T – 0	P – 0	C- 3

Course Objectives

- To define the construction of a mid-ship section and other parts
- To demonstrate about shipyard facilities and machines
- To explain the various production stages and techniques

Unit-1 History of Indian Ship building **9**

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

Unit-2 Fabrication of component parts **9**

The cutting process – tools, physical chemical background of the cutting process, mechanical cutting, devices for thermal cutting, general description of the various machines, photoelectric and NC- control devices, edge preparation, problems of accuracy; Bending of rolled and built up sections - general description of bending, control of the bending process, automation of bending; Plate bending, uniaxial bending, biaxial bending (devices, cold bending, heat-line bending), possibilities of automated plate bending.

Unit-3 Assembly of Ship's Structures **9**

Prefabrication – general remarks, basic problems of prefabrication, pattern of prefabrication, welding in prefabrication, Data generation for ship building process. Basic welding in shipbuilding, welding methods, standards, symbols
Sub-assemblies: 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 flat and corrugated sections, flat sections with curvature – assembly jigs, welding process, its 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.

Unit-4 Erection of ship's hull **9**

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

Unit-5 Launching **9**

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

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define the labor, material, machine and space resource requirements
CO2	Explain the productivity term
CO3	Estimate ship efficiency and machine utilization figures
CO4	Adapt the activity networks for planning purposes
CO5	Perceive the knowledge about the fabrication processes

Textbooks:

1) Taggart; Ship Design and Construction, SNAME
2) Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
3) Dormidontov V.K. & et.al.; Shipbuilding Technology, Mir Publishers, Moscow.
4) Eyres D.J.; Ship Construction William Heinemann Ltd, London, 1982

References:

1) Ship Construction, 2007, Sixth edition, D. J. Eyres, Butterworth-Heinemann, ISBN 13: 9-78-0-75-06-8070-7
2) Merchant Ship Construction, H. J. Pursey, Brown, Son & Ferguson, Ltd., Nautical Publishers
3) Ship Production, 2nd edition, 1995, Richard Lee, The Society of Naval Architects and Marine Engineers, ISBN 0-939773-57-0
4) Practical Construction of Ship, RM Newton,
5) Shipbuilding Technology, V. K Dormidontov, MIR Publishers
6) Ship Construction – Sketches and Notes 2003, Kemp and Young, Elsevier, ISBN 0-7506-3756-0

21CBNA53	Advanced Offshore Engineering	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get understanding of oil and gas field development, deep water challenges, riser systems, platform types, remote operated vessels, Mooring lines -Typical mooring configuration, material and construction, anchors and ancillary equipment, static mooring analysis, etc.

Unit I Introduction of Oil and gas field **9**

Oil and gas field development Options: Platform types, marine riser systems, current design trends and deep-water challenges, Upstream, Midstream, Downstream, Exploration, Appraisal, Development, Production, Economics

Unit II Riser systems: **9**

Flexible pipe structure and material, typical configurations, top tensioned vertical risers, hybrid risers. Flow assurance: multi-phase flow, deposition of solids, thermal management, corrosion. Riser analysis: governing equations, boundary conditions, natural frequency.

Unit III Mooring system **9**

Mooring lines -Typical mooring configuration, material and construction, anchors and ancillary equipment, static mooring analysis - mooring and anchoring system for different offshore structure TLP, spar, semisubmersibles, drill ships.

Unit IV Vortex induced vibration **9**

Vortex induced vibration: VIV Parameters, drag, lift, vortex shedding, surface roughness, Strouhal number, VIV assessment, fatigue life calculation, Simplified VIV Analysis Examples of VIV Analysis

Unit V Remotely operated vehicles **9**

Remotely operated vehicles: ROV categories- Micro, mini, general, Light work class, Heavy work class, Trenching & Burial, AVUs ROV-handling systems, construction and materials, navigation and control, Remote Piloting, Manipulator arms, HD and 4k Video Cameras, Tooling Solutions.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Summarize the types of riser systems and illustrate the current economical situations
CO2	Categorize the types configurations and analyze risers for various boundary conditions
CO3	Demonstrate types of mooring anchors and its configuration methods
CO4	Evaluate and find the solution for VIV problems in Offshore Structures
CO5	Illustrate about the various underwater vehicles Elaborately

Textbooks

1. Handbook of Offshore Engineering, Subrata K. Chakrabarti, Vol I, Vol II, USA, 2005
2. BC Grewick, Jr. Construction of marine and offshore structure, CRC Press, 2000.
3. RD Blevins, Flow induced vibrations, Van Nostrand Reinhold, 1990.
4. N Barltrop, Floating structures: A Guide for design and analysis, OPL, 1998.

Reference Books

1. EE Allmendinger, Submersible vehicle systems design. SNAME, 1990.
2. HO Bordeaux, Buoy engineering, John Wiley, 1975.

21CBNA54	Marine Materials and Metal Joining Techniques	L - 3	T - 0	P - 0	C - 3

Course Objectives:

- To define the fundamental science and engineering principles relevant to materials used in marine field.
- To illustrate the basic principles of various mechanical testing methods and NDT methods
- To interpret the practical knowledge about the structure and properties of metals. The problems encountered in welding various metals and metal alloys are reviewed in detail.

Unit-1 Introduction **9**

Definition, Historical Background, Development in Welding, Science of Welding, Welding Metallurgy: Introduction, Structure of metals, Crystallization 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, Preheating, HAZ.

Unit-2 Types of Welding **9**

Gas metal arc welding – Process, different metal transfers, power source, electrodes, shielding gas, uses of Gas in metal arc welding, mechanized system in shipbuilding - Introduction, philosophy of automation in welding, different welding systems in shipyards, Welding in production shop – SMAW, GTAW, EBW, LBW, SAW, Gravity welding, Auto contact welding, CO2 Welding, Friction Welding. Principle, process & applications

Unit-3 Panel line production **9**

One-sided welding – SAW, MIG welding, welding of stiffeners, Welding in building berth - External welding on the berth, Electro-slag welding, Electro gas welding, One-sided welding (Flux Asbestos backing, Ceramic backing etc.); Internal welding on the berth, Comparison of European, Japanese & Indian Welding Process

Unit-4 Welding Problems & Defects **9**

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

Unit-5 Adhesive Bonding as a Joining Technique **9**

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

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Apply the core concepts in Materials Science to solve marine engineering problems.
CO2	Select materials for design and construction of marine structures
CO3	Evaluate NDT method and able to interprets the results obtained from NDT methods
CO4	Perceive knowledge about the Welding Procedure Specification, Procedure Qualification Record
CO5	Explain about advanced welding technique like laser beam, robotic and Friction stir welding

Textbooks

1. Davies, A.C.; Welding, Cambridge University Press, Low Price Edition, 1996.
2. Richard, Little; Welding Technology, McGraw Hill Publications, New Delhi.
3. Joe Lawrance; Welding Principles for Engineers, Prentice Hall Inc. Englewood Cliffs, N.J.
4. Welding Handbook – Vol.:1,2,3; American Welding Society
5. O.P. Khanna; A Textbook of Welding Technology, Dhanat Rai & Sons.

Reference Books

1. Rossi, Welding Technology, McGraw Hill.
2. Koenigsberger and Adaer, Welding Technology, Macmillan.
3. Howard B Cary., Modern Welding Technology, 4th edition, Prentice Hall, New Jersey, USA, 1997.
4. AWS Welding Handbooks, AWS, New York, 1995.

21CBNA51	Seamanship and Fire Fighting Lab	L - 0	T - 0	P – 3	C - 1

Course Objectives: To familiarize the students with seamanship terminologies, tools and equipment's used on board the ship, firefighting and lifesaving appliances, types of anchors, parts of anchors, type of flags, fenders and materials, types of ropes and knots, etc.

List of experiments

1. Types of ropes and knots
2. Types anchors, parts of anchors
3. Lifesaving appliances
4. Fire Fighting appliances
5. Parts of ship
6. Main mast/Arial
7. Type of flags
8. Parts of main mast
9. Type of fenders & materials
10. Mooring Lines & types
11. Gangway
12. Anchors and chain cables, chain locker

Total Hours: 40

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Familiarize seamanship terminologies
CO2	Know the tools and equipment used on board Ship
CO3	Gain knowledge in firefighting and lifesaving appliances,
CO4	Understand the types of anchors, parts of anchors, type of flags, fenders and materials
CO5	Familiarize the types of ropes and knots

Text Books: In-House Prepared Lab Manual.

21PBNA52	Ship Design Calculation Drawing & Drafting – III (SDCADD-III)	L - 0	T - 0	P - 3	C - 1

Course Objectives:

- To illustrate the Light weight, wetted surface calculation and painting area calculation
- To evaluate the trim, stability calculation, load line calculation and freeboard
- To draw the accommodation layout
- To evaluate rudder and propeller dimensions using manual calculations

List of Exercises:

1. Lightship weight calculation (Excel)
2. Trim and Stability Calculation (Excel)
3. Accommodation Layout (AutoCAD)
4. Wetted surface area and Painting area estimation (Excel)
5. Tonnage and Equipment number calculation (Excel)
6. Freeboard and Load line Calculation (Excel & AutoCAD)
7. Propeller calculation
8. Rudder Calculation

Total Hours: 40

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define the ship properties like wetted surface area, free board load line calculations, etc.
CO2	Make the use of the software to draw the accommodation layout of the ship
CO3	Explain about the tonnages, equipment number, free board and load line
CO4	Define the appendages like propeller and rudder and their types, uses and their significance
CO5	Evaluate the particulars of rudder and propeller using their detailed sketch done by the software

21PBNA53	Ship Design Software – Structural Strength	L - 0	T - 0	P - 3	C - 1

Course Objectives: To develop students' ability to understand and carry out practice in ship design software, so that the student is capable of using the software in ship/offshore engineering. This module will include the structural detailing of ship components

List of Exercises:

Working with Frames

Adding a Frame, adding a Frame Opening, Calculating Frames, Frame Visibility, Deleting Frames, Modifying Frames, Moving Frames, Copying Frames

Working With Decks

Adding a Deck, deleting a Deck, adding a Deck Opening, Drawing Decks, Deck Visibility, Modifying Decks, Moving Decks, Copying Decks, Deck Limitations,

Working with Stringers

Adding Stringers. Generating Stringers, generating a Family of Stringers, Modifying Stringers, Longitudinal Girders, Adding Points to Stringers, Moving Stringer Points, Deleting Stringer Points, Modifying Stringer Points, Duplicating Stringers, Breaking Stringers, Joining Stringers, Breaking Stringers at Bulkheads, Mirroring Stringers, Girth Centerline, Calculating Stringers, Calculating Stringer Inverse Bending Lines, Adding Inclined Sections, Displaying Inclined Sections.

Working with Plates

Plating a Whole Surface, adding a Plate, deleting a Plate, Defining Triangular Plates, Plate clash detection, Plate Development Methods and Options, Calculating Plates, Girth Differences, Plate Strain, Plate Development and Rolling Jigs, Plate User Coordinate Systems (UCS), Plate Inset Lines, Plate Templates, Shell Expansion, Plate Displays,

Total Hours: 40

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

CO1	Define basics of the software and their significance - Structural
CO2	Familiarize the components in structural strength
CO3	Gain knowledge in working with parts in structural drawing
CO4	Formulate the design of stringers
CO5	Evaluate the loads on plates

21RBNA51	Ship Design Project - Phase I	L - 0	T - 0	P - 4	C - 2

Course Objectives: The student will be able to carry out data collection, collation, and design calculations independently with the help of the guide. The student will have to choose any ship or offshore engineering project for design work. They have to complete the preliminary calculation up to fixing of main dimensions and preliminary checks. Detailed design will be carried out in phase II of project

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Develop the data for the finalizing the main dimensions of the Ship/Offshore structures

CO2 Make use of BSRA series to optimize the Offset table

CO3 Illustrate the lines plan, hydrostatic curves and Bonjean curves

CO4 Evaluate the hydrostatic properties, total resistance and tank capacities of the Ship/Offshore structures

CO5 Construct the model midship section and general arrangement plan

CO6 Create Stability booklet

Total Hours: 40

21CBNA61	Sea Keeping and Maneuvering	L - 3	T - 0	P - 0	C - 3

Course Objectives: To develop the student's capability to understand the sea keeping aspects of the ships and offshore structures, ships motion control in the sea way, use of stabilizers, and dynamics of the floating offshore systems, dynamic effects of ship in seaway, etc.

UNIT I Coordinate system **9**

Ship in Regular Waves - Coordinate Systems, Equations and Motion - uncoupled Heave, Pitch and Roll; Coupled Heave and Pitch - Hydrodynamic Forces - Radiation Forces - Strip Theory. Probabilistic Approach - Introduction to Random Response Theory Random Response of linear, Systems under wave Loading, Directional Spectra for Waves - Probabilistic Design Criteria - General Motion Analysis of Floating Bodies, Time and Frequency Domain Approach.

UNIT II Dynamic effects of ship in seaway **9**

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.

UNIT III Ship motion control **9**

Ship Motion Control - Control of Roll - Passive Stabilizers (Bilge keel, Sails, Free Surface Tanks, U-tanks, moving weight) Controlled - Passive Stabilizers, Active Stabilizers (fin, gyro, active-tank) Rudder stabilization, Control of Pitch.

UNIT IV Sea keeping performance criteria **9**

Sea keeping Performance and Design Aspects - Sea - keeping performance criteria and ship seaways responses, factors affecting pitching, heaving and rolling, guidelines for design.

UNIT V Dynamics of floating system **9**

Dynamics of floating systems: Equations of motion for SDOF Systems, Time and Frequency domain solutions - Oscillators of Floating Bodies, Added Mass and Moment of Inertia, and Hydrodynamic damping - Exciting Forces and moments due to Waves. Strip theory for Slender Bodies - Symmetric and Unsymmetric Coupled Motions Effect of Forward Speed - 3D Effects - Dynamic Effects - Roll and Pitch Damping Devices.

Total hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Solve the hydrodynamic and loading conditions acting on ships
- CO2 Explain the dynamic effects of ships in seaway conditions
- CO3 Outline the idea of ship motion control
- CO4 Rule on seakeeping performances for hydrodynamic conditions
- CO5 Formulate the equations for dynamics of floating systems

Text Books

1. Lewis E.U; "Principles of Naval Architecture" (2nd Rev) Vol. III**,** 1989,
2. Bhattacharya.R; "Dynamics of Marine Vehicles" 1978, Wiley Inter Science, Newyork.

Reference Books

1. Lamb.H; "Hydrodynamics", 1945 Cambridge University Press, UK.
2. Newmann.J.N; "Marine Hydrodynamics".MIT Press, USA ,1977
3. Newmann J.N; "Theory of Ship Motions Advanced Applied Mechanics", 1980
4. Price W.G & Bishop R.E, "Probability Theory of Ship Dynamics", Chapman & Hall, London1982.

21CBNA62	Ship Structural Design and Vibration	L - 3	T - 0	P - 0	C - 3

Course Objectives: This subject will give the student the knowledge about ship building materials, ship structural design concepts, structural components of the ship and the design aspects, general considerations, external loads, framing systems, structural design procedure, etc.

Unit-1 Introduction **9**

Historical review, the structure of wooden ships. Transition from wood to steel. The structure of riveted ships and welded ships. Riveting and welding in ship building. Structural changes from riveted to welded ships. General mid-ship section structural arrangements for different types of ships- general cargo ship, oil tanker-single and double hull, bulk carrier, container ship, tug, trawler, passenger ship, cross channel ferry.

Unit-2 Structural parts, functions and classification rules **9**

Different structural elements- keel, transverse frames, longitudinal frames, web frames, vertical keelson, beams, girders, floors, brackets, pillars, stem bars, stern frames, bulkhead stiffeners, platings etc.-their structural configuration, design features and functional aspects. Assembly of various structural elements into the structural parts of the ship such as double bottom structure, side shell, single bottom structure, bulkhead structure, deck structure, aft-end structure, fore-end structure, super structure etc. Structural design as per classification society rules. Use of relevant standards in structural design.

Unit-3 Structural Design of Bottom, Side Shell, Bulkhead, deck, fore-end, aft-end structures **9**

Bottom structures, structural design of single bottom and double bottom structures, their structural configuration and determination of dimensions and scantlings of stiffeners, frames, longitudinal, inner and outer bottom plating, Shell plating and framing-layout of strakes, spacing of framing, shell expansion plan, longitudinal and transverse frames, ordinary and web frames, end connections of frames, Bulk heads-structural arrangement of bulk heads, longitudinal and transverse bulk heads, determination of scantlings and sizes of structural parts of bulkheads, plating and stiffening of bulk heads, in flat, corrugated, Swaged and non-water tight bulk heads, connection of bulkheads with side shell, decks etc., partial bulk heads. Decks - deck plating, subdivision of strakes and structural arrangements of longitudinal and transverse stiffeners. Determination of scantling, end-connections of deck stiffeners. Fore-end structure-stem profiles, plating and stiffening of the fore end structures, panting arrangement, stem design-built up or cast, bulbous bow construction, details of arrangements, chain locker, hawse pipes, paint stores, forward collision bulkheads, determination of scantlings. Aft-End structure-stern profiles, plating and stiffening of aft-end structure, stern frame – built up or cast, details of stern tube, bossings, shaft struts etc. Different types of rudder configurations and stern fittings for these rudder types. Nozzles and propeller arrangements. Determination of structural scantlings.

Unit-4. Structural Design of Engine Room, Superstructure, Cargo Handling Arrangements, Hatches, Special Ships, Welded Structures and Computer Applications **9**

Engine Room – Horizontal subdivision of engine room, platforms, decks, shaft tunnel and recesses, Engine casting, foundations of Diesel engines, turbines, boilers, auxiliary machinery. Static and dynamic loads in engine room. Structural design of engine room and determination of scantlings. Superstructure – Structural design and details of openings, expansion joints etc. Determination of scantlings, Construction and design of cargo handling systems and equipment – loads on derricks, masts and rigging. Determination of scantlings. Deck cranes –details of installation and structural arrangements necessary. Hatch covers – loads acting on hatch covers, various types of hatch cover and their structural design. Structural design of special types of ships – fishing vessels, tugs, tankers, dredgers, icebreakers, and submarines. Stress Concentration and fatigue in ship structures. Computer applications in structural design. Various methods of joining structural parts and elements. Design of welded structures. Problem of fracture in welded structures. Design and strength of butt – welds, fillet welds, Tee and corner joints, bracketed connections. Structural fire protection.

Unit-5 Hull Vibration of Ships **9**

Flexural vibrations of a beam. Free and forced vibrations, vibration of undamped spring-mass system, damped vibrations. The exciting forces on hull of ships, modes of hull vibration. Calculation of hull frequencies – factors influencing frequency, empirical formulae for hull frequency estimation. Analytical

methods for calculation of hull modes (elementary treatment only). The Stodala's interpolation method. Propeller exciting forces. Damping – Types of damping. Special local vibration problems – Rudder vibration, cavitation, stress and vibration levels, human reaction to vibration. General methods of reducing vibrations. Devices for reducing main hull vibration. Synchronising devices for twin – screw ships, rotating weight neutralisers, Kurt nozzles.

Total hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Classify the types of ships in marine sector from past to present
CO2	Make use of rule book to design structural components of ships
CO3	Value the role of classification societies in structural design of ships
CO4	Compile and give solution to structural design based on engine room superstructure, and cargo handling equipment's
CO5	Estimate scantlings for midship, fore and aft of a ship

Textbooks:

1. Ship Construction by D.J. Eyers

Reference Books:

1. Strength of Ship Structures by W. Muckle
2. Principles of Naval Architecture by Ed.V. Lewis
3. Ship Design and Construction by R.Taggart

21CBNA63	Offshore Structural Design	L - 3	T - 0	P - 0	C - 3

Course Objectives: To develop the student's ability to carry out offshore structure design calculations, and understand the various aspects of the design covering design loads, tension and compression members, plates and beams, design of cylindrical members, design of tubular joints, etc.

UNIT I Planning of Offshore Structure design **9**

Planning of Offshore Structures - Design criteria and procedures – WSD and Load Resistance Factor Design - Design loads – dead loads and live loads - load combinations - Determination of wave, wind and current loads.

UNIT II Design of plates and beams **9**

Design criteria of plates and beams – considerations - Design of tension members and compression members - Materials used for plates and beams- Analysis of loading on beams and plates, End fitting effects in column testing, crippling strength test.

UNIT III Design of cylindrical members **9**

Design of cylindrical members – axial compression, biaxial bending and combined loads; Hydrostatic implosion, effects of external hydrostatic pressure, local buckling, the residual stresses, Ultimate strength, monotonic loading behavior and strength.

UNIT IV Design of Tubular joints **9**

Design of Tubular joints – Ultimate static strength formulas for welded tubular joints, Punching shear method and calculation of allowable joint capacity; stress concentration factor, Fatigue analysis and Design – SN curve method.

UNIT V Pile Design **9**

Pile Design – International standard and recommendations, Pile drivability, Pile driving monitoring, Pile Capacity for axial bearing loads and axial pull out loads; Soil reaction for axially loaded piles and laterally loaded piles; Structural Design of piles.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Understand the various loading acting on the structural members of an offshore platform
CO2	Illustrate the design considerations for the plates and beams
CO3	Evaluate the strength of the cylindrical structural member
CO4	Evaluate and design of tubular joints for various design factors
CO5	Interpret the design stages and rules and regulations involved in the pile design under various loading conditions

Textbooks

1. S.K. Chakrabarti, "Handbook of Offshore Engineering", Elsevier Publications 2005.
2. Dawson T.H., "Offshore Structural Engineering" Prentice Hall, 1983.

Reference Books

1. API RP 2A WSD 1993
2. API RP 2A LRFD 2000

21CBNA64	Ship Production II	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get an insight into the various type of launching methods, launching calculations, outfitting activities onboard the vessel, including installation of machinery, shafting, propeller, cabling, basin trials, sea trials, contractual obligation etc.

Unit-1 Outfitting of ships **9**

Workshops –piping shop, fitters shop, Carpenters shop (wood, plastics), Mechanical workshop, Machine shop (preassembly of blocks), Other workshops (electrical installation, painting, insulation, etc.); Technological process in the hull installation work –Technological process in installing the main machinery, installation of shafting and propeller, installation of the main machinery, installing of auxiliary machinery and boilers, installation of piping systems, electrical installation, hull installation work; Pre and advanced outfitting.

Unit-2 Production design **9**

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), quality control. Problems of accuracy – tolerances, standards, measuring techniques (theodolite, laser, etc.); quality control

Unit-3 Process planning in shipbuilding **9**

Planning for operations – interconnection between production design and process planning, production and process analysis, assembly charts, operation process charts, flow process charts; Process selection. Application of models for process planning, scheduling and control – Gantt charts, CPM & PERT, transportation models etc.; Special aspects of application of these in shipbuilding process.

Unit-4 Capacity planning **9**

Estimation of future capacity of a shipyard method, strategies for modifying capacity, models for capacity planning under the special conditions of shipbuilding.

Unit-5 Production Standards **9**

Production standards in several parts of the ship production process, work measurement systems, methods of man-hour determination, use of computers, correlation between size of series and needed man-hours. Systems of maintenance and quality control.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Explain the functions of hull outfit items in ship
- CO2 Solve the productivity of the worker and efficiency shipyards
- CO3 Develop the planning schedule using software
- CO4 Explain the problem occurs during the construction and inspection
- CO5 Adapt the international standards in the shipbuilding processes

Textbooks

1. Ship Production, 2nd edition, 1995, Richard Lee, The Society of Naval Architects and Marine Engineers, ISBN 0-939773-57-0
2. Shipbuilding Technology, V. K Dormidontov, MIR PublishersElwood S.Buffa; Modern Production/Operations Management, Wiley Eastern Ltd.
3. Richard J. Hopeman; Production - Concepts, Analysis, Control, 3`d Edition, Charles E. Merril Publishing Co.
4. Arthur C.Laufer; Operations Management, South-Western Publishing Co.
5. Khanna, O.P.; Industrial Engineering and Management, Dhanpat Rai Publication.
6. Richard` I. Levin, et.al.; Production/Operations Management: Contemporary Policy for Managing Operating Systems, Tata-McGraw Hill Publishing Co. Ltd.
7. Taggart; Ship Design and Construction, SNAME

Reference Books

1. Ship Construction, 2007, Sixth edition, D. J. Eyres, Butterworth-Heinemann, ISBN 13: 9-78-0-75-06-8070-7
2. Merchant Ship Construction, H. J. Pursey, Brown, Son & Ferguson, Ltd., Nautical Publishers
3. Practical Construction of Ship, RM Newton, Ship Construction – Sketches and Notes 2003, Kemp and Young, Elsevier, ISBN 0-7506-3756-0

21PBNA61	Offshore Design Software	L - 0	T - 0	P - 3	C - 1

Course Objectives: To develop students' ability to understand and carry out practice in software, so that the student is capable of using the software in ship/offshore engineering. This module will include the offshore vessel modeling, load application, load analysis, modes of vibration, frequency domain transportation, RAO data extraction

List of Exercises:

Design fundamentals: Overview, Basics & Function, Software Commands & Macro, String Functions

Modeling: Barge & Vessel Modeling, Model Parameter, defining defaults & Model Defining Options, Defining Parameters & Parameter Options, Defining Points, Classes, Beams, Element Attributes, Load Group & Compartments, Generate Isometric View, Model & Analysis plotting

Analysis: Extracting Modes of Vibration, Frequency Domain Transportation Solution, Defining Load Cases, Obtaining Applied Loads, performing a Structural Analysis, structural post processing, Bending Moments and Shears, Force Response Operators, Post–Processing Beams, Post–Processing Generalized Plates, Post–Processing Joints

Transportation Analysis: Structure Weight calculation, Hydrodynamics, Response Amplitude Operator (RAO), RAO Data Extraction for Marine Operation

Total Hours: 45

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

CO1 Define basics of design software, commands and functions
CO2 Utilize designing tool to know the importance of design for various conditions
CO3 Analyze shear force, bending moment responses and factors affecting the forces
CO4 Analyze weights estimations, Hydrodynamics and Response Amplitude Operator
CO5 Compile the hydrodynamics, RAO and SF and BM responses

18ETN041	Ship Design Calculation Drawing & Drafting – IV (SDCADD-IV)	L - 0	T - 0	P - 3	C - 1

Course Objectives:

- To illustrate design & drawing of various types of doors and hatches, Manholes, open & Exit, ladders, life saving equipment, navigation arrangement, launching and dock plan

List of Exercises:

1. Door plan, Design & drawing of various types of doors and hatches
2. Location of manholes and bottom plugs
3. Types and arrangement of access openings and exits
4. Types and arrangement of ladders
5. Arrangement of life saving plan
6. Mast Design and Navigational light arrangement
7. End launch calculation, End launching curves
8. Docking plan, Docking calculation Welding schedule

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Understand the Door Plan

CO2 Draw Manholes, open & Exit, ladders

CO3 Design lifesaving equipment, navigation arrangement,

CO4 Evaluate and draw the launching Plan

CO5 Evaluate and draw the dock plan

21RBNA61	Ship Design Project-Phase-II	L - 0	T - 0	P - 6	C - 2

Course Objectives: The student will be able to carry out detailed design of the project in this phase and he will have to complete the project work by the end of the semester. He will give a seminar presentation on the calculations and drawings carried out to the guide so that he gains more confidence in the design aspects.

Total Hours: 60

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

CO1	Evaluate the scantlings of the ship/offshore like thickness of the shell plates
CO2	Design Shell expansion and Superstructure plans
CO3	Construct Accommodation and Engine room layouts
CO4	Design the GA, propeller and rudder
CO5	Estimate the power required like horse power, engine power, shaft power and delivered power

21CBNA71	Ship Conversion Technology	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get in depth knowledge about conversion of one type of ship to another type including fixing of revised length, beam and depth, the cargo carrying capacity and redesignated functions. Checks on sea keeping qualities, selection of main engine, etc.,

UNIT I Introduction **9**

Basic ship parameters, existing ship stability condition, cross curves of stability, statical stability, and damage stability for the existing ships, principal particulars of the ship, general arrangement drawing of the ship including deck layout, engine room layout, accommodation layout, deck machinery for the existing ship.

UNIT II Fixation of revised length, beam and depth **9**

Fixation of the revised length, beam and depth based on the cargo capacity and redesignated functions, layout general arrangement, including engine room lay out, deck plans, water tight bulk head arrangements, fore peak and aft peak arrangements, anchor and anchor handling arrangements, computation of steel weight, equipment and outfit mass, engine plant mass, weight margin etc.

UNIT III Stability calculations **9**

For the revised requirement of length, breadth, and depth workout block coefficient and prismatic coefficient, mid ship section design, water plane area coefficient, revised functions of stability criteria, cross curves stability, statical stability curves, damaged stability, sea keeping maneuvering, rudder design, steering gear arrangement etc.

UNIT IV Hull design **9**

Shape of sectional area curve bow and forward section forms, bulbous bow design, stern forms, conventional method of lines design, propeller clearances, propeller design, model testing, Ship yard operations, hull production, hull structural design, outfitting production (hull), outfitting production (machinery).

UNIT V Powering **9**

Selection of main engine based on the revised powering calculations, revised shaft length, shaft bearings, propeller calculations, interaction between ship and propeller, ship resistance under trial conditions, additional resistance under service condition, rudder design.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define the basic concepts about Conversion Tech
CO2	Illustrate the engine room layout, outfit and other parts
CO3	Distinguish between revised length and original length
CO4	Design the repaired propeller and outfit items
CO5	Select the main engine based on the revised powering calculations and revised shaft length

Text Books

1. K J Rawson and E C Tupper "Basic Ship Theory", Longman, 1976.
2. E.C. Tupper "Introduction to Naval Architecture" by, Butter worth Heinemann
3. H. Schneekluth and V. Bertram, "Ship Design for Efficiency and Economy",2nd edition, Butterworth-Heinemann, 1998

Reference Books

1. Yasuhisa Okumoto, Yu Takeda, Masaki Mano, "Design of ship hull structures" Springer Publications, 2009

Robert Taggart, "Ship design and construction", SNAME Publications

21CBNA72	Construction of Offshore Structures	L - 3	T - 0	P - 0	C - 3

Course Objectives: To develop student's ability to understand practical aspects of fabrication and construction of offshore structures, Deep Sea operations, Phenomena for Deep-Sea Operations, Properties of Materials for the Deep Sea, Platforms in the Deep Sea, launching, Removal of Offshore Platforms, Removal of Piled Structures, etc.

Unit I Introduction **9**

Introduction to constructability, Construction stages for offshore structure. Principle of constructability, Facilities and methods for fabrication, Launching, Assembly and Jointing Afloat, Material Selection and procedures, Access, Tolerances, Survey control, Quality control and assurance, safety, Control of construction: Feedback and Modification, Contingency Planning, Manuals, On-site Instruction Sheets, Risk and reliability Evaluation.

Unit II Construction in deep sea **9**

Construction in deep sea, Considerations and Phenomena for Deep-Sea Operations, Properties of Materials for the Deep Sea, Platforms in the Deep Sea: Compliant Structures: Guyed Towers, Compliant (Flexible) Tower, Articulated Towers, Tension-Leg Platforms (TLP's), SPARS, Ship-Shaped FPSOs, Deep-Water Moorings, Construction Operations on the Deep Seafloor, Deep-Water Pipe Laying, Seafloor Well Completions, Deep-Water Bridge Piers.

Unit III Decommissioning of offshore platform **9**

Removal of Offshore Platforms, Removal of Piled Structures (Terminals, Trestles, Shallow-Water Platforms), Removal of Pile-Supported Steel Platforms, Removal of Concrete Gravity: Base Offshore Platforms, New Developments in Salvage Techniques, Removal of Harbor Structures.

Unit IV Marine structures in arctic sea floor **9**

Arctic Marine Structures, Sea Ice and Icebergs, Atmospheric Conditions, Arctic Seafloor and Geotechnics, Oceanographic: Ecological Considerations, Logistics and Operations, Earthwork in the Arctic Offshore, Ice Structures.

Unit V Pipeline installation **9**

Steel and Concrete Structures for the Arctic: Steel Tower Platforms, Caisson-Retained Islands, Shallow-Water Gravity-Base Caissons, Jack-Up Structures, Bottom-Founded Deep-Water Structures, Floating Structures, Well Protectors and Seafloor Templates, Deployment of Structures in the Arctic, Installation at Site, Ice Condition Surveys and Ice Management, Durability, Constructability, Pipeline Installation, Current Arctic Developments

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Outline the construction stages and principles of fabrication survey, QCQA, safety standards, and Identify the K factors
- CO2 Make use of recommended practices and rule book to construct the types of offshore structures
- CO3 Examining the structures and concluding for decommissioning of offshore structures and its methods based on various sea conditions
- CO4 Analyze various sea conditions and its criteria for arctic sea conditions
- CO5 Explain the methods of pipeline installations

Textbooks

1. API recommended practice 2A-WSD, "Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms" - Working Stress Design
2. B.C Gerwick, "Construction of Marine and Offshore Structures", CRC Press, Florida, 2000.
3. Subrata K Chakrabarti, "Handbook of Offshore Engineering", Vol 1, Vol 2, Elsevier Publishers, 1st edition, 2005.

Reference Books

1. Libros y Manuales de Ingenieria, "Construction of Marine and Offshore Structures", 3rd Edition, CRC Press.
2. McClelland, B & Reifel, M.D., "Planning & Design of fixed Offshore Platforms", Van Nostrand, 1986
3. Graff, W.J., "Introduction to Offshore Structures", Gulf Publ. Co. 1981.

21CBNA73	Finite Element Analysis	L – 3	T – 0	P – 0	C – 3

Course Objectives: To impart the student with the basic knowledge about finite element analysis of structural elements which will be useful for the design of ships and offshore structures. This subject cover one dimension and two-dimension FEM, isometric elements, analysis of plates and application of FEM.

Unit I Introduction **9**

Concepts of FEM – steps involved – merits and demerits – energy principles Discrimination – Raleigh – Ritz method of functional approximation. Principles of Elasticity: Stress equations – strain displacement relationships in matrix form plane stress – plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

Unit II One dimensional and Two-Dimensional FEM **9**

One dimensional FEM: Stiffness matrix for beam and bar elements – shape functions foe ID elements. Two-dimensional FEM: Different types of elements for plane stress and plane strain analysis displacement models – generalized coordinates – shape functions – convergent and compatibility requirements – geometric invariance – natural coordinate system – area and volume coordinates – generation of element stiffness and nodal load matrices

Unit III Isometric elements **9**

Concept – different Isoparametric elements for 2D analysis -formulation of 4-noded and 8-noded Isoparametric quadrilateral elements – Lagrange elements – serendipity elements. Axi Symmetric Analysis: bodies of revolution – axi-symmetric modeling – strain displacement relationship – formulation of axi symmetric elements.

Unit IV Analysis of Plates **9**

Introduction to Finite Element Analysis of Plates: basic theory of plate bending – thin plate theory –stress resultants – Mindlin's approximations – formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

Unit V Applications of FEM **9**

Introduction to non – linear analysis – basic methods – application to Special structures- Three-dimensional FEM: Different 3-D elements-strain-displacement relationship –formulation of hexahedral and Isoperimetric solid element.

Total hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Formulate the finite element mathematical modeling concepts for boundary value engineering Problems.
- CO2 Analyze the problems in one dimensional structure including trusses, beams and frames
- CO3 Analyze the problems in Isometric Elements
- CO4 Analyze the problems in Plate Elements
- CO5 Apply the finite element method to solve two- and three-dimensional problems

Textbook:

1. Robert D.Cook, David S, Malkus and Michael E. Plesha, "Concepts and Applications of Finite Element Analysis" Wiley, 1989.
2. OC Zienkiewicz, "Finite element Methods" Butterworth Heinemann, 5th edition, 2002
3. GS Krishna Murthy, "Finite element analysis, theory and programming" 2nd edition, Mc-graw Hill publishing.

Reference Books:

1. Tirupathi Chandra Patila and Belugunudu, "Introduction to Finite elements in engineering" Pearson Education Limited, 2014
2. JN Reddy, "Introduction to Finite element Method", McGraw-Hill, 2006.

21CBNA74	Standards and Recommended Practices	L - 3	T - 0	P - 0	C - 3

Course Objectives: This course will enable the student to understand the various standards and rules available for the design of ships and offshore structures. The rule includes ILO and ILLO regulations, Standards of Training, Certification and Watch keeping, etc.

UNIT I IACS and IMO regulations **9**

Codes and regulations for international association of classification society (IACS AND MEMBERS IN IACS), International Maritime Organization (IMO), Marine Pollution (MARPOL), Safety of life at sea (SOLAS).

UNIT II ILO and ILLO regulations **9**

Codes and regulations for International Labour organization (ILO) – International Regulations for Preventing Collisions at Sea (COLREG) –(ILLO) – (IMS) – The International Ship and Port Facility Security (ISPS)

UNIT III STCW regulations **9**

Standards of Training, Certification and Watch keeping for Seafarers (STCW) – SHIP RECYCLING – Emergency Position Indicating Radio Beacons (EPIRB) – Global Maritime Distress and Safety System (GMDSS)

UNIT IV Recommended practices **9**

Codes and regulations for Offshore Rules, MODU Rules, API CODE – DNV RP Codes and Recommended Practices, NORSKE Standards

UNIT V Offshore codes **9**

API 16Q for drilling riser - API 2RD for production Riser - API 17 A Design and operation of subsea production system - API 17 B for Flexible pipes, API 17 C to K - ISO 13628 Design and operation of subsea system – AWS – NACE - IMO

Total hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Compare the regulations of IMO and IACS standards
CO2	Choose the best IACS standards for the constructions of the vessel
CO3	Explain the regulations of the ILO and ILLO
CO4	Improve the knowledge about the Classification societies and their functions
CO5	Select the Offshore codes for the construction

Text Books

1. IMO Publications and documents
2. Dawson, T.H., “Offshore Structural Engineering” Prentice Hall, 1983
3. API RP 2A., “Planning Designing and Constructing Fixed Offshore Platforms”, API
4. McClelland, B & Reifel, M.D., “Planning & Design of fixed Offshore Platforms”, VanNostrand, 1986

Reference Books

1. Graff, W.J., “Introduction to Offshore Structures”, Gulf Publ. Co. 1981.
2. Reddy, D.V & Arockiasamy, M., “Offshore Structure”, Vol.1 & 2, Kreiger Publ. Co 1991
3. Morgan, N., “Marine Technology Reference Book”, Butterworths, 1990.

21PBNA71	Shipyard Training	L - 0	T - 0	P - 3	C - 1

Course Objectives: The students will be attached to various shop floors in the shipyard to observe and study the shipyard practices during the summer vacation. The student will be able to see for himself production of ship and offshore structure at various stages. They are to submit their workbook on completion of shipyard attachment.

They will study and familiarize themselves with the following,

1. Shipyard Layout
2. Shipyard Organization Chart
3. Dry-dock Layout
4. Services in dry dock
5. Types of dock blocks
6. Dry dock gate arrangements
7. Various stages of hull erection
8. Plate preparation arrangement
9. Types of plate surface preparation
10. Mechanical engineering workshops
11. Electrical workshop
12. Out fitting arrangement in the out-fitting wharf

Total Hours: 40

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Know the outline of shipyard practices and various departments
CO2	Classify and understand the different types of drydocks
CO3	Explain and Summarize about the shipyard layout and organization chart
CO4	Take part in the hands-on training on various sections in shipyards
CO5	Combine the overall knowledge gained from shipyard and create a training report

21RBNA71	Minor Project	L - 0	T - 0	P - 6	C - 2

Course Objectives: To develop student's ability to understand and carry out project work on a chosen topic independently and submit for evaluation. This will enhance the student's independent thinking and ability to work independently on selected topic and carry out research work later.

The students will be allotted minor project from the department and they will have to complete the project and submit the report for evaluation.

Total Hours: 40

21CBNA81	Ports Design and Infrastructure	L - 3	T - 0	P - 0	C - 3

Course Objectives: The objective of this course is to understand the design of Ports and the infrastructure we should have in the ports and harbor. This course will also give in-depth knowledge about the operation of the ports.

Unit I: Introduction **9**

Ports and harbor as the interface between the water and land infrastructure an infrastructure layer between two transport media. The fundamentals: Wave conditions inside harbor – wave disturbance & seiching Water circulation

UNIT II: Breakwater 9

Break water, jetties & quay walls; Mooring, berthing and ship motion inside the port Cargo handling

UNIT III: Design issue **9**

Port layout in regards to (1) wave action (2) situation (3) navigability (AKO) Berthing Facilities
Design of port infrastructure in regards to (1) cargo handling (2) cargo storage (3) integrated transport of goods
Planning multipurpose port terminals

UNIT IV Port operations **9**

Physical aspects: Allowable wave conditions for cargo handling. Wave conditions for human safety on quays and breakwater. Forecasting /nowcasting of wave & current conditions for port operations. Dredging and navigability. Hazard scenarios
Management aspects: VTMS & Management of computerized container terminal. Safety & environment (handling of fire, oil spill, rescue….) Total Quality Management in ports.

UNIT V: Sustainability **9**

Global trades & port restricting / reforms. Impacts of possible climate change scenarios. Sustainable development strategies for cities and Ports

Case Studies:

Layout operations and future issues of one or two existing ports to be analyzed.

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define Port infrastructure, wave conditions in harbor
CO2	Explain berth, moorings and cargo handling
CO3	Design of port infrastructure in regards to cargo handling cargo storage
CO4	Illustrate port operations like dredging and navigability
CO5	Explain port restrictions and impacts of climate changes

Total Hours: 45

21RBNA81	Major Project / Industry Internship Project	L - 3	T - 0	P - 14	C - 7

Course Objectives:

The student will be asked to undergo a technical/non-technical project supervised by the faculty member or tie-up with the industry. Guidelines for the same have framed by the department.

SYLLABUS

PROFESSIONAL ELECTIVE COURSES

21EBNA51	Marine Corrosion and Coating Engineering	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get in depth knowledge about the chemistry of corrosion, galvanic action, type of paints, varnishes, enamels, metallic coatings and protection, surface preparation, coating applications, methods of applications, manufacturers specification, etc.

Unit I Corrosion **9**

Galvanic cell, Formation theory- Differential aeration theory. Factors influencing rate of corrosion. Chemical and electrochemical corrosion, types of corrosion, general methods of prevention and control of corrosion, sacrificial anode method, paints, varnishes and enamels, metallic coatings, hot dipping, galvanizing, electroplating.

Unit II Protective Coatings Application **9**

Paints-definition- components of paints and their functions- Special paints- Luminescent, heat resistant, fire retardant, Anti-fouling paints Health & Safety, Access Systems, Surface Preparation, Paint Types, Paint application and various methods, Paint Manufactures specification, Coating Inspection and Coating Inspection Equipment

Unit III Abrasive Blast Cleaning **9**

Abrasive Blast Cleaning Introduction, Health and Safety, Blast Media, Abrasive Blast Cleaning Standards & Quality Control, Abrasive Blast Cleaner Operational procedures, Process Control, Bead blasting, Hydro-blasting, Micro-abrasive blasting, Automated blasting.

Unit IV Paint Spraying& inspection **9**

Introduction, Health and Safety, Paint Materials, Airless Spray Equipment, Conventional Air Spray Equipment, coating failures, metallic coating, design and construction, concrete, coating surveys, paint manufacture specialist coating, ISO and other international standards, quality management, paint testing, paint thickness measurement (dry and wet) , soluble slats, fire protection

Unit V IMO& NACE Guidelines **9**

Marine PSPC, External corrosion and Coating Surveys, Cathodic Protection, Metallic Coatings, Specialist Coatings, Pipeline and facility external corrosion control, Facilities and pipelines cathodic protection design, Pipeline Coatings, and pipeline coating inspection, Pipeline HVAC induced interference, Coating Failures Degradation mechanisms and their control, Paint Repair Technologies, Estimation of paints qty.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Define corrosion life and select the methods of corrosion protection
- CO2 Explain the knowledge about the paint schemes and types
- CO3 Develop the requirement of the cathodic protection
- CO4 Perceive the knowledge about the galvanic process and other anti-corrosive processes
- CO5 Evaluate the paint schemes and their Dry film thickness range

Text Books

1. EC Tupper, “Intoduction to Naval Architecture”, Betterworth- Heinemann, UK
2. Lloyds painting manuals
3. Paint manufactures recommendations

Reference Books

1. Painting Schemes of Indian coast guard, shipping corporation of India and Indian navy.
2. ISO and other international standards on painting. Onboard maintenance painting guide, international paints

21EBNA52	Subsea Engineering	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get knowledge about offshore production, gas reserves and fields, subsea production systems, risers FPSOs and FPVs, Pipelines and flowlines - Design and functions – Route survey, Autonomous Underwater Vehicles (AUVs) etc

Unit I Introduction to Subsea Production **9**

Introduction to offshore production, Background to offshore production systems, Global oil and gas reserves and fields, Introduction to offshore exploration and drilling, Introduction to subsea engineering - Building blocks, Subsea Production Systems (SPS) and Umbilicals, Risers and Flowlines (URF)Other elements, Systems design. Types of subsea completions, Extensions to existing platforms, Tiebacks to existing production hosts.

Unit II Production systems **9**

Production systems for floating hosts: Floating Production, Storage and Offloading systems (FPSOs) and Floating Production Vessels (FPVs), Well to beach developments (gas fields)**,** Flow assurance for subsea production systems – Hydraulics, Wax, Hydrates. Wellheads, Xmas Trees and Manifolds-Wellheads, Drilling subsea wells, Wellheads as part of drilling and production operations, Blowout preventers, Design and functions, Installation, Examples, Xmas trees, Types of trees, Dual bore vertical trees and spool/horizontal trees, Design and function, Suppliers, Installation, New developments (drill through and all electric trees) – Examples- Manifolds - Templates - Types of manifolds (wells clustered around manifold or template manifold) - Design and functions - Installation – Examples

Unit III Pipelines, Flowlines and Risers **9**

Pipelines and flowlines - Design and functions - Route survey - Pipe selection of materials and coatings - Installation methods - Operations – Examples. Risers - Requirements and functions - Flexible dynamic risers - Design - Operation and use - Manufacture - Current developments - Hybrid riser towers - Steel catenary risers – Examples

UNIT IV Control Systems, Umbilical's and Equipment Costs **9**

Subsea production control systems - Types - Electro-hydraulic multiplex control systems - Equipment and suppliers - Operations - Installations – Examples. Drilling control systems, Umbilical's - Functions - Design and manufacture - Installation – Examples. Costs of subsea equipment. Underwater Operations, Subsea Maintenance and New Technologies**.** Underwater engineering operations. Subsea Deepwater installation activities. Inspection, maintenance and repair - Shallow water – diver operations - Deepwater diverless interventions - Remote Operated Vehicles (ROVs) - Autonomous Underwater Vehicles (AUVs) Decommissioning activities - Production hosts - Subsea equipment**.** New technologies - Subsea pumping - Subsea processing - Requirements - Systems and examples

UNIT V Subsea Reliability, Subsea Field Development Examples and Case Studies and Decommissioning Activities **9**

Subsea completions - interfaces with other functions, Drilling and well completions, Production hosts - Government authorities. Examples of fields developed with subsea completions. Increased production to existing production host - North Sea fields. Tie back to production host - Gulf of Mexico fields - Norwegian fields. Subsea production to floating host - North Sea fields - Angolan fields - Australian fields - Brazilian fields. Gas fields – deepwater production to shallow water host - MCE (Gulf of Mexico) - Malampaya field (Philippines). Gas fields – well to beach - Orman Lange field (Norway) - West Delta Deep (Egypt)

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Explain subsea production system. and its components and illustrate extension of existing Platforms through subsea developments**.**
CO2	Demonstrate the floating production host with respect to FPSO's and FPV's and explain the concept of Flow Assurance for subsea production including Hydraulics, Wax, hydrates
CO3	Compare the pipeline installation methods and classify the different types of risers used in the subsea technology
CO4	Categorize the subsea control systems including Umbilical and explain its functions
CO5	Explain subsea deep-water installation, inspection, maintenance and repairs.

Text Books:

1. Yong Bai, Qiang Bai, "Subsea engineering handbook", 1st edition, gulf professional publishing, 2012
1. Andrew C Palmer and Roger A King, "Subsea pipeline engineering", 2nd edition, PennWell corporation, 2008

Reference Books:

1. Yong BaI, Qiang Bai, "Subsea pipelines and risers", Elsevier,2005.

21EBNA61	Marine Refrigeration and Air-conditioning	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get knowledge about the refrigeration and air conditioning systems onboard the ship, compression and evaporator systems, Psychometric charts, Marine Refrigerating Plants**,** refrigerated cargo vessel and refrigerated containers, etc.

UNIT I Basic Refrigeration and Air conditioning **9**

Reversed Carnot cycle- vapor compression cycle –Refrigerating effect-co-efficient of performance – cooling capacity-refrigerants and secondary refrigerant used in marine practice and their justification-rating of refrigeration plant –methods for improving C.O.P –use of vapor tables –applied problems

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UNIT II Marine Refrigerating Plants **9**

Refrigeration Cycle, Undercharging of Refrigeration System, Overcharge of Refrigeration System, Typical marine refrigerating plants with multiple compression and evaporator system –heat pump cycles – refrigeration in liquefied gas carriers.

UNIT III Air conditioning **9**

Psychrometric charts-various processes-comfort and industrial A/C –Effective temperature and comfort-chart-unitary and central A/C system Marine Air Conditioning, Principles of air conditioning – psychrometric properties of air – comfort condition – control of humidity – airflow and A.C.Capacity – Calculation for ships plants. Design and construction details of various equipment for air conditioning used in marine practice and their justification and humidity.

Unit IV Marine Refrigeration **9**

Design and constructional details of various equipment used for refrigeration in marine practice, operation and maintenance, Refrigeration and A/C components. Operation, maintenance and troubleshooting of compressors and its unloader lubrication system for different compressors –properties of lubrication for refer compressor. Evaporators- condensers –expansion devices- thermostatic switches- solenoid valves-low pressure and high pressure but Out switches. Gas leak detection- rectification and charging of gas.

Unit V Refrigerated Cargo Vessels and Refrigerated Containers **9**

Refrigerated cargo vessel- hold arrangements-air ventilation and circulation systems-insulation-precooling, classification society requirement, survey and certification guidelines, refrigerated containers-guide lines, duties responsibility of marine engineers- ventilation system- controlled atmosphere- carriage of fruit cargoes.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Solve the problem in the thermodynamics cycles

CO2 Describe the refrigeration cycle which is followed in marine vehicles and their systems

CO3 Make use of Psychrometric charts to know the properties of the air like temperature and humidity

CO4 Explain constructional details of various equipment in marine practice

CO5 Illustrate the classification societies requirements, survey and certificate guidelines

Textbooks:

1. Arora C.P. “Refrigeration & Air Conditioning”, 1st adition, Sri Eswar enterprises, Chennai
2. Stoecker, Willbert.F Jones, Jerold.W., “Refrigeration and air conditioning”, 2nd edition, Tata McGraw-Hill, Delhi 1985

Reference Books:

1. D.A.taylor, “ Introduction to marine Engineering”, 2nd Edition, Butter Worth, London
2. J.R.Stott, “Refrigerating Machinery and Air Conditioning Plant”, 1st Edition, The Institute of marine engineers, London, 1974, Reprint 1998.

21EBNA62	High Performance Marine Vehicles	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get knowledge about the design aspects of non-conventional vessels, high speed crafts and special type of vessels. This will include mono hull, multi hulls, catamaran, trimaran, SWATH vessels, and other unconventional hulls, etc.

UNIT I Introduction **9**

Introduction: Basic differences between conventional and high-performance crafts - Special features - Types – Monohull - planning craft - hydrofoil craft - air cushion vehicles – Multihulls – Catamaran – trimaran - SWATH vessels - Unconventional hulls

UNIT II Hull forms **9**

Hull forms - aero and hydrodynamic force - stability criteria, resistance of very slender hulls, in particular importance of form factors, transom stern effects prediction of form factors for transom stern vessels, effect of water depth on HSE resistance.

UNIT III Resistance Prediction methods **9**

Resistance prediction methods for HSE, regression, methods, potential flow methods, assumption and boundary conditions, This Ship theory, assumptions, approximation, key results, transom flow modeling, application to optimization, Introduction to Kelvin-Neumann approach, full non-linear potential flow methods, CFD, hybrid methods, Wave wake, background to problem, aspirations, for wave wake criteria, maximal way height criteria, wave energy and energy flux criteria, designing for minimal wave wake.

UNIT IV Powering and Propulsion **9**

powering and propulsion - seaworthiness - maneuvering and control - structures and materials. Comparative performance and applications - maritime operational requirements. General features of marine water jets, water jet theory, mass flow rate, Gross thrust, net thrust, momentum drag.

UNIT V Water Jet and SWATH **9**

Water jet propulsion, efficiency of water jet systems and losses, cavitation consideration, preliminary design of water jets, general design characteristics of SWATH and comparison to catamaran, Sea keeping design consideration. Dynamic stability of SWATH, control design, motion sickness and comfort factors, damage stability standards

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Demonstrate the concept behind the designing of various high-speed crafts
- CO2 Illustrate the various hull forms used in designing od small craft vessels
- CO3 Interpret the various methods in predicting the resistance of various high-speed crafts
- CO4 Explain the concept behind the powering of high-speed crafts
- CO5 Adapt the new technologies in designing of novel small crafts

Text Books

1. Lewis, Edward V. “Principles of Naval Architecture: Resistance, Propulsion and Vibration”, Vol 2, Society of Naval architects and Marine Engineers. 1990
2. Rawson, KJ and Tupper EC “Basic Ship Theory”, Longman. 1976

Reference Books

1. Muralidhar, K and Biswas, G “Advanced Engineering Fluid Mechanics”, Cambridge University Press, John Wiley, 1996.
2. Rama Durghaiah, D, “Fluid Mechanics and Machinery”, New Age International Publishers, 2002.

21EBNA71	Ship Trials	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will learn the various harbor and sea trials to be carried out for a vessel prior to commissioning and handing over to the owner. The trials will include harbor trials, sea trials, maneuvering trials and speed trials which is a contractual obligation.

UNIT I Installation Inspection **9**

Ships Machinery Installation including main engines – generators - pumps - compressors and air reservoirs – eductors - steering gear and steering gear system - fire main pumps and systems, deck machineries, boat davits, anchor and anchor chain cable system etc., Inspection by Surveyors - Complete Shaft alignment checks.

UNIT II Basin Trials (Harbor Trials **9**

Start main engine in alongside condition, precautions to be taken, check marine engineering parameters start generators, monitoring performance, paralleling of generators, synchronizing of generators, load sharing, throw output. Start compressors and monitor performance. Fill up the Air reservoirs and note down the timing. Start sea water pumps, bilge educators and other auxiliary machinery. Conduct steering / Rudder trials, Anchor trials in harbor.

UNIT III Sea Trials **9**

Observe the performance of all auxiliary machineries at sea and record the performance, Anchor Trials at sea by lowering and hoisting of anchor, Record the readings, run main engine at various regimes and observe the performance.

UNIT IV Maneuvering trials **9**

Evaluating maneuverability by Maneuvering trials, turning circle trials, various terms involved in turning circle, ships heeling while turning – zig zag maneuvering, Spiral maneuvering, Pull Out Maneuvering, Crash Stopping, Contractual Obligation, contractual clause - penalty clause - Speed trials - measured mile run.

UNIT V Maneuvering devices **9**

Maneuvering devices such as rudders, special rudders, active rudders, kitchen rudders- Other devices such as vertical axis propeller, cycloidal rudder, flap rudder, lateral thrust units, rotating propulsion pods, rudder forces and torque, ships handling at slow speed, broaching, ships handling at shallow and confined waters, interaction between ships, dynamic stability and control of submarines, underwater vehicles.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Define the ship machineries and their functions

CO2 Explain the functions of main engine, generator and other machineries

CO3 Illustrate the performance of all auxiliary machineries at sea and record the performance

CO4 Evaluate the maneuverability by Maneuvering trials, turning circle trials, various terms involved in turning circle, ships heeling while turning

CO5 List the devices such as rudders, special rudders, active rudders and propeller

Text Books:

1. K J Rawson and E C Tupper, “Basic Ship Theory”, Longman, 1976
2. Lewis, E.U.; “Principles of Naval Architecture”, (2nd Rev.), SNAME, New Jersey, U.S.A.

Reference Books:

1. Robert Taggart, “Ship design and construction”, SNAME Publications

21EBNA72	Computational Fluid Dynamics	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will gain knowledge about theoretical computational and experimental methods, flow models, wave dominated flow, boundary element method, finite volume method, finite difference method and finite element method, etc.

UNIT I Introduction **9**

Introduction: Theoretical computational considerations and implementation; experimental validation. Hierarchical flow models: Potential flow, panel methods.

UNIT II Flow model **9**

Numerical solutions of boundary layer, incompressibility, vorticity and irrotationality, irrotational and incompressible boundary conditions. Potential flow models, linearity, example of flow around a circle, convection of fluid, wave-dominated flow, solution of linear convection.

UNIT III Boundary element method **9**

Relative merits and practical utilization of boundary element method, finite volume method, finite difference method and finite element method.

UNIT IV Design and creation of grids **9**

Design and creation of grids: structured and unstructured mesh generation, mesh adaptation, numerical stability

UNIT V Capturing the essence of turbulence **9**

Capturing the essence of turbulence: modeling approaches, Reynold's stress in RANS-based models, large eddy simulation.

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Define the theories behind fluid computations
CO2	Understand the flow model for different flows
CO3	Compute the flow using boundary element method
CO4	Design grids and mesh
CO5	Understand the turbulence phenomena

Text books

1. J.D.Anderson. CFD: The basics with applications, ed 6, 1995
2. D.C.Wilcox, Turbulence modeling for CFD.

Reference Books

1. H.K.Versteeg and W Malalasekera: An introduction to CFD – The Finite volume method.
2. P.Knupp and S.Steinberg. Fundamentals of grid generation, CRC press 1994.

21EBNA81	Design of floating offshore structures	L - 3	T - 0	P - 0	C - 3

Course Objectives: The student will get in depth knowledge about the floating offshore structures, semi-submersible, Heave RAO Calculation, functions and configurations of TLPs, design of Spar platform, Turret Design, design of drill ships, Design and conversion of FPSO, FPS, etc.

Unit I Semi-Submersible **9**

Design of semi-submersible: Functions and Configurations of Semi-submersibles, Sizing of Semi-submersibles, Initial Design Process, Heave RAO Calculation, Weight and Buoyancy Estimates, Semi-submersible Hull Structure, Design Example

Unit II Functions and Configurations of TLPs **9**

Design of TLP: Functions and Configurations of TLPs with applications, TLP Mechanics, Sizing of TLP, Weight Estimates of TLPs, Design Example, mooring line analysis, Weight and Buoyancy Estimates, pretension in tethers, response analysis of various degrees of freedom.

Unit III Design of Spar platform **9**

Design of Spar platform: Spar Description, Spar Riser Systems, Spar Mooring, Spar Sizing, Drilling from a Spar, Spar Construction and Installation, Mathieu instability, Roll - pitch analysis - new configurations and applications in spar design - Design Example

Unit IV Design and conversion of FPSO, FPS **9**

Design and conversion of FPSO, FPS: FPSO Hull Design, evaluation of different hull configurations, Hull Structure, Deck Structure, reserve of strength, corrosion margin and corrosion rates, field design life, environmental conditions, estimation of conversion work package, Turret Design and Selection, Stages of conversion such as tower-yoke, calm, calm-yoke, Design Example.

Unit V Design of Drillship **9**

Design of Drillship: Design Considerations, Loads, Initial Scantling Evaluation, Total Strength Assessment, Topside and Hull Interface Structures, Fatigue Strength Assessment of Drill ships, Material Selection, Design Example

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Demonstrate the concept behind the design process weight estimation buoyancy and RAO factors for Semisubmersibles
CO2	Illustrate the design configuration and analysis weight estimation for Tension Leg Platform
CO3	Interpret the design consideration for SPAR Platforms
CO4	Explain the design concept of FPSO, FPS
CO5	Summarize the various design concepts of drillships

Text Books

1. Subrata K Chakrabarti, “Handbook of Offshore Engineering”, Vol 1, Elsevier Publishers, 1st edition, 2005.
2. Subrata K Chakrabarti, “Handbook of Offshore Engineering”, Vol 2, Elsevier Publishers, 1st edition, 2005.
3. Jeom Kee Paik and Anil Kumar Thayamballi, “Ship-Shaped Offshore Installations Design, Building, And Operation”, Cambridge university press, 2007

Reference Books:

2 Hiroshi Iwasaki, “A preliminary design study of Tension Leg Platform”, Massachusetts Institute of Technology, Department of Ocean Engineering, 1981

API, ABS, DNV codes

21EBNA82	Underwater Acoustics	L - 3	T - 0	P - 0	C - 3

Course Objectives:

The Objective of this course is

- To understand the fundamentals of underwater operations
- To gain knowledge in systems and machinery used in underwater

UNIT – 1: Sound **9**

Wave motion, Sound pressure, Reference intensity, Source level, Radiated power, Limitations to sonar power, Cavitation, Interaction, Changes to arrays, Projector sensitivity, Hydrophone sensitivity, Spectrum level, Sound in air and in sea water. Propagation of Sound in the Sea - Propagation loss, Losses, Spreading losses, Absorption losses, Spherical spreading and absorption, Propagation in the real ocean, The speed of sound, Sound speed profiles, Deep sound channel, Reliable acoustic path, Surface duct propagation, Convergence zone propagation, Bottom bounce propagation, Propagation loss models, Ray theory and the Hodgson model, Hodgson example, Performance prediction, Multipath propagation

UNIT – 2: Arrays **9**

Need for projector arrays, need for hydrophone arrays, Beam patterns, Directivity of a dipole, The general line array, Shading, Shaded arrays: transmit source levels, Directivity index, Line array: beam pattern vs. steer angle, Broadside array: length and spacing, Beam pattern for a continuous line, DI of a simple dipole, DI of a line array, DI of a planar array, DI of a cylindrical array, DI formulae based for simple arrays, Conformal arrays, Spherical arrays, Volumetric arrays, Beam formers, Domes and arrays.

UNIT – 3: Noise in Sonar Systems **9**

Sources of noise, Thermal noise, Noise from the sea, Noise from a vessel, the sonar environment, Self-noise, Electrical noise, Machinery noise, Flow noise, Propeller noise, Variation with speed, Variation with frequency, Directivity, Self-noise and radiated noise, Addition of noise levels, Receiver noise factor, Noise factor of a sonar, Acceptable receiver noise level, Alternative calculation, Practical values

UNIT – 4: Reverberation **9**

Sources of reverberation, Scattering and reflection, Boundary roughness, Classes of reverberation, Backscattering, strength, Reverberation target strength, Volume reverberation, Boundary reverberation, Scattering layers, Volume scattering strength, Sea surface scattering strength, Bottom scattering strength, Variation with fi-equency, Reverberation under ice

UNIT – 5: The Sonar **9**

Passive Sonar - Radiated noise, Radiated noise: source level, Nature of radiated noise, Practical values, Broadband and narrowband, Normalization, A Note on Swaths, Passive arrays, Passive aural, Passive displays, Formulae for detection threshold, Active sonar equations, Reverberation index, Reverberation and Target Echoes in the main lobe, and sidelobes, Range, pings and doppler shift, Reverberation rejection by CW pulses, Practical reverberation envelopes, Full and half-beam processing, Beam forming, FM phase binning process, CW processing, Large aperture array, Detection performance

Total Hours: 45

Course Outcomes:

After successful completion of the course, the student will be able to

CO1 Understand the fundamentals in Underwater Acoustics

CO2 Gain knowledge in arrays

CO3 Part knowledge in noises of the underwater system

CO4 Know the reverberation phenomena

CO5 Understand the sonar systems

Textbook:

1. Sonar for Practicing Engineers – A.D. Waite - Third Edition – John Wiley

References:

1. Principles of Underwater Sound – (1983) Robert J Urick – Mc Graw Hill Publications
2. Understanding Active Noise Control C.H. Hansen
3. Underwater Acoustic Systems Rodney F.W

SYLLABUS

GENERAL ELECTIVE COURSES

21GBNA51	Engineering Economics and Management	L - 2	T - 0	P - 0	C - 2

Course Objectives: The student will learn economic science, consumption, utility, business organization, partnership, laws of production, personnel management, competition advertisement and product differentiation, management control: power, authority responsibility and accountability etc.

UNIT I Introduction **6**

Definition – nature and scope of economics science – economics relation between economics decision and technical decision – economic efficiency and technical. Consumption – utility – diminishing marginal utility – indifferent map analysis.

UNIT II Four factors of production **6**

Production: Four factors of production and their peculiarities law of production – increasing – diminishing and constant return forms of business organization proprietorship – partnership joint stock company – division of labour- large scale production price mechanism. Demand and supply-elasticity of demand – different market structures- competition- monopoly- monopolist competition advertisement and product differentiation.

UNIT III Systems concept **6**

Systems concept, management control: power, authority responsibility and accountability; managerial functions conventional structures and relationships, hierarchy; the hierarchy of objectives; management by objectives; different schools of thought in management.

UNIT IV Personnel Management **6**

Personnel Management Recruitment, employment tests labour turnover, operator training; suggestion systems; Industry safety. Wages and Incentives; feature of wages; time and piece rate different incentive plans; profit sharing; job evaluation and ranking; factors of comparison and point rating.

UNIT V Behavioral science and psychology **6**

Scope and methods of behavioral science and psychology. Basic psychological processes perception, motivation, learning and retention. Psychology of individual differences – the concept of personality, measurement and assessment of personality. S-O-B model; A conceptual scheme for the understanding of work performance and behaviour of individuals and groups in the organization context. Marketing Management: Concept of marketing in sales approach product principles of accounting and finance statements.

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Define Scope of economic sciences relation between economics decision and technical decision
- CO2 Perceive the factors of production and their peculiarities law of production and division of labour- large scale production price mechanism
- CO3 Explain system concepts management control power and accountability
- CO4 Define personnel management, Industrial safety, wages, incentive profit sharing
- CO5 Explain basics of psychological process learning and retention and concept of marketing management

Text Books

1. R.R. Borthwal "Industrial Economics-An introductory text", New age, International publication, 2nd edition.
2. Paul A. Samuel, "Economics – An Introductory analysis" Mcgraw hill, 1961.

Reference Books

1. Stephen P. Robbins; "Organizational Behaviour – Concepts Controversies Application," Prentice – Hall Pvt.' New Delhi, 1996
2. Fred Luthans, "Organizational Behaviour", Mcgraw – Hill Inc,1995

21GBNA52	Production and Project Management	L - 2	T - 0	P - 0	C - 2

Course Objectives: The student will learn production design, application of the principles of design for production in shipbuilding – joining of parts, ship building process planning, scheduling, process analysis and flow process charts, controlling the ship building process to meet the delivery date of the ship.

UNIT 1 Production design **6**

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), quality control.

UNIT II Problems of accuracy **6**

Problems of accuracy - tolerances, standards, measuring techniques (theodolite, laser, etc); quality control. 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 selection.

UNIT III Planning, scheduling and controlling 6

Application of models for process planning, scheduling and control - Gantt charts, CPM & PERT, transportation models etc.; Special aspects of application of these in shipbuilding process. Procedure control and systems control of production, time and motion study, material control and plant safety, industrial relations, personal management, training human relations, labour organization, dry docking and maintenance of ships.

UNIT IV Capacity planning **6**

Capacity planning - estimation of future capacity of shipyard methods, strategies for modifying capacity, models for capacity planning under the special conditions of shipbuilding - classes of capacity planning - lead strategy, lag strategy, match strategy, adjustment strategy.

UNIT V Production standards **6**

Production standards - production standards in several parts of the ship production. Process. Work measurement systems, methods of man - hour determination, use of computers, correlation between size of series and needed man – hours. Systems of maintenance and quality control. Shell plate development & Nesting, Application of Gantt-charts and network techniques. Design of a panel -line and capacity calculation, design of a special part of a shipyard layout (e.g., steel stockyard, dry-dock)

Total Hours: 30

Course Objectives:

After successful completion of the course, the student will be able to

CO1	Relate the structural design and prefabrication
CO2	Define the process planning in shipbuilding and production and process analysis
CO3	Apply the process planning, scheduling and control - Gantt charts, CPM & PERT
CO4	Estimate of future capacity of shipyard methods, strategies for modifying capacity
CO5	Apply the Gantt-charts and network techniques and capacity calculation

Text Books

1. Taggart, “Ship design and construction”, SNAME chapter 15, 1980
2. Storch R. Lee, Hammon C.P. & Bunch H.M. “Ship Production”, Cornell Maritime Press, Maryland, USA, 1988
3. Eyre’s D.J. “Ship Construction” William Heinemann Ltd, London, 1982

Reference Books

1. Dormidontov V. K. “Shipbuilding Technology”, Mir publishers, Moscow.
2. Buffa, “Modern production operations management”, 6th edition, Wiley 1980

21GBNA61	Total Quality Management	L - 2	T - 0	P - 0	C - 2

Course Objectives:
To facilitate the understanding of Quality Management principles and process. Better capture and conversion of the quality needs.

Unit I Introduction **6**
Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM framework – contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer complaints, customer retention – costs of quality.

Unit II TQM Principles **6**
Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, SS, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

Unit – III TQM Tools and Techniques I **6**
The seven traditional tools of quality – New Management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – stages, Types.

Unit – IV TQM Tools and Techniques II **6**
Control Charts – Process capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – concepts, improvement needs – Performance measures.

Unit – V Quality Systems **6**
Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.

Total Hours: 30

Course Outcome:
CO1 Know about the basics of TQM.
CO2 Know the customer focus on TQM
CO3 Understand the Principles of TQM
CO4 Learn improvement process in TQM
CO5 Know about Tools & Techniques

Text Books:
1. Dale H. Besterfiled, et at; “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint 2006

Reference Books:
1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006
3. Janakiraman.B and Gopal R.K., “Total Quality Management – Text and cases”, Prentice Hall (India) Pvt. Ltd., 2006

21GBNA62	Quality Control and Quality Assurance	L - 2	T - 0	P - 0	C - 2

Course Objectives: The student will understand basic definition of quality, Quality history, Major contributors to quality, quality control, quality assurance, quality management, Cost measurement, Utilizing Quality Costs for Decision-Making, quality planning and development, etc.

Unit I Introduction **6**

Definitions of quality: Quality basics and history, Major contributors to quality, approaches to managing quality, Quality control, quality assurance, quality management, difference between Quality assurance and quality control, quality control measures.

Unit II Total Quality Management **6**

Strategic Quality Management: STQM, Dimensions, measures, and metrics, Garvin's approach to operationalizing quality dimensions, quality planning, key elements of quality planning, quality costs analysis, Cost Measurement, Utilizing Quality Costs for Decision-Making

Unit III Designing Quality **6**

Designing Quality into Products and Services: Seven management tools Quality function deployment (QFD) Design for six sigma (DFSS) Robustness, Reliability, Risk assessment (FMEA and FTA), Design-quality, Conformance quality, quality costs.

Unit IV Customer Requirement **6**

Identification of customer requirements, documentation requirements and control, quality planning, design and development, skilled labour, competence/ training and awareness, quality of purchased products, verification purchased products,

Unit V Quality Inspection and Testing **6**

Identification and traceability, Non-destructive testing, operation control, Dimensions of quality, inspection / testing, measurement and monitoring of products, dock trials, sea trials, standard Waterfall SDL, staged model, v model, evolutionary development.

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Define quality assurance and quality control basics
- CO2 Illustrate strategic quality management
- CO3 Design Quality into Products and Services
- CO4 Identify the customer requirements, documentation requirements and control
- CO5 Explain the Non-destructive testing, operation control, Dimensions of quality

Text Books

1. Frank M Eyne “Quality planning and analysis”, McGraw-Hill, 2001
2. ISO 9001:2008, QMS manuals

Reference Books

1. Madhav N. Sinha, Walter W. O. Willborn, “The management of quality assurance”, Wiley, 1985
2. Storch, Rl, Hammon, Cp, Bunch, Hm & Moore, R; Ship Production, 2nd Cornell maritime Press, 1995, SNAME Publications

21GBNA71	Health Safety and Environment Management	L - 2	T - 0	P - 0	C - 2

Course Objectives: The student will learn about safety, health and environmental management, basic definitions, safety organizations, hazard and hazard control, safety in design and operation, Hazard assessment. Fatality risk assessment, fire prevention, etc.

Unit I Introduction **6**

Introduction to safety, health and environmental management. Basic terms and their definitions of safety in petroleum and offshore industry. Importance of safety in petroleum and offshore industry. Rules on safety regulations.

Unit II Safety **assurance and assessment** **6**

Safety assurance and assessment. Safety in design and operation. Organizing for safety. Hazard, classification and assessment. Hazard evaluation and hazard control

Unit III Environmental issues and Management **6**

Environmental issues and Management. Atmospheric pollution. Flaring and fugitive release. Water pollution- drilling waste, produced water, oil spills, cooling water, processed water- soil waste rock cutting, oil sludge, drilling solid waste, production waste. Environmental monitoring. Environmental impact and decommissioning.

Unit IV Risk assessment **6**

Environmental management. Accident's modeling- release modeling. Fire and explosion modeling. Toxic release and dispersion modeling. Accident investigation and reporting. Concepts of HAZOP and PHA. Risk assessment and management. Risk picture- definition and characteristics. Risk acceptance criteria. Quantified risk assessment. Hazard assessment. Fatality risk assessment. Marine systems risk modeling. Risk management.

Unit V Safety measures **6**

Safety measures in design and process operations- inserting, explosion, fire prevention, sprinkler systems. Principles and methods and concept optimization for offshore petroleum industry. Analysis of case studies from offshore and petroleum industry

Total Hours: 30

Course Outcomes:

After successful completion of the course, the student will be able to

- CO1 Define the Basic terms and their definitions of safety in petroleum and offshore industry
- CO2 Explain the Safety in design and operation. Organizing for safety. Hazard, classification and assessment
- CO3 Explain the Environmental monitoring, Environmental impact and decommissioning
- CO4 Identify the Risk assessment and management. Risk picture- definition and characteristics
- CO5 Analyze the case studies from offshore and petroleum industry

Text Books

1. Skelton, B. "Process safety analysis*",* Gulf Publishing Company, Houston, 210pp, 1997.
2. Jan Erik Vinnem "Offshore Risk Assessment: Principles, Modelling and Applications of QRA studies". Springer, 577pp, 2007.
3. Terje Aven and Jan Erik Vinnem. "Risk Management with applications from Offshore Petroleum Industry". Springer, 200pp. 2007

Reference Books

1. Jorg Schneider. *"*Introduction to Safety and Reliability of Structures". Structural Engineering Documents Vol. 5, International Association for Bridge and Structural Engineering (IABSE), 138pp.1997
2. Lees, F.P. "Loss Prevention in Process Industries: Hazard identification, Assessment and Control", *Vol. 1-3*, Butterwort-Heinemann, Oxford, 1245pp. 1996

21GBNA81	Marine Pollution	L - 2	T - 0	P - 0	C - 2

Course Objectives

1. This course provides basic knowledge about marine environment.
2. To provide the classification of marine pollution.
3. To understand the measure to prevent the pollution.
4. Provide the knowledge about impact of pollution.

UNIT I – Introduction **6**

The oceans – Maritime zones; Need for marine environment protection; Sources of marine pollution.

UNIT II –The Law of The Sea **6**

The law of the sea and marine pollution – Navigation, exclusive economic zone, continental shelf, deep seabed mining, exploitation regime, marine scientific research.

UNIT III – Pollution from Oil & Harmful Substances **6**

Prevention of pollution by oil – operational measures and accidental discharges; Double hulls standards. Control of pollution by noxious liquid substances in bulk – discharge criteria and measures; Types of substances; residues discharge concentrations and conditions.

Prevention of pollution by harmful substances Carried by Sea in Packaged Form – requirements of standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications; Introduction to International Maritime Dangerous Goods Code (IMDG code).

UNIT IV – Pollution by Sewage and Garbage from Ship **6**

Need for pollution control by sewage/garbage; Measures for dumping the garbage; Disinfected sewage disposal and measures. Types of garbage onboard ships; Measures for dumping the garbage; Disposal of all form of plastics into sea.

UNIT V –Prevention of Air Pollution from Ships **6**

Limits on Sulphur oxide and Nitrogen oxide emissions from ship exhausts; Designated emission control areas; Stringent standards for SOx, NOx and particulate matter; Mandatory technical and operational energy efficiency measures.

Total:30 Hours

Course Outcome

After completion of the course, the students will be able to

CO1: Recall the nature of pollution and its possible sources.
CO2: Apply the law of the sea key provisions.
CO3: Apply measures and understand the requirement of pollution from oil and harmful substances.
CO4: Revention of pollution from sewage and garbage.
CO5: Evaluate the air pollution from ships during the initial phase of design.

TEXT BOOKS:

1. International Maritime Organization (IMO) conventions, International Convention for the Prevention of Pollution from Ships (MARPOL), United Kingdom, 2005.
2. United Nations, United Nations Convention on the Law of the Sea, New York.
3. J.W. Doerffer, Oil Spill Response in the Marine Environment, Pergamon Press, 1992, ISBN 0-08-041000-6.

References:

4. John H. Bates, UK Marine Pollution Law, Lloyd's of London Press, 1985, ISBN 1- 85044-028-X.
5. Ricardo Beiras, Marine Pollution–Sources, Fate and Effects of Pollutants in Coastal Ecosystems, Elsevier, 2018.
6. R.B. Clark, C. Frid and M Atttrill, Marine Pollution, 4th Edition, Oxford Science Publications, 1997, ISBN 0-19-850069-6

SYLLABUS

VALUE ADDED COURSES

21VBNA01 SHIP HULL SURVEY AND REPAIR

Course Objectives:

- To define the responsibilities of the classification society people
- To explain the rules and regulations of the new ship building processes
- To adopt the knowledge about the statutory and periodical surveys

Unit-1 Repair of Ship Hull **9**

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.

Unit-2 Underwater welding & Ship Repair facility **9**

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.

Unit-3 Marine surveys & Marine Surveying Agencies **9**

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

Unit-4 Ship Classification Societies **9**

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.

Unit-5 Statutory Surveys & Other Bodies **9**

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.

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Compare different types of repair activities, Repair of hull
CO2	Define the problems encountered in repair, facilities in shipyard,
CO3	Explain about marine surveys, activities of classification societies
CO4	Compare various classification societies and their standards
CO5	Inspect the various parts of ship and guide the workers with regulations

Textbook

1. Witherby (IACS) General Cargo Ships, Guidelines for surveys Assessment and Repair Hull Structures
2. Witherby (IACS) Surveyors Guidance

21VBNA02 RISERS AND MOORING LINES

Course Objectives:

This program provides an intensive learning experience in the aspects of theory and practical areas of Offshore Engineering. This curriculum covers all the necessary inputs to provide expertise in Designing Risers and Mooring Lines

Unit I Introduction **9**

Historical Background, Upstream, Downstream, Middle Stream, Oil & gas development options

Unit II Risers **9**

Riser Background, Types, Application, Static & dynamic analysis

Unit III Mooring **9**

Mooring Background, Types, Application, Static & dynamic analysis

Unit IV: Vortex Induced Vibration **9**

Flow around circular cylinders: VIV - Vortex-induced vibration, derivation and calculation

Unit V: Tutorials Coursework & Presentations **9**

Riser Calculations, Mooring line calculation, Development in Riser and Mooring Line Technology

Course Outcomes:

After successful completion of the course, the student will be able to

CO1	Explain the basic concepts of Risers and Mooring lines behavior
CO2	Examine the forces acting on the Risers and explain the different types of risers
CO3	Evaluate the forces acting on the moorings and explain the types of mooring lines
CO4	Understand the concepts of vortex induced vibration
CO5	Evaluate the problems in designing of risers and mooring lines

Text Books

1. Subrata K Chakrabarti, “Handbook of Offshore Engineering”, Vol 1, Elsevier Publishers, 1st edition, 2005.
2. Subrata K Chakrabarti, “Handbook of Offshore Engineering”, Vol 2, Elsevier Publishers, 1st edition, 2005.