Bangladesh Maritime University

Uniform Curriculum

of

B.Sc (Honours) in Marine Engineering
For 7 Marine Academies

Bangladesh Marine Academy, Chattogram
Bangladesh Marine Academy, Pabna
Bangladesh Marine Academy, Barisal
Bangladesh Marine Academy, Rangpur
Bangladesh Marine Academy, Sylhet
Marine Fisheries Academy, Chattogram
International Maritime Academy, Gazipur

Effective from the Session: 2025 -26 Onwards

AUTHORITY OF PUBLICATION

1. A curriculum Committee formed vide memorandum no. BSMRMU/FSA/DEAN-658/24/355 dated 23 June 2024 drafted the curriculum of B.Sc (Honours) in Marine Engineering Program [Committee approved by syndicate meeting vide memorandum no. ……]. The committee comprises the following members:

SI NO	Name	Designation
a.	**Cdre. Md. Atiqur Rahman, (G), NUP, NPP, afwc psc, PhD, BN** Dean, Faculty of Shipping Administration Bangladesh Maritime University	President
	Faculty Members of FSA	
b.	**Mohammad Nazmus Sakib** Assistant Professor, Department of Maritime Science Bangladesh Maritime University	Member
c.	**Shohida Aktar** Lecturer, Department of Port and Shipping Management Bangladesh Maritime University	Member Secretary
	Representative from the Affiliated Marine Academies	
d.	**MarEngr. Md. Humayun Kabir** Commandant Bangladesh Marine Academy, Sylhet	Member
e.	**MarEngr Md. Zakir Hossain** Chief Engineer Bangladesh Marine Academy, Rangpur	Member
f.	**Lieutenant Commander Kazi Sadiquzzaman Pias, (E), BN** Engineering Instructor Bangladesh Marine Academy, Barishal	Member
g.	**MarEngr Md. Abdullahel Kafee** Chief Engineer International Maritime Academy, Gazipur	Member
h.	**MarEngr Sharif Ahmad** Chief Engineer Marine Fisheries Academy, Chattogram	Member
i.	**MarEngr Md. Ahsan Jan Chowdhury** Chief Engineer Bangladesh Marine Academy, Pabna	Member

	External Members nominated by the Vice Chancellor	
j.	**MarEngr Md. Arafat Hossain** Engineer & Ship Surveyor & Examiner Department of Shipping	Member
k.	**Dr. Kazi Khadem-Ul-Islam Shahidullah** Asst. Professor & Curriculum Expert Bangladesh University of Professionals	Member
	Expert Members nominated by Academic Council	
l.	**MarEngr Md. Azizur Rahman** Engineering Instructor Bangladesh Marine Academy, Chattogram	Member
m.	**Tapas Bhowmik** Assistant Professor, Department of Port & Shipping Management Bangladesh Maritime University	Member

2. After reviewing the curriculum of similar Marine Engineering programs from several renowned marine academies and universities abroad, the curriculum committee prepared a draft curriculum for the B.Sc (Honours) in Marine Engineering program.

3. The curriculum of the B.Sc (Honours) in Marine Engineering program has been developed in alignment with STCW standards, IMO Model Course 7.04, Bangladesh National Qualifications Framework (BNQF), Bangladesh Accreditation Council (BAC), and University Grants Commission (UGC) guidelines. The draft curriculum was subsequently submitted to the Academic Council for approval.

4. After incorporation of the suggestion of the Academic Council (49^{th} meeting held on 11 December 2025, Item no. 06), the curriculum was presented to the syndicate.

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PREAMBLE

The B.Sc (Honours) in Marine Engineering is a four-year undergraduate degree program of Bangladesh Maritime University (BMU), designed to meet national and international requirements in Maritime Education and Training (MET). The program aims to develop competent marine engineering officers through an integrated approach combining theoretical knowledge, practical training, and professional skills, in accordance with the competency-based framework of the STCW Convention, as amended. The program provides comprehensive academic instruction and technical training in the principles, operation, and maintenance of marine engineering systems, including marine propulsion, electrical power generation and distribution, refrigeration and air-conditioning, steering and auxiliary systems, as well as the competencies required for controlling ship operations and ensuring the safety and care of persons on board at both the operational and management levels of marine engineering.

This curriculum applies to all students enrolled in the B.Sc. (Honours) in Marine Engineering program conducted through the Engineering Departments of the affiliated academies of Bangladesh Maritime University, namely:

i. Bangladesh Marine Academy, Chattogram;
ii. Bangladesh Marine Academy, Pabna;
iii. Bangladesh Marine Academy, Barisal;
iv. Bangladesh Marine Academy, Rangpur;
v. Bangladesh Marine Academy, Sylhet;
vi. Marine Fisheries Academy, Chattogram; and
vii. International Maritime Academy, Gazipur.

The provisions of this curriculum shall likewise apply to any marine academies that may be affiliated with Bangladesh Maritime University in the future, ensuring uniformity and academic equivalence across all affiliated institutions.

The curriculum has been developed primarily in accordance with the STCW Convention and Code, ensuring that all learning outcomes, competencies, and practical training align with international seafarer standards. Academic and pedagogical guidance has been drawn from IMO Model Course 7.04 to ensure compliance with STCW requirements and alignment with the regulatory standards of the Department of Shipping (Bangladesh). Furthermore, the curriculum conforms to the academic quality assurance frameworks of the Bangladesh National Qualifications Framework

(BNQF), Bangladesh Accreditation Council (BdAC/BAC), and the University Grants Commission (UGC).

To ensure continued relevance, academic rigor, and regulatory compliance, the curriculum may be reviewed and revised periodically to incorporate amendments to BMU Examination Regulations, international maritime conventions, national regulatory directives, and stakeholder requirements. All proposed revisions shall be examined by the Uniform Curriculum Committee, whose recommendations shall be submitted to the Academic Council of Bangladesh Maritime University for consideration and approval. Any amendment shall come into effect only upon formal approval by the Academic Council.

The Uniform Curriculum Committee shall convene at least once every three years for systematic curriculum review and quality enhancement. Additional meetings may be convened by the President of the Committee as deemed necessary to address urgent academic, regulatory, or industry-driven developments in the maritime sector.

1 Program Description

The B.Sc (Honours) in Marine Engineering is a four-year undergraduate degree program of Bangladesh Maritime University (BMU). The program provides comprehensive academic and technical training in marine engineering systems, covering propulsion, electrical power, refrigeration and air-conditioning, steering and auxiliary systems, as well as the skills needed to operate ships safely and manage marine engineering operations.

The program is divided into 8 semesters of 6 months each, including twelve months On-Board Training/ Industrial Attachment. Total credit for the program is 160 with thesis.

The duration of each semester is 26 weeks. In each semester, 15 weeks are dedicated to classroom learning, while the remaining weeks are utilized for makeup classes, preparatory leave, final examinations, and other curricular and co-curricular activities.

The B.Sc. (Honours) in Marine Engineering program is divided into eight (8) semesters, each of six (6) months' duration, including a total of twelve (12) months of On-Board Training / Industrial Attachment. The program comprises a total of 160 credits, inclusive of a thesis/project component.

Each semester consists of 26 weeks, of which 15 weeks are allocated to classroom instruction. The remaining weeks are utilized for examinations, preparatory leave, recess, and other curricular and co-curricular activities, in accordance with BMU academic guidelines, as detailed below:

The B.Sc. (Honours) in Marine Engineering is a four-year undergraduate degree program offered by Bangladesh Maritime University (BMU). The program provides comprehensive academic and technical training in marine engineering systems, covering propulsion, electrical power, refrigeration and air-conditioning, steering and auxiliary systems, as well as the skills required to operate ships safely and manage marine engineering operations. The program is structured over eight (8) semesters, each of six (6) months' duration, including a total of twelve (12) months of On-Board Training/Industrial Attachment. It comprises a total of 160 credits, including a thesis work.

Each semester consists of 26 weeks, of which 15 weeks are allocated to classroom instruction. The remaining weeks are used for examinations, preparatory leave, recess, and other curricular and co-curricular activities. In accordance with the academic guidelines of Bangladesh Maritime University (BMU), the semester distribution is as follows:

i. Classes	15 weeks
ii. Mid Term Examinations	02 week
iii. Preparatory Leave	02 weeks
iv. Term Final Examination	03 weeks
v. Recess	04 weeks

[This semester structure follows the BMU framework. However, individual affiliated academies may organize and implement their semester activities within this guideline while maintaining overall alignment with BMU academic standards.]

2 **Vision of the Program:**

To be a center of excellence in marine engineering education and training, producing globally competent, ethical, and innovative marine engineering officers to serve the international maritime industry.

3 Mission of the Program:

i. To provide education and training in marine engineering in compliance with national and international standards, including the STCW Convention and Code, and BMU/UGC requirements.
ii. To develop competent, ethical, and globally employable graduates with solid engineering foundations, communication skills, and the ability to work in diverse marine environments.
iii. To equip students with the knowledge, skills, competencies, professional attitudes, and values required for certification as Officer-in-Charge of an Engineering Watch (OICEW) and for effective service on modern seagoing ships.
iv. To deliver an industry-relevant, internationally benchmarked curriculum using state-of-the-art teaching and training facilities and practical learning approaches, fostering research, innovation, analytical thinking, and lifelong learning.

4 Program Educational Objectives

The aim of the B.Sc (Honours) in Marine Engineering Program is to:

I. Provide and equip students with knowledge, understanding, proficiencies, skills, competences, attitudes and values to qualify and prepare them for assessment and certification as Officer-in-Charge of an Engineering Watch (OICEW) in a manned engine-room or designated duty engineer officer in a periodically unmanned engine room on seagoing ships powered by main propulsion machinery of 750 kW propulsion power or more; and
II. Produce graduates who are qualified to pursue a professional career or advanced studies in a related maritime field of specialization.
III. Demonstrate leadership, ethics, and teamwork in multicultural and multidisciplinary maritime environments.
IV. Promote lifelong learning, research, and innovation through analytical thinking, use of modern engineering tools, and continuous professional development for careers or advanced studies in maritime and related fields.

5 Program Learning Outcomes

The graduates of the Bachelor of Science in Marine Engineering program shall have acquired the knowledge and competencies necessary to perform the following:

i. Demonstrate the ability to perform the competence at the operational level under Section A-III/1 of the STCW Code.
ii. Apply knowledge in mathematics, science and technology in solving problems related to the profession and the workplace.
iii. Work in a multi-cultural and/or multi-disciplinary team.
iv. Understand professional and ethical responsibilities.
v. Communicate effectively in oral and written English.
vi. Understand the impact and implications of various contemporary issues in the global and social context of the profession.
vii. Engage in lifelong learning and keep abreast with developments in the field of specialization and/or profession.
viii. Use appropriate techniques, skills and modern tools in the practice of the profession in order to remain globally competitive.
ix. Conduct research using appropriate research methodologies.

6 Enabling Objectives

The Syllabus for the 4-Year **"B.Sc (Honours) in Marine Engineering"** is according to the requirements of STCW conventions as amended by IMO and that of the Department of Shipping, Government of the People's Republic of Bangladesh, for competencies required for "**Officer in charge of an Engineering Watch".** A graduate of the Bachelor of Science in Marine Engineering program is prepared for careers in, among others:

i. Merchant Marine profession
ii. Commercial Marine fishing
iii. Maritime Industry
iv. Ship building and repair
v. Ship operations and management
vi. Port operations and management
vii. Ship surveying and inspection
viii. Offshore industry
ix. Maritime Education and Training
x. Industrial and Commercial Establishment

xi. Government Service
xii. Bangladesh Navy
xiii. Bangladesh Coast Guard
xiv. Maritime Industry Authority, etc.

7 Admission Information

7.1 Admission Requirements: These are the minimum qualifications and standards applicants must meet to be considered eligible:

i. Applicants must have passed SSC and HSC or equivalent examinations in the Science group with a minimum GPA of 4.00. In the HSC or equivalent examination, they must obtain at least 60% marks or GPA 3.50 separately in Physics and Mathematics, and at least 50% marks in English. If an applicant obtains less than 50% marks or GPA 3.00 in English, an overall IELTS score of 5.5 is mandatory.
ii. For English-medium candidates following the Oxford curriculum, a minimum grade of C in at least five subjects, including Physics, Mathematics, and English, in O-Level is required, and a minimum grade of C in A-Level, including Physics and Mathematics, or an equivalent qualification, is mandatory.
iii. Applicants must be citizens of Bangladesh.

7.2 Admission Procedures

7.2.1 Admission Circular:

The admission notice is usually circulated in November through media advertisements and the Department of Shipping website.

7.2.2 Written Examination (Written Method): 100 Marks

Candidates will be selected based on the marks obtained in the admission test as follows:

Subject-wise mark distribution (Total 100):

i. **Physics:** 25 Marks
ii. **Mathematics:** 25 Marks
iii. **English:** 25 Marks

iv. **Bangladesh and General Knowledge:** 25 Marks

The pass mark for the written examination is 50%, and candidates must obtain 50% marks separately in English.

7.2.3 Final Selection:

i. Candidates who pass the written test will be required to participate in a Preliminary physical test, and only those who qualify in the physical test will be allowed to appear in the oral examination.
ii. Before final selection, candidates must successively pass a Psychometric Test, an Eye Examination, and a Final Medical Check-up.
iii. Final merit list along with waiting list will be published on DoS website.

8 Teaching Strategy

The teaching strategy of the B.Sc. (Honours) in Marine Engineering program integrates lecture-based instruction for theoretical courses, demonstrations for laboratory sessions and hands-on training in workshops and simulators. This is complemented by case studies, group discussions, seminars, fieldwork, and twelve months of on-board/industrial training, all designed to develop students' theoretical knowledge, practical skills, analytical abilities, and professional competencies in line with STCW standards.

8.1 Assignment of Credits:

i. For theoretical courses, one lecture of 60 minutes per week per semester is equivalent to one credit hour.
ii. For laboratory courses, 120 minutes of practical work per week per semester is equivalent to one credit hour.
iii. Credit hours are also assigned to study tours, co-curricular activities, presentation and skill development activities, undertaken by students. The allocation of credit hours for such activities varies depending on their nature and academic requirements.

8.2 Conduct of Courses

The following guidelines shall be followed in conducting the courses:

i. At the beginning of the term, the course teacher shall prepare a detailed course outline

incorporating the course syllabus, methods of performance evaluation and grading, a list of recommended textbooks and references, and a tentative schedule of classes, examinations, and academic activities.

ii. Thesis work shall be assigned individually on topics relevant to marine engineering and related disciplines, in accordance with the objectives of the program and approved academic guidelines

iii. Individual and group assignments, presentations, and related academic tasks shall be assigned to students as required by the respective courses.

9 Assessment Strategy

9.1 Grading Scale

Letter grades and corresponding grade points will be awarded by the provisions (unified UGC grading system) shown below:

Grade	Grade points	Numerical Markings
A+	4.0	80% and above
A	3.75	75% to below 80%
A-	3.50	70% to below 75%
B+	3.25	65% to below 70%
B	3.00	60% to below 65%
B-	2.75	55% to below 60%
C+	2.50	50% to below 55%
C	2.25	45% to below 50%
D	2.00	40% to below 45%
F	0.00	below 40%
I	Incomplete	-
W	Withdrawn	-
X	Projects/Thesis continuation	-
E	Expelled	Due to exam offence

9.2 Performance Evaluations

i. **Theoretical Courses:** The performance of the theoretical courses shall be evaluated through continuous assessment and semester final examination. Forty percent (40%) of marks of a course shall be allotted for **continuous assessment** and remaining sixty percent (60%) shall be allotted to the **Semester Final Examination**. The continuous assessment shall include class attendance and participation, quizzes/class test, term paper/assignments/case study and midterm examinations. Distribution of marks is as follows:

Class attendance	05%
Class Participation/Observation	05%
Assignment/Term paper	05%
Quizzes/Class Test	10%
Mid-term Examination (Written)	15%
Final Examination	60%
Total	100%

The basis for continuous assessment awarding marks for **class attendance** will be as follows:

Class Attendance Rate	Allocated Marks
90% and above	100%
85% to 89%	90%
80% to 84%	80%
75% to 79%	70%
70% to 74%	60%
65% to 69%	50%
60% to 64%	40%
59% and below	0%

- The number of quizzes/class tests of a theoretical course will be n+1, where n is the number of the credit hours of the course. Evaluation of performance of quizzes/class tests will be on the basis of best quizzes.
- A number of individual and group assignments, presentations, etc. shall be assigned to students as per the course requirements. The number of assignments of a theory or practical is *n*, where *n* is the number of credit hours of the course.
- The scheme of continuous assessment that a particular teacher wishes to follow for a course will be announced as course outline on the first day of the term. The performance of a student will be evaluated in terms of two indices, viz. Semester Grade Point Average (SGPA), and Cumulative Grade Point Average (CGPA).

ii. **Skill Development Courses:** The performance of the Industrial Visit/study tour of each student will be evaluated as follows:

Content	Marks
Attendance	20%
Participation	20%
Visit Report	30%
Presentation	30%

iii. **Thesis:** Thesis will be evaluated out of 100 marks, ensuring a comprehensive assessment of research quality. Each student will conduct their research under the guidance of an assigned **Supervisor**. If required, a **Co-Supervisor** may be appointed to provide additional expertise and support. The marks distribution for the thesis is as follows:

Content	Marks
Report	60%
Presentation	30%
Oral Exam	10%

10 Eligibility for Appearing Term Final Examination

To be eligible for appearing at the examination, a student shall have to fulfil the following criteria:

I. A student has to participate in the required number of classes, practical classes, tutorials. In this case, a student has to participate in the following number of classes to sit for the examination:
    a) 75% or above- Qualified.
    b) 60%- 74%- Non-Collegiate. In this case, the student must apply for appearing in the examination and pay the required fees.
    c) 59% or below- Disqualified.

II. Candidates shall have to fulfil the other conditions mentioned in the examination circular.

11 The Requirements for Promotion to the Next Term

A student is required to fulfil the following conditions for promotion to the next higher class/ semester:

I. A student has to take the required courses for a particular semester/level as per the syllabus of the program.

II. A student shall be promoted to the second semester of each level (year/ session) of two semesters, irrespective of his/her results in the first semester, provided he/she does not have 'F' grades in more than two subjects including *backlog subjects* (if any).

12 Grade Improvement/Change

If a student passes a course with a grade point between 2.0 and 2.75, he/she will have the opportunity to participate in the improvement exam in that course only once. In this case, a student will be allowed to participate in the improvement exam only one subject/ course in a semester.

- If a student fails to improve his/ her previous grade despite participating in the improvement exam, his/ her previous grade will remain valid.
- For improvement of grade, the improvement exam will mean only the theoretical part (60%) of the subject/ course. In the case of Laboratory/ Practical/ Sessional/ Oral Examination, the improvement exam will not be accepted.

- The fee for improvement examination shall be fixed by the University.

13 The medium of Instruction and Examination

The medium of instruction and answer in the examination is English.

14 Course Code Designation System

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

i. The first digit corresponds to the year in which the course is normally taken by the students.
ii. The second digit corresponds to the semester in which the course is normally taken by the students.
iii. The last two digits denote a course, where an odd number is used for a theoretical course and an even number for Laboratory/Practical course.

15 Curriculum Structure

B.Sc (Honours) in Marine Engineering Program consists of a total of 56 courses, excluding non-credit courses and is divided into the following categories:

Category	**No. of Theory Courses**	**No. of Lab/Practical Courses**	**No. of Non-Credit Courses**	**Credit Hours**	**Percentage**
Core Courses	20	8	-	72	45%
Allied Engineering Courses	10	3	-	34.5	21%
Elective Courses	2	-	-	6	4%
GED Courses	6	3	-	22.5	14%
Capstone Courses	2	2	-	25	16%
Non-Credit Ancillary Courses	-	-	5	-	
Total	**40**	**16**	**5**	**160**	**100%**

Code	Course Name	Credit
Core Courses		
Theory		
BME 1107	Engineering Thermodynamics	3
BME 1109	Material Strength & Workshop Process	3
BME 1201	Marine Internal Combustion Engine-I	3
BME 1203	Marine Auxiliary Machinery-I	3
BME 1205	Basic Naval Architecture	3
BME 1211	Machine Drawing-I	3
BME 2101	Marine Internal Combustion Engine-II	3
BME 2103	Machine Drawing-II	3
BME 2105	Marine Propulsion and Steering	3
BME 2107	Marine Boiler and Steam Engineering	3
BME 2109	Marine Auxiliary Machinery-II	3
BME 2113	Turbocharger and Scavenging Technology	3
BME 2203	Ship Construction	3
BME 2205	Fluid Mechanics and Hydraulics	3
BME 2207	Applied Heat	3
BME 2211	Applied Mechanics	3
BME 4101	Maneuvering and Associated Systems	3
BME 4103	Deck Machineries and Bridge Equipment	3
BME 4109	Ship Building Technology	3
BME 4111	Control Engineering	3
Practical		
BME 1106	Marine Workshop Practices-I	1.5
BME 1206	Marine Workshop Practices-II	1.5
BME 2102	Maintenance of Machineries-I	1.5
BME 2104	Marine Workshop Practices-III	1.5
BME 2202	Maintenance of Machineries-II	1.5
BME 4104	Control Engineering Sessional	1.5
BME 4106	Engine Room Simulator Sessional	1.5
BME 4204	Welding Technology	1.5
Allied Engineering Courses		
Theory		
BME 1111	Basic Electrical Engineering	3
BME 1209	Basic Electronics Engineering	3
BME 2111	Marine Electrical Machineries	3
BME 2209	Marine Environment Pollution and Protection	3
BME 4105	Marine Electrical Installation and Instrumentation	3

BME 4205	Industrial Engineering	3
BME 4115	Maritime Law and Policy	3
BME 4201	Energy Efficiency and Alternative Fuel	3
BME 4203	Power System Protection	3
BME 4205	Ship Operation and Management	3
Practical		
BME 1202	Basic Electrical & Electronics Engineering Sessional	1.5
BME 1204	Computer Programming and Applications	1.5
BME 4102	Marine Electrical Installation and Instrumentation Sessional	1.5
Elective Course – Any Two from the following		
Theory		
BME 4209	Power Plant Technology	3
BME 4211	Advanced Oil Tanker Cargo Operation	3
BME 4213	Fishing Vessel Technology	
BME 4215	Maritime Economics	3
BME 4217	Environmental Science	3
BME 4219	Recycling of Ships	3
BME 4221	Ship Operation & Management	3
BME 4223	Ship Chartering and Brokering	3
BME 4225	Marine Survey and Accident Investigation	3
BME 4227	Renewable Energy Sources and Applications	
General Education Courses		
Theory		
BME 1101	Physics	3
BME 1103	Mathematics	3
BME 1105	English	3
BME 1207	Leadership and Professional Ethics	3
BME 2201	Industrial Chemistry	3
BME 4107	Research Methodology	3
Practical		
BME 1102	Physics Sessional	1.5
BME 1104	Maritime English and Communication Skill Sessional	1.5
BME 2204	Industrial Chemistry Sessional	1.5
Capstone Course		
BME 2206	Industrial Visit	1.5
BME 3002/ BME 3004	On-Board Training/Ashore Training	16
BME 4202	Seminar/Workshop	1.5
BME 4207	Thesis	6

Total 56 Courses (Excluding Non-Credit Courses)	160

16 Course Schedule for B.Sc (Honours) in Marine Engineering Program

Year-1: Semester-1		
Code	**Course Name**	**Credit**
Theoretical		
BME 1101	Physics	3
BME 1103	Mathematics	3
BME 1105	English	3
BME 1107	Engineering Thermodynamics	3
BME 1109	Material Strength and Workshop Process	3
BME 1111	Basic Electrical Engineering	3
Practical		
BME 1102	Physics Sessional	1.5
BME 1104	Maritime English and Communication Skill Sessional	1.5
BME 1106	Marine Workshop Practices-I	1.5
Total		**22.5**

Year-1: Semester-2		
Code	**Course Name**	**Credit**
Theoretical		
BME 1201	Marine Internal Combustion Engine-I	3
BME 1203	Marine Auxiliary Machineries-I	3
BME 1205	Basic Naval Architecture	3
BME 1207	Leadership and Professional Ethics	3
BME 1209	Basic Electronics Engineering	3
BME 1211	Machine Drawing-I	3
Practical		
BME 1202	Basic Electrical & Electronics Engineering Sessional	1.5
BME 1204	Computer Programming and Applications	1.5
BME 1206	Marine Workshop Practices-II	1.5
Total		**22.5**

Year-2: Semester-1		
Code	**Course Name**	**Credit**
Theoretical		
BME 2101	Marine Internal Combustion Engine-II	3
BME 2103	Machine Drawing-II	3
BME 2105	Marine Propulsion and Steering	3
BME 2107	Marine Boiler and Steam Engineering	3
BME 2109	Marine Auxiliary Machineries-II	3
BME 2111	Marine Electrical Machineries	3
BME 2113	Turbocharger and Scavenging Technology	3
Practical		
BME 2102	Maintenance of Machineries-I	1.5
BME 2104	Marine Workshop Practices-III	1.5
Total		**24**

Year-2: Semester-2		
Code	**Course Name**	**Credit**
Theoretical		
BME 2201	Industrial Chemistry	3
BME 2203	Ship Construction	3
BME 2205	Fluid Mechanics and Hydraulics	3
BME 2207	Applied Heat	3
BME 2209	Marine Environment Pollution & Protection	3
BME 2211	Applied Mechanics	3
Practical		
BME 2202	Maintenance of Machineries-II	1.5
BME 2204	Industrial Chemistry Sessional	1.5
BME 2206/ BME 2208	Industrial Visit/ Applied Mechanics Sessional	1.5
Total		**22.5**

Year-3 (Semester-1 & Semester-2)		
Code	**Course Name**	**Credit**
BME 3002	On-Board Training	16
OR		
BME 3004	Ashore Training	16
Total		**16**

Year-4: Semester-1		
Code	**Course Name**	**Credit**
Theoretical		
BME 4101	Maneuvering and Associated Systems	3
BME 4103	Deck Machineries and Bridge Equipment	3
BME 4105	Marine Electrical Installation and Instrumentation	3
BME 4107	Research Methodology	3
BME 4109	Shipbuilding Technology	3
BME 4111	Control Engineering	3
BME 4113	Industrial Engineering	3
BME 4115	Maritime Law and Policy	3
Practical		
BME 4102	Marine Electrical Installation and Instrumentation Sessional	1.5
BME 4104	Control Engineering Sessional	1.5
BME 4106	Engine Room Simulator Sessional	1.5
Total		**28.5**

Year-4: Semester-2		
Code	**Course Name**	**Credit**
Theoretical		
BME 4201	Energy Efficiency and Alternative Fuel	3
BME 4203	Power System Protection	3
BME 4205	Ship Operation and Management	3
BME 4207	Thesis	6
	Elective Course (Any two)	6
Practical		
BME 4202	Seminar / Workshop	1.5
BME 4204	Welding Technology	1.5
Total		**24**

List of Elective Courses:

Category	Code	Course Name	Credit
Elective Courses	BME 4209	Power Plant Technology	03
	BME 4211	Advanced Oil Tanker Cargo Operation	
	BME 4213	Fishing Vessel Technology	
	BME 4215	Maritime Economics	
	BME 4217	Environmental Science	
	BME 4219	Recycling of Ships	
	BME 4221	Ship Operation and Management	
	BME 4223	Ship Chartering and Brokering	
	BME 4225	Marine Survey and Accident Investigation	
	BME 4227	Renewable Energy Sources and Applications	

Grand Total = 22.5+22.5+24+22.5+16+28.5+24 = 160 Credits

List of Non-Credit Courses:

Each student shall have to register a minimum of 3 (Three) Non-Credit Courses as a part of requirement of the degree. A list of Non-Credit Courses is given below:

i. Basic Ancillary Course on Personal Survival Technique (PST)
ii. Basic Ancillary Course on Elementary First Aid (EFA)
iii. Ancillary Course on Fire Prevention and Fire Fighting (FPFF)
iv. Ancillary Course on Personal Safety and Social Responsibility (PSSR)
v. Basic Tanker Course (Oil, Chemical and Gas)

17 Equivalence with Marine Engineer Officer Competency Examination

The Syllabus for the 4-year **"Bachelor of Science in Marine Engineering"** is according to the requirements of STCW conventions as amended of IMO and that of the Directorate General of Shipping, Government of the People's Republic of Bangladesh for competencies required for "**Officer in charge of an Engineering Watch"**.

THE CERTIFICATE OF COMPETENCY (COC) LEVEL CLASS-3,2,1 FOR MARINE ENGINEER OFFICER EXAMINATION			
Serial No	Subjects according to the requirements of STCW conventions as amended of IMO and DG Shipping for COC (Certificate of Competency level) of Marine Engineer Officer	STCW requirements covered by the Subjects under this curriculum.	
1	Mathematics	Mathematics	*COC -3*
2	Applied Mechanics	Applied Mechanics	*COC-3,2,1*
		Fluid Mechanics and Hydraulics	*COC-2,1*
3	Applied Heat	Engineering Thermodynamics	*COC-3,2,1*
		Applied Heat	*COC-2,1*
4	Electro-technology	Basic Electrical Engineering	*COC-3,2,1*
		Basic Electronics Engineering	
		Marine Electrical Machineries	*COC-2,1*
		Marine Electrical Installation and Instrumentation	*COC-2,1*
		Power System Protection	*COC-2,1*
5	Naval Architecture	Basic Naval Architecture	*COC-3,2,1*
		Ship Construction	*COC-2,1*
		Ship Building Technology	*COC-2,1*
6	Machine Drawing	Machine Drawing-I	*COC-2,1*
		Machine Drawing-II	*COC-2,1*

7	Engineering Knowledge (General)	Marine Auxiliary Machinery-I	*COC-3,2,1*
		Marine Auxiliary Machinery-II	*COC-3,2,1*
		Marine Propulsion and Steering	*COC-2,1*
		Energy Efficiency and Alternative Fuel	*COC-2,1*
		Deck Machineries and Bridge Equipment	*COC-2,1*
		Control Engineering	*COC-1*
		Maritime Law and Policy	*COC-1*
		Marine Environment Pollution and Protection	*COC-2,1*
8	Engineering Knowledge (Motor)	Engineering Thermodynamics	*COC-3,2,1*
		Marine Internal Combustion Engine-I	*COC-3,2,1*
		Marine Internal Combustion Engine-II	*COC-3,2,1*
		Marine Boiler and Steam Engineering	*COC-3,2,1*
		Turbocharger and Scavenging Technology	*COC-3,2,1*
		Maneuvering and Associated Systems	*COC-3,2,1*

18 Course Profile

18.1 Year-1, Semester-1

18.1.1 BME 1101: Physics

3.00 Credit, 3 hrs. /wk.

Aims:

To provide an understanding on the concepts, principles and processes of basic science in the particular field of electricity and magnetism and modern physics, principles and processes of applied science in the particular field of waves and oscillations and wave mechanics.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Basic concept of electricity and magnetism such as potential and field.
ii. Relativity and quantum physics.
iii. Relate concepts together and to the other areas of physics.
iv. Mathematical wave equation.

Syllabus Contents:

i. **Hydrostatics:** Hydrostatic pressure; Change of pressure with elevation; Pascal's law; Equilibrium of floating bodies.

ii. **Surface Tension and Viscosity:** Adhesive and Cohesive Forces; Molecular origin of Surface Tension; Pressure and surface tension; Contact angle and capillarity; Measurement of the angle of contact; Experimental determination of surface tension; Factors affecting surface tension;Newton's law of Viscosity; Stokes Law; Terminal velocity for Falling bodies.

iii. **Electricity & Magnetism:**Coulomb's Law, Electric field (E), Gauss's Law and its application, Electric potential (V), Capacitors and capacitance, Capacitors with dielectrics, Dielectrics-an atomic view, Charging and discharging of a capacitor, Ohm's Law, Kirchoff's Law, Magnetic field, Magnetic induction, Magnetic force on a current carrying conductor, Torque on a current carrying loop, Hall effect, Faradays Law of electromagnetic induction, Lenz's Law, Self-induction, Mutual induction, Magnetic properties of matter, Hysteresis curve, Electromagnetic oscillation, L-C oscillation and its analogy to simple harmonic motion.

iv. **Modern Physics:**Michelson-Morley's experiment, Galilean transformation, Special theory of relativity and its consequences, Quantum theory of radiation, Photo-electric effect, Compton effect, Wave Particle duality, Interpretation of Bohr's postulates, Radioactive disintegration, Properties of nucleus, Nuclear reactions, Fission, Fusion, Chain reaction, Nuclear reactor**.**

v. **Waves & Oscillations:**Differential equation of a simple harmonic oscillator, Total energy and average energy, Combination of simple harmonic oscillations, Lissajous figures, Spring-mass system, Calculation of time period of torsional pendulum, Damped oscillation, Determination of damping coefficient, Forced oscillation, Resonance, Two-body oscillations, reduced mass, Differential equation of a progressive wave, Power and intensity of wave motion, Stationary wave, Group velocity and phase velocity, Architectural acoustics, Reverberation and Sabine's formula.

References:

i. Halliday, D., Resnick, R., & Walker, J. (2018). Fundamentals of physics (11th ed.).

ii. Wiley. Beiser, A. (2003). Concepts of modern physics (6th ed.). McGraw-Hill.

iii. Subrahmanyam, N., Lal, B., & Avadhanulu, M. N. (2014). Waves and oscillations.

18.1.2 BME 1103: Mathematics

3.00 Credit, 3 hrs. /wk.

Aims:

The objective of the course is to solve the Algebraic problems, Matrices, Trigonometrical problems, Statistical problems in maritime domain and to teach the students differential and integral calculus, ordinary differential equations and complex variable that is most widely used in the engineering core subjects. It will provide the foundation in mathematics to prepare the students for subjects that are more specialized and most widely used in the engineering core subjects.

Learning Outcomes:

On successful completion of this unit, students will be able to:

i. Algebraic to problems relevant, theory of equations, matrices including inverse matrix, compute elgen values and vectors using characteristic polynomial, solve system of liner equations.
ii. Trigonometrical problem relevant to De-moivres theorem, exponential functions of complex arguments and Gregory's series.
iii. Statistical problems relevant Discrete and continuous variables, Frequency Distributions, Mean, Median and Mode, mean deviation and standard deviation, Correlation and its applications, understand the basic of statistical methods in the context of marine technology.
iv. Calculate limits, infinite limits and limit at infinity using appropriate techniques including L' Hospital Rule.
v. Compute derivatives of various types of functions.
vi. Expand functions using Taylor's theorem and Maclaurin's theorem.
vii. Evaluate maximum and minimum value of functions of single and double variables.
viii. Calculate indefinite and definite integrals by basic integration formulas.
ix. Provide a physical interpretation of the gradient, divergence and curl.
x. Explain the fundamental concept of differential equations.
xi. Distinguish between liner, nonlinear, partial and ordinary differential equations.
xii. Solve 2^{nd} and higher order differential equations using different methods.

Syllabus Contents:

i. **Algebra:**

Theory of Equations: relations between roots and Co-efficient; Sums of the power of the roots Descartes' rule of signs: increasing or decreasing all roots of the equation by the same number, logarithms, Quadratic Equations.

ii. **Matrices:**

Different kind of matrices; elementary properties; solution of systems of equations.

iii. **Trigonometry:**

a. De Moivres' Theorem
b. Deduction from De-Moivres' Theorem
c. Trigonometrically and exponential functions of complex arguments
d. Gregory's Series

iv. **Statistics:**

a. Discrete and continuous variables
b. Frequency Distributions
c. Mean, Median and Mode
d. Mean deviation and standard deviation
e. Correlation and its applications

v. **Differential Calculus:**

a. Differential Co-efficient
b. Successive differentiation
c. Partial Differentiation
d. Maxima and Minima

vi. **Integral Calculus:**

a. Indefinite Integrals
b. Definite Integrals

vii. **Co-ordinate Geometry:**

a. Pair of straight Lines, General equations of second degree, the Tangents and normal on the curves.

b. Co-ordinates of three dimensions, Direction cosines and rations, plane.

viii. **Ordinary Differential Equation:** Degree and order of ordinary differential equation; Formation of differential equations; Solutions of first order differential equations by various methods: Variables separable, Homogenous equations, Equation reducible to homogeneous form, exact differential equations, the Linear equations. Linear differential equations with constant co-efficient, and Inverse Operator; Solution of general Liner Equations of 2^{nd} and higher orders with constant coefficient.

References:

i. Kreyszig, E. (2011). Advanced engineering mathematics (10th ed.). John Wiley & Sons.
ii. Shahidullah and Bhattachargee, 2015, A text book on Higher Algebra, Publisher: New Book Palace.
iii. S.A Sattar, 2008, A text book on Higher Trigonometry, All Publishers.
iv. Atiyah, M. F., & MacDonald, I. G. (1969). *Introduction to commutative algebra*. Addison-Wesley.

18.1.3 BME 1105: English

3.00 Credit, 3 hrs. /wk.

Aims:

This introductory course develops cadets' English language proficiency with an emphasis on basic language skills and grammatical competence The course demonstrates practical language use in writing and speech while focusing on enhancing cadets' overall English proficiency.

In addition, this course is also designed to provide Marine Engineer officers with the English language skills required under STCW Section A-II/1 for watchkeeping officers. It emphasizes the use of English in written and oral forms for effective communication on board and ashore, understanding Engineering, navigational as per IMO Standard Marine Communication Phrases (SMCP).

Learning Outcomes:

Successful completion of this course shall enhance the students' English language competencies and provide the skills necessary to carry out internal and external communication while on board

the vessel.

Syllabus Contents:

i. **Grammar**:
   - Types of sentences and structures- Active/Passive voice;
   - Gerunds and infinitives;
   - Adjectives: comparative and superlative;
   - Modal verbs;
   - Direct/Indirect speech;
   - The zero article, articles (a/an/the);
   - Right form of verbs;
   - Syntax & sentence construction.

ii. Vocabulary & Maritime Terminology:
   - General vocabulary (synonyms, antonyms, idioms, transitional words)**;**
   - Sentence completion (with & without clues)**;**
   - Industry terminology from real shipboard contexts**;**
   - Oral communication for watchkeeping,
   - Engineering and operational duties.

iii. Composition on Current Affairs

iv. Academic Report Writing:
   - Business Correspondence – Letter Writing – Formal, Drafting, Bio-data Resume/Curriculum Vitae;
   - Report Writing – Structure, Types of report – Practice Writing.

v. Listening and Speaking Skills:
   - Communication / Public Speaking skills, Features of effective speech, verbal-nonverbal;
   - What is public speaking, how to improve public speaking skills
   - Effective listening strategies for multi-lingual crew and shore communications

vi. **Literature for language:**
   - Short story- Othello, The necklace, Lather and nothing else
   - Poetry- Stopping by woods on a snowy evening.

References:

i. Eastwood, J. (2011). *Oxford practice grammar* (3rd ed.). Oxford University Press.

ii. Blakey, T. N. (2011). *English for maritime studies*. Routledge.

18.1.4 BME 1107: Engineering Thermodynamics

3.00 Credit, 3 hrs. /week.

Aims:

(i) To provide the Learners basics idea of temperature, pressure, volume, mass, heat that is the thermodynamic properties and their relations.

(ii) To develop the knowledge about thermodynamic laws, processes, cycles, P-V and T-S diagrams and their application. Knowledge about Enthalpy, Entropy, steam properties, internal combustion engines and parts of engines.

(iii) To have a good knowledge of working principle of 2 Stroke and 4 Stroke Marine IC Engines related problems, compressors, steam, steam engine, gas dynamics, gas turbine, Fuels and combustion etc.

Learning Outcomes:

Upon completion of this course, the student will gain a comprehensive knowledge on engineering thermodynamics

Syllabus Contents:

i. **Fundamentals**

Mass, force of gravity, work, power, energy, mechanical efficiency, pressure, pressure gauges, manometer, gauge pressure and absolute pressure. Barometer, Vacuum gauge. Volume and specific volume, Temperature and absolute temperature, swept volume and clearance volume, system, boundary, thermodynamic processes and cycles, Heat and specific heat. Mechanical equivalent of heat, water equivalent, latent heat and sensible heat, thermal expansion of metals, Linear expansion, expansion of liquids, and Apparent cubical expansion.

ii. **Perfect Gases**

Boyle's and Charles' laws, Combination of Boyle's and Charles' laws. Characteristic equation of a perfect gas, Specific heat of gases, Energy equation, relationship between specific heats, Ratios of specific heat. Compression and expansion of a gas in a closed system. Ratios of expansion and compression. Relationship between temperature, volume and pressure for constant pressure, volume, temperature, Isothermal and Adiabatic processes. Work transfer. Relationship between heat energy supplied and work done, and problems

iii. **Enthalpy and Entropy**

Definition of Enthalpy and Entropy: Unit of entropy, General expression for change of entropy of a perfect gas, change of entropy of a perfect gas during various thermodynamic processes and problems

iv. **Ideal Cycles**

Ideal thermal efficiency, Carnot cycle, Ericson cycle, Sterling cycle, Otto cycle. Diesel cycle, Dual combustion cycle and P-V and T-S diagrams, related problems.

v. **Diesel Engine Cycle**

4-stroke and 2-stroke cycles; Deviation from ideal conditions in actual engines; Limitation in parameters, Timing Diagrams of 2-stroke and 4-stroke engines. General Description of I.C. Engines; Comparative study of slow speed, medium speed and high-speed diesel engines suitability and requirements for various purposes.

vi. **Fuels, Combustion and Dissociation**

Definition of Fuel, Combustion, Combustion Equation, Analysis of the Products of Combustion, stoichiometric combustion, Actual combustion, Calorific value, chemical equation. Excess Air, Mixture strength. Dissociation. Effect of Dissociation on LC-Engines.

References

i. Joel, R. (1996). *Basic engineering thermodynamics in S.I. units* (5th ed.).

ii. Brijlal, B., & Subrahmanyam, N. (2005). *Heat and thermodynamics*. S. Chand & Company Ltd.

iii. Rathore, D. P., & Kumar, P. (2012). *Engineering thermodynamics: Principles and applications*. McGraw-Hill Education.

iv. Reed's Publications. (n.d.). *Applied heat for engineers*. Reed's Publications

18.1.5 BME 1109: Material Strength and Workshop Process

3.00 Credit, 3 hrs. /week.

Aims:

To provide the theoretical knowledge to support the use of hand, power and machine tools and measuring instruments that is required in marine engineering maintenance.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Understand the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior
ii. Apply the systematic methods for solving engineering problems in solid mechanics
iii. Analyze the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading
iv. Build the necessary theoretical background for further structural analysis and design courses
v. The use of common workshop tools;
vi. The use of machine tools and machine process;
vii. The use of measuring instruments;
viii. Fitting and overhauling of machines;
ix. Safety measures in workshop process

Syllabus Contents:

i. **Material Strength:** Stiffness relationships; Hooke's law; Stress and strain; Modulus; Simple beam theory; Second moment of area; Bending stress; Shear force and bending moment diagrams; Torsional, combined and off-axis loading; Principal stresses.
ii. **Common Workshop Tools**: Description and uses of different types of calipers, Straightedges, try squares, vices, Hammers, chisels, Scrapers, files, Drills, reamers, Tapes, V-Blocks, face plate, Marking blocks, Carpentry tools, Patten maker’s tools, smithy tools Molding tools.
iii. **Machine process and Machine Tools**: The geometry of cutting processes machines of cutting, chip formation, cutting forces and power, Friction of chip on tools Generation and dissipation of heat in cutting. Standard nomenclature for cutting tools. Cutting speeds and

feeds, estimation of machining time. The fundamental Cutting process. Application in hand tools as chisel, file and saw, geometrical control of the cutting edge.

iv. **Measuring Instruments and Inspection:** Description and use of Venire scale, Micrometer, Dial gauge, Depth gauge, thread gauge, Feeler gauge, Wire Gauge, pattern maker's scale, Taper gauge, snap gauge, plug gauge, Optical methods of measurement, Principles of interchangeability, limit system. Use of limit gauge.

v. **Safety Measures:** Sources of danger and methods of protection. Types of guards and safety devices, factory Act regulations.

References:

i. Choudhury, S. K. (2005). *Workshop technology: Part I & II*. Media Promoters & Publishers.

ii. Gere, J. M., & Goodno, B. J. (2012). *Mechanics of materials* (8th ed.). Cengage Learning.

iii. Black, B. J. (1982). *Workshop processes, practices and materials*.

iv. Pritchard, R. T. (1979). *Technician workshop processes and materials*. Hodder and Stoughton.

18.1.6 BME 1111: Basic Electrical Engineering

3.00 Credit, 3 hrs. /week.

Aims:

To provide students with the theoretical knowledge on the fundamentals of marine electrical and electronic practice.

Learning Outcomes:

Upon completion of this course, students will be able to:

i. Analyze DC and AC electrical circuits using fundamental laws, network theorems, and circuit analysis techniques.

ii. Explain the principles of energy storage, magnetic fields, electromagnetic induction, and their applications in electrical machines.

iii. Apply AC and three-phase circuit concepts, including power, power factor, and resonance, to practical marine electrical systems.

Syllabus Contents:

i. **The electric circuits**: Ohm's law, Simple Series and parallel circuits and Related problem, voltage and current division, Simple mixed circuit related problem, Wye(Y)-delta transformation, Kirchhoff's current and voltage laws and related problem, independent and dependent sources

ii. **Network theorems**: Source transformation, Superposition, Thevenin's, Norton's theorem and Maximum power transfer theorem with applications in circuits having independent sources,

iii. **Energy storage elements**: Inductors and capacitors, series parallel combination of inductors and capacitors. Responses of RL and RC circuits: Natural and step responses.

iv. **Magnetic quantities and variables**: Flux, permeability and reluctance, magnetic field strength, magnetic potential, Magnetic materials, B-H curves, M-H curves, Hysteresis, Eddy current.

v. **Electromagnetic Induction**: Lenz law, Faraday's Electromagnetic induction law, Fleming's R/L hand rule and its area of application (Generator/ motor principle).

vi. **Alternating Current Theory**: Simple continuous periodic waves: frequency, amplitude, instantaneous, maximum r.m.s. and average values, or factor; Phase representation of AC quantity; Use of complex quantities in AC circuits: Phase difference; Parameters of AC circuit; Relationship between resistance, reactance and impedance; Simple series (R, L, C, RL, RC, RLC) and parallel (RLC) ac circuits with related wave and phasor /vector diagram, Related problems. Concept of different power in ac circuit, Power factor, treatment of power factor and improving Power factor. Resonance circuit; Concept of Single and polyphase systems;

vii. **Three-phase system**: Delta/star Connection and Power; Balanced three-phase system: treatment of three-phase circuit, Effect of unbalanced load

References:

i. Theraja, B. L., & Theraja, A. K. (2014). *A textbook of electrical technology: Basic electrical engineering* (Vol. 1).

ii. Alexander, C. K., & Sadiku, M. N. O. (2017). *Fundamentals of electric circuits* (6th ed.).

McGraw-Hill Education.

iii. Kerchner, R., & Corcoran, J. (2001). *Alternating current circuits* (4th ed.). Prentice Hall.

iv. Boylestad, R. L. (2010). *Introductory circuit theory*. Prentice-Hall India Pvt. Ltd.

v. Morley, A., & Hughes, E. (1995). *Principles of electricity* (3rd ed.). Longman.

18.1.7 BME 1102: Physics Sessional

1.50 Credit, 3 hrs. /wk.

Aims:

The objective of this course is to teach students how to conduct experiments using the protocols and methods offered in the discipline and interpret the results of these experiments.

Learning Outcomes:

On successful completion of this unit, students will be able to:

i. demonstrate that they can conduct an experiment using the protocols and methods offered as in the discipline.

ii. interpret the results of experiments, observations, understand and explain the random or systematic error associated with their experiment and make appropriate conclusion.

Syllabus Contents:

[Physics sessional is based on the Physics theory courses. Minimum 7 (Seven) experiments must be carried out from the following lists.]

i. Determination of specific resistance of a wire using a meter bridge.

ii. Determination of the specific heat of a liquid by the method of cooling.

iii. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.

iv. Determination of frequency of a tuning fork by using Melde's Apparatus.

v. Determination of the value of g, acceleration due to gravity by means of a compound pendulum.

vi. Determination of spring constant and effective mass of a given spring and hence to calculate the rigidity modulus of the material of the spring.

vii. Determination of the surface tension of water by the method of capillary rise.

viii. Determination of the surface tension of mercury and the angle of contact by Quinckes' method.
ix. Determination of buoyantup draught as a function of immersion depth (Archimedes principle).

References:

i. Manini, N. (2014). Introduction to the physics of matter. Springer.
ii. Purcell, E. M., & Morin, D. J. (2013). Electricity and magnetism (3rd ed.). Cambridge University Press.
iii. Bernstein, J., Fishbane, P. M., & Gasiorowicz, S. G. (2012). Modern physics. Pearson.
iv. Taylor, J., Zafiratos, C., & Dutta, M. A. (2010). Modern physics for scientists and engineers. Pearson.
v. Brijlal, B., & Subrahmanyam, N. (2015). Properties of matter. S. Chand & Company.
vi. Rafiquallah, A. K. (n.d.). Concept of electricity and magnetism. Students Publication.

18.1.8 BME 1104: Maritime English and Communication Skill Sessional

1.50 Credit, 3 hrs. /wk.

Aims:

To provide adequate knowledge on English that deals with maritime terminology and the use of English sufficient to allow the use of engineering publications and the performance of engineering duties concerned with the ship's safety and operation.

Learning Outcomes:

This course will:

i. Enable trainees to master the English language related to marine engineering;
ii. develop trainees' ability to use engineering publications written in English and perform the engineer's duties;
iii. Ensure that trainees possess the knowledge, understanding and proficiency in English as set out in the STCW Code;
iv. Give trainees wide-ranging opportunities to practise communication in English for both maritime and general purposes; and

v. Promote the study skills essential for continuing independent learning at sea

Syllabus Contents:

Adequate knowledge of the English language to use engineering publications:

i. Use publications regarding main and auxiliary machinery and associated control systems
ii. Use publications regarding fuel, lubrication, bilge, ballast and other pumping systems and associated control systems
iii. Use publications regarding electrical, electronic and control systems
iv. Use publications regarding hand tools, machine tools and measuring instruments for fabrication and repair on board
v. Use publications regarding pollution prevention requirements
vi. Use publications regarding the seaworthiness of the ship
vii. Use publications regarding preventing, controlling and fighting fires on board
viii. Use publications regarding life-saving appliances
ix. Use publications regarding monitoring compliance with legislative requirements
x. Use publications regarding personnel and ship safety

Adequate knowledge of the English language to perform engineering duties:

i. Use internal communication systems.
ii. English language associated with taking over and handing over a watch.
iii. English language associated with keeping a watch and handing over a watch.
iv. English language associated with maintenance of the machinery space logs and the significance of the readings taken.
v. English language of safety and emergency procedures.
vi. English language of application of leadership and team working skills.
vii. English language associated with Port State Control.
viii. English language associated with bunkering operation.

References:

i. International Maritime Organization. (n.d.). *IMO model course 3.17 / Standard Marine Communication Phrases (SMCP)*. IMO.

ii. Blakey, T. N. (1988). *English for maritime studies* (2nd ed.). Prentice Hall College Division.
iii. Blakey, T. N. (2011). *English for maritime studies*. Routledge.
iv. Eastwood, J. (2011). *Oxford practice grammar* (3rd ed.). Oxford University Press.

18.1.9 BME 1106: Marine Workshop Practices-I

1.50 Credit, 3 hrs. /wk.

Aims:

To provide the students with sufficient practical skills on the use of hand and power tools as required on board to perform the duties of an operational level engineer officer.

Learning Outcomes:

After successful completion of this course, trainees will possess sufficient skill and knowledge in the use of hand and power tools to carry out and/or supervise the work normally encountered as maintenance or repair work on board ship. Trainees will be able to select and use the correct tools in any given situation and carry out the necessary maintenance to ensure that they are kept in good order and ready for use.

Syllabus Contents:

Experiment/Jobs list: **[**Experiment/Jobs must be carried out from the following lists]

i. Introduction to the elements of the marine workshop.
ii. Safety issues of Marine workshop/ Marine workshop practices
iii. Orientation of hand-held engineering tools including bench vice, different types of files; screw drivers; centre punch; hammer; hacksaw frame and blade; dividers; slide calipers etc.
iv. Preparation of a square bar from mild steel plate as per given dimensions.
v. Preparation of a drill drift using hand held engineering tools.
vi. Preparation of a chisel from MS rod using different engineering tools.
vii. Preparation of chipping hammer from MS plate using different engineering tools
viii. Preparation of a fitting fixing from MS plate using different engineering tools.

References:

i. Black, B. J. (1982). *Workshop processes, practices and materials*.

ii. Pritchard, R. T. (1979). *Technician workshop processes and materials*. Hodder and Stoughton.

18.2 Year-1, Semester-2

18.2.1 BME 1201: Marine Internal Combustion Engine-I

3.00 Credit, 3 hrs. /wk.

Aims:

(i) To provide an understanding of the basic concepts, working principles and processes of marine internal combustion engines.

(ii) To provide a foundation for the appreciation of working principles, components, maintenance and troubleshooting of large-bore, 4-stroke marine diesel engines running at low speed, normally using direct drive, fitted with piston rods and guides.

(iii) To provide some ideas on regular watchkeeping.

(iv) To provide basic ideas of about control system.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. 4-stroke engine working principle
ii. Engine fuel oil, lubricating oil and cooling system
iii. Safety devices in engines
iv. Calculation of engine power
v. Construction and operational principles of 2- stroke marine diesel engine components
vi. Maintenance and repair of 4-stroke marine diesel engines
vii. Performance monitoring and troubleshooting of 2-stroke marine diesel engines
viii. Fundamentals of automatic control of engineering equipment.

Syllabus Contents:

i. Review of Heat-engine cycle & Ideal-gas cycle

ii. **Introduction:** General Description of I.C. Engines. Comparative study of slow speed, medium speed and high-speed diesel engines suitability and requirements for various purposes.

iii. **Medium and high-speed four-stroke Marine diesel engines:** Engine components including bedplate,cylinder block, cylinder jacket, cylinder liner, cylinder head, exhaust gas manifold, air-inlet manifold,air cooler, engine crankcase, bearing housing and shell, lubrication-oil sump, piston, connecting rod, connecting rod bolts, gudgeon pin, crankshaft, camshaft and chain, push rods, fuel injector, air inlet and exhaust valves and rockers.

iv. **Cooling of I.C. Engines:** Various cooling media used; their merits and demerits, cooling of pistons, cylinder heads, coolant conveying mechanism and systems, maintenance of coolant and cooling system.

v. **Fuel oil system of IC engines:** IC engine fuel oil supply and circulation system from fuel oil tanks to engines.

vi. **Lubrication Systems:** Lubrication arrangement in diesel engines including Coolers & filters Cylinder,Lubrication etc.

vii. **Coupling and Gears:** Engine couplings and reduction gears used in conjunction with medium speed engine, development in exhaust valve design, V-type engine details.

viii. **Watch Keeping:** Importance of watch keeping, Records keeping, log book, watch handing over & taking over etc.

ix. **Control:** Fundamentals of Automatic Control, Types of controls (on/off , Open & close loop & others), Temperature, Pressure & level indicating instruments, Transmission of Signals: transmitters; Controlling Elements- pneumatic, electrical,

Manipulator Elements: Pneumatic; Electrical Servomotors; Hydraulic Servomotor, Flowchart for Automatic and Control Systems.

References:

i. Morton, TD Motor Engineering Knowledge for Marine Engineers. London. Thomas Reed Publications Ltd, 1994 (ISBN 09-01-2856-5).

ii. A.J Wharton, 1991, Diesel Engines, 3rd edition Publisher: Butterworth and Heinemaan.

iii. D.A Taylor, 2001, Introduction to Marine Engineering, Publisher: Butterworth and Heinemaan.

18.2.2 BME 1203: Marine Auxiliary Machineries-I

3.00 Credit, 3 hrs. /week.

Aims:

To provide a foundation for the appreciation of the technical aspects of pump operation, maintenance, and troubleshooting, as well as associated systems, including evaporators, distillers, heat exchangers, and condensers.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Principles of Pumping and types of Pumps
ii. Construction, operation, maintenance and troubleshooting of distillers
iii. Construction, operation, maintenance and troubleshooting of heat-exchangers.

Syllabus Contents:

i. **Piping arrangement:** Layout of main and auxiliary machinery in engine room, arrangements of steam, bilge, ballast and oil fuel systems, Lube oil and Cooling system with various fittings. Domestic freshwater and seawater hydrophone system.
ii. **Pumps:** Types of pumps for various requirements, their characteristics and application in ships. Centrifugal, Gear Pumps, Screw pumps and Reciprocating pumps. Care and Maintenance of Pumps.
iii. **Operation of pumping system:** Routine Pumping Operations; Operation of Bilge Ballast and Cargo Pumping Systems
iv. **Evaporators and distillers:** Construction and Operation of different types of evaporators. Fresh Water generators. Conditioning arrangements of distilled water for drinking purposes.
v. **Heat Exchangers:** tubular and plate type, reasons for corrosion, tube removal, plugging, and materials used.
vi. **Condensers:** Shapes and types of condensers, constructional details, location and method of securing, working principles, contraction and expansion allowances, leak test. Effect -

change of temperature, circulating water quantity, and condenser surface.

vii. **Oily water separator:** Construction, Description, operation & maintenance.

viii. **Sewage treatment plant:** Construction, Description, operation & maintenance.

ix. **ODME:** Construction, Description, operation & maintenance.

References:

i. Russell, P. A., Jackson, L., & Morton, T. D. (2024). *General engineering knowledge for marine engineers* (Reeds Vol. 8). Bloomsbury Publishing.

ii. Taylor, D. A. (1990). *Introduction to marine engineering* (2nd ed.). Butterworth.

18.2.3 BME 1205: Basic Naval Architecture

3.00 Credit, 3 hrs. /week.

Aims:

To provide an understanding of the geometry of ships & hydrostatic calculation with emphasis on stability of ships. Propulsion and rudder theory will also be addressed in this course.

Learning Outcomes:

After successful completion of this course, the participants will have sufficient knowledge on:

i. Maintaining the seaworthiness of the ship, including ship stability, carriage of cargoes on deck; heavy lifts, containers, bulk cargoes, grain, dangerous goods, oil tankers.

ii. Theory and operation of Power, resistance, propulsion and propeller and rudder theory.

Syllabus Contents:

i. **Geometry of ship & hydrostatic calculation:** Ships lines, Displacement Calculation, First and Second moment of area, Simpsons rules, application to area and volume, Trapezoidal rule, mean and mid-ordinate rue, Tchebycheff's rule and their applications, Tonnes per Cm. Immersion. Coefficient of form, Wetted surface area, Similar figures. Centre of gravity, effect of addition and removal of masses, Effect of suspended mass.

ii. **Stability of Ships:** Statical stability at small angles of heel, Calculation of B.M, Inclining

experiment, Free surface effect, stability at large angles of heel, curves of statical stability, dynamical stability, angle of loll; stability of a wall sided ship, movement of centre of gravity, list and its correction.

iii. **Resistance & Power:** Frictional, Residuary & Total resistance, Froude's Law of comparison, Effective power calculations, Ships correlation Factor (SCF), Admiralty co-efficient, Fuel Coefficient and Fuel consumption. Effect of viscosity and application of ITTC formula.

iv. **Longitudinal Stability and trim:** Longitudinal BM, Moment to change trim one cm. Change of trim, change of L.C.B. with change of trim, Change of trim due to adding or deducting weights, alteration of draft due to change in density, Flooding calculations, Floodable length curves, M.O.T. method for determination of floodable lengths, factors of subdivision, Loss of stability due to grounding, Docking stability. Pressure on chocks.

v. **Propulsion & Propellers:** Definitions, apparent and real ship wake, thrust, relation between power, relation between mean pressure and speed, measurement of pitch, cavitation, propeller types, fixed pitch, Variable Pitch, ring propeller, Kort nozzles, Voith Schneider propeller, theory, Blade element theory, Law of similitude and model tests with propellers, propulsion test, Geometry and geometrical properties of screw propellers, ship model correlation ship trials.

vi. **Rudder Theory:** Action of the Rudder in turning a ship, force on rudder, Torque on stock, calculation of force torque on non-rectangular rudder, angle of heel due to force torque on rudder, Angle of heel when turning. Types of rudder, model experiments and turning trials, Area and shape of rudder, position of rudder, stern rudder Bow rudders.

References:

i. Stokoe, E. A. (n.d.). Reed's naval architecture for marine engineers. Reeds Publishing.

ii. Barrass, B., & Derrett, D. R. (2006). Ship stability for masters and mates (6th ed.). Butterworth-Heinemann. https://doi.org/10.1016/B978-0-7506-6784-5

18.2.4 BME 1207: Leadership and Professional Ethics

3.00 Credit, 3hrs. /week.

Aims:

(i) To provide the students with the knowledge, skill and understanding of leadership, teamwork and management skills at the operational level on board a ship; to meet STCW requirements for the application of leadership and teamwork skills, in accordance with the 2010 Manila Amendments, specifically as stated in table A-II/1, A-III/1 and A-III/6.

(ii) To provide the students with an overview of Professional Ethics, like Human Values, Engineering Ethics, Engineering as Social Experimentation, Safety, Responsibilities and Rights, Global Issues, etc.

Learning Outcomes:

This course will enable the students to have:

i. Working knowledge of shipboard personnel management and training;
ii. A knowledge of related international maritime conventions and recommendations, and national legislation;
iii. Ability to apply task and workload management;
iv. Knowledge and ability to apply effective resource management; and
v. Knowledge and ability to apply decision-making techniques;
vi. Knowledge of professional ethics.

Syllabus Contents:

PART-A

i. **Introduction to Management Principles and Practice:** Need for sound Management principles and Practice and growth of modern management through various Managerial Functions, Planning, Organizing, staffing, Directing, controlling and Co-ordination; Principles of locating a Plant and Developing Organization Structure. Various types of organizational structures; Authority and Responsibility. Boundaries of Authority.
ii. **Shipboard personnel management and training:** Organization of crew, authority

structure, responsibilities, cultural awareness, inherent traits, attitudes, behavior, cross-cultural communication; shipboard situation, informal social structures on board; human error, situation awareness, automation awareness, complacency, boredom; leadership and team working; training, structured shipboard training programs; knowledge of personal abilities and behavioral characteristics.

iii. **International Maritime conventions and national legislation:** International maritime conventions – SOLAS, MARPOL, STCW, and MLC, role of IMO, ILO; Recommendations and national legislation.

iv. **Task and workload management:** Planning and coordination; personnel assignment; human limitations; personal abilities; time and resource constraints; prioritization; workloads, rest and fatigue; management (leadership) styles; challenges and responses.

v. **Resource management:** Effective communication on board and ashore; allocation, assignment and prioritization of resources; decision making reflecting team experience; assertiveness and leadership, including motivation; obtaining and maintaining situational awareness; appraisal of work performance; short and long term strategies.

vi. **Decision-making techniques**: situation and risk assessment; identify and consider options; selecting course of action; evaluation of outcome effectiveness; decision making and problem-solving techniques; authority and assertiveness; judgment; emergencies and crowd management.

vii. **Personnel Management:** The personnel function Requirement and role of psychological tests in recruitments; Training, performance appraisal and reward system, Legal requirements and regulation of working Condition, Employer's liabilities for health and safety, Leadership and Discipline, Motivation and incentives, Problems of Accident, Fatigue, etc., Relationship with Trade union and workers participation in management.

PART-B

i. **Human Values:** Objectives, Morals, Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the workplace, Spirituality.

ii. **Engineering Ethics**: Overview, Senses of engineering ethics, Variety of moral issues, Types

of inquiries, Moral dilemma, Moral autonomy, Moral development (theories), Consensus and controversy, Profession, Models of professional roles, Responsibility, Theories about right action (Ethical theories), Self-control, Self-interest, Customs, Religion, Self-respect, Case study: Choice of the theory.

iii. **Engineering As Social Experimentation:** Engineering as, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The Challenger.

iv. **Safety, Responsibilities and Rights:** Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis, Safety lessons from 'the challenger', Case study: Power plants, Collegiality and loyalty, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights.

v. **Global Issues:** Globalization, Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics.

References:

i. International Maritime Organization. (2014). *Leadership and teamwork* (IMO Model Course 1.39). IMO.

ii. The Nautical Institute. (2013). *Maritime leadership & management skills*. The Nautical Institute.

iii. Govindarajan, M., Natarajan, S., & Senthilkumar, V. S. (2013). *Professional ethics and human values*. PHI Learning Private Limited.

iv. Martin, M. W., & Schinzinger, R. (2010). *Ethics in engineering* (4th ed.). McGraw-Hill Education.

18.2.5 BME 1209: Basic Electronics Engineering

3.00 Credit, 3 hrs. /week.

Aims:

To provide students with the theoretical knowledge on the fundamentals of basic electronics.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

i. Explain the operating principles and characteristics of semiconductor devices, including PN junction diodes, rectifiers, filters, and voltage regulators.
ii. Analyze the construction, biasing, characteristics, and applications of bipolar junction transistors (BJTs) and field-effect transistors (FETs/MOSFETs) in switching and amplification circuits.
iii. Describe the working principles and applications of power electronic devices (SCR/thyristor), oscillators, operational amplifiers, and basic digital electronic systems.

Course Contents:

i. **P-N Junction as a Circuit Element**: P-N junction diode, Biasing, current-voltage characteristics of a PN junction diode. Simplified DC and AC diode models.
ii. **Rectifier, Filters and Power supply**: Rectification and rectifier, Rectifier classification, filter and its Classification, Zener diode and voltage stabiliser.
iii. **Bipolar Junction Transistors**: Construction, Working principle of PNP and NPN transistors, Biasing, Common base, Common-emitter and Common Collector Configurations, Input and output characteristics of C B, C, E and CC configurations, Load line analysis, Operating point. Performance of transistor operation, cutoff and saturation points, BJT as a switch, Single stage BJT amplifier circuits: BJT as a voltage amplifier/Current Amplifier; Concept of Multistage amplifier.
iv. **FET and MOSFET**: Introduction to FET and MOSFET, MOSFET as a switch, CMOS inverter.
v. **Thyristor/SCR**: Construction, working principle, characteristics, uses, Advantages/disadvantages

vi. **Others**: Introduction to Oscillators, Op Amp, digital electronics.

References:

i. Mehta, V. K., & Mehta, R. (2008). *Principles of electronics* (11th ed.). S. Chand Publishing.

ii. Boylestad, R. L., & Nashelsky, L. (2012). *Electronic devices and circuit theory* (11th ed.). Pearson Education.

iii. Sedra, A. S., & Smith, K. C. (2019). *Microelectronic circuits* (8th ed.). Oxford University Press.

18.2.6 BME 1211: Machine Drawing-I

3.00 Credit, 3 hrs. /week.

Aims:

To provide a general understanding of the technical aspects of engineering drawing to meet the mandatory minimum requirements for knowledge, understanding and proficiency related to maintenance and repair at the operational Level.

Learning Outcomes:

On completion of this course, students will be:

i. Competent to obtain any required information from engineering drawings produced to international standards and conventions.

ii. Should the need arise, they will also be able to produce drawings of an adequate standard for the manufacture of components.

iii. They will possess knowledge of design principles, which will enable maximum benefit to be gained from subsequent experience.

iv. Assembly of sectional, outside and plan views of parts fitted, removed and in functional order.

Syllabus Contents:

i. **Types of Drawing:** General arrangement; assembly drawings; component drawings; single-partdrawings; pictorial drawings.
ii. **Line-work:** First angle and third angle projection; third-angle projection with hidden detail; auxiliaryprojection
iii. **Pictorial Projection:** isometric projections; oblique projections
iv. **Development:** The development of a 90°intersection of circular trucking, a cone, square pyramid, square-to- round transition piece.
v. **Dimensioning:** Dimensions a simple component, applying all correct standards
vi. **Diagrams:** The interpretation of piping, hydraulic and pneumatic
vii. Marine machinery components and auxiliary equipment dismantled; to be conceptualized in assembly and laid out as working & functional parts. Sectional views in elevation & plans executed. Part sectional views depiction. Such auxiliary equipment includes:
    a. Blocks (6 assignments)
    b. Cable support
    c. Pipe Vice
    d. Connecting rod
    e. Crank shaft
    f. Pump coupling
    g. Keyed joints
    h. Nuts & Bolts
    i. Shaft supports
    j. Knuckle joint

References:

i. Beck, H. G. (2006). *Reed's engineering drawings*.
ii. Simmonds, C. H., & Maguire, D. E. (1983). *Progressive engineering drawing for T.E.C. students*. Hodder and Stoughton.
iii. Pickup, F., & Parker, M. A. (2003). *Engineering drawing with worked examples* (3rd ed.). Butterworth-Heinemann.

18.2.7 BME 1202: Basic Electrical and Electronics Engineering Sessional

1.50 Credit, 3 hrs. /wk.

Aims

The students will perform experiments/jobs to provide a foundation for practical skills relating to the theories learned in the theory course.

Learning Outcomes:

On successful completion of this unit, students will be able to demonstrate that they can experiment/Jobs using the protocols and methods offered in the discipline.

Syllabus Contents:

[Minimum 7 (Seven) experiments/Jobs must be carried out from the following lists.]

i. Introduction to Electrical quantities measuring meters (Ammeter, Voltmeter, Ohmmeter, Multimeter, Wattmeter, Energy meter etc.)
ii. Characteristics of Series and Parallel circuits.
iii. Verification of Ohm's Law.
iv. Verification of KCL and KVL.
v. Study of Superposition Theorem Circuit Analysis.
vi. Determination the value of resistance and inductance in a coil.(RL series AC circuit)
vii. Determination the value of resistance and capacitance in a RC series AC circuit.
viii. Determination the value of resistance, Inductance, and capacitance in a RLC series AC circuit.
ix. Determination the Power factor from a single-phase AC circuit.
x. Measurement of the Power of Single phase and three phase balanced AC circuit.
xi. Study the relation between line voltage/currents and phase voltage/ current in Star and Delta Connected load.
xii. Determination of phases sequence from the three-phase circuit.
xiii. Determination of the value of Resistor and capacitor using color code.
xiv. Show the skill of identifying the electronic components and soldering/desoldering.
xv. Study the lead identification and testing of diode, BJT, FET, MOSFET.
xvi. Study the V-I characteristics of PN junction diode

xvii. Study the I/O characteristics of a Transistor.
xviii. Design and Construction of Half-Wave/Full wave rectifier and calculation of ripple factor.
xix. Study the I/O characteristics of a Transistor.
xx. Other experiments/Jobs (if needed) based on the theory course 'Basic Electronics Technology.

References:

i. Laboratory Manual for AC Electrical Circuits by James M. Fiore, Version 1.2.1
ii. Introduction to Electric Circuits: Lab Manual 9th Edition, By Brian Kelly

18.2.8 BME 1204: Computer Programming and Applications

1.50 Credit, 3 hrs. /week.

Aims:

The objective of this course is to build upon the engineering student's knowledge of engineering problem-solving and computer programming skills.

Learning Outcomes:

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

i. Understand/identify the terms of computer technology;
ii. Write and execute computer programs to solve engineering problems;
iii. Develop computer programs from flowcharts and implement these programs in advance software Programming language;
iv. generate, edit, compile, and debug computer programs;
v. generate graphical solutions or representations of given engineering problems.

Syllabus Contents:

i. **Introduction to computer application and automation:** Goals of office automation, characteristics of office and office automation system, obstacles to the growth of office automation, trends in office automation, Office automation tools and technology, Word

processing and Excel, PowerPoint. GNUPLO.

ii. **Introduction to Computer Programming**: Flow chart and algorithm; Variables and operators; Functions; Sequential, Selective and Repetitive Structures; Arrays; Subprograms; Applications in Marine Engineering.

iii. **Exercises/Projects:** Hands on exercises/project work using computer programs (MATLAB/ FORTRAN/ C++, etc.).

References:

i. The C programming language; B. Kernighan and D. Ritchie.

ii. Deitel, P., & Deitel, H. (2016). *C++ how to program* (10th ed.). Pearson.

iii. Chapman, S. J. (2017). *MATLAB programming for engineers* (6th ed.). Cengage Learning.

iv. Mayo, J. (2016). *Microsoft Excel 2016 bible*. John Wiley & Sons.

18.2.9 BME 1206: Marine Workshop Practices-II

1.50 Credit, 3 hrs. /week.

Aims:

To provide a theoretical and practical knowledge on lathe, shaper, drill machine, gas cutting and brazing, etc.

Learning Outcomes:

The trainees will acquire skills in:

i. The use of lathes and shaping machines;

ii. The maintenance of machine tools to ensure that they are kept in good working order and ready for use;

iii. The correct procedure for setting up and securing work for given machining operations;

iv. Selecting the appropriate machine tools and machining sequence for any given task;

v. Hand on skill on gas cutting and brazing.

Syllabus Contents:

(Study the necessary theory on lathe, shaper, drill machine, gas cutting and brazing, etc. and safety issues about them)

List of Jobs/ Experiments: [Minimum 3 (three) Jobs /experiments must be carried out from the following topic /lists.]

I. **Square block:** To make a square block by Shaper machine. The job involves measuring of MS shaft as per the given measurement and scribing; cutting the shaft by a power hacksaw machine; fixing the shaft on the shaper machine vice, and carrying out the job on shaper machine.
II. **Tapered shaft:** To make a tapered shaft on a lathe machine. The work involves measuring of MS shaft as per the given measurement and scribing; cutting of the shaft by power hacksaw machine; fitting the shaft on the lathe machine chuck; to start the job on lathe machine.
III. **Bolt and Nut on lathe machine:** The work involves measuring of MS shaft as per given measurement and scribing; cutting of the shaft by power hacksaw machine; to fit the shaft on lathe machine chuck; continue to work on lathe machine.
IV. **Gas Cutting and Brazing:** Comprehensive study on Gas cutting and brazing and necessary jobs related to Gas cutting and brazing.

References:

i. Bruce J. Black (1982), Workshop processes, practices and materials
ii. Pritchard, R.T. Technician Workshop Processes and Materials. London, Hodder and Stoughton, 1979.

18.3 Year-2, Semester-1

18.3.1 BME 2101: Marine Internal Combustion Engine-II

3.00 Credit, 3 hrs. /week.

Aims:

(i) To provide an in-depth knowledge of smaller bore, 2-stroke marine diesel engines, its maintenance, etc.
(ii) To develop an idea on the causes of vibration and balancing.
(iii) To provide the knowledge on Fuel oil, lubricating oil and cooling water systems and Power balancing etc.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Construction and operational principles of four-stroke marine diesel engine components.
ii. Maintenance and repair of 2-stroke marine diesel engines.
iii. Performance monitoring and troubleshooting of 2-stroke marine diesel engines.

Syllabus Contents:

i. **Basic Construction of large-bore two-stroke engines:** Discussion on the major components of large bore marine diesel engines including the bedplate, a main bearing, an 'A' frame and entablature, guides, a liner, cooling-water jacket, a cylinder head, diaphragm, turbocharger, scavenge trunk, air cooler, crankshaft, connecting rod, crosshead, piston, bottom end bearing, top end bearing, camshaft, push rod, rocker, exhaust valve or port, air-inlet port, chain or gear train driving the camshaft.
ii. **Maintenance:** Maintenance, repair and overhauling of medium and high-speed marine diesel engines.
iii. **Vibration and Balancing:** Fluctuation of energy, Purpose of the flywheel, Simple harmonic motion, static balance and dynamic balance, critical speed and bared speed range, operation of vibration damper.

iv. **Cooling of I.C. Engines:** Various cooling media used; their merits and demerits, cooling of pistons, cylinder heads, coolant conveying mechanism and systems, maintenance of coolant and cooling system.
v. **Fuel oil system of IC engines:** IC engine fuel oil supply and circulation system from fuel oil tanks to engines.
vi. **Lubrication Systems:** Lubrication arrangement in diesel engines, including Coolers and filters Cylinder, Lubrication etc.
vii. **Indicator diagrams; and power calculations:** Construction details of indicator instrument. Significance of diagram Power Calculations, fault detection, simple draw cards and out of phase diagrams. Power balancing, Performance characteristic Curves, Test bed and Sea trials of diesel engines.

References:

i. Morton, T. D. (2013). Reeds Vol 12: Motor engineering knowledge for marine engineers (4th ed.). Bloomsbury Academic.
ii. Taylor, D. A. (2001). Introduction to marine engineering (2nd ed.). Butterworth-Heinemann.
iii. Wharton, A. J. (1991). Diesel engines (3rd ed.). Butterworth-Heinemann.

18.3.2 BME 2103: Machine Drawing-II

3.00 Credit, 3 hrs. /week.

Aims:

To provide an advanced understanding of the technical aspects of engineering drawing including the General drawings of various machinery components.

Learning Outcomes:

On completion of this course, trainees will be able to carry out:

i. Assembly drawings of main machinery, sectional, outside and plan views of parts fitted, removed and in functional order.
ii. Marine auxiliary equipment dismantled; to conceptualize in assembly and lay out as working and functional parts.

Syllabus Contents:

i. Marine machinery components and auxiliary equipment dismantled; to be conceptualized in assembly and laid out as working & functional parts. Sectional views in elevation & plans executed.Part sectional views depiction. Such auxiliary equipment to include:

   a. Gear pump
   b. Safety valve
   c. Mechanical seal
   d. Muff Coupling
   e. Stuffing box
   f. Check valve

ii. Marine engine components were dismantled. Assembly drawings of main machinery. Sectional, Outsideand plan views of parts fitted, removed & in functional order. Such drawings should include:

   a. Fuel Control lever
   b. Air inlet valve
   c. Cylinder relief Valve
   d. Starting air pilot valve
   e. Bilge suction strainer
   f. Crane hook
   g. Four ram steering gear.

References:

i. Beck, H. G. (2006). *Engineering drawings* (Revised ed.). Reeds Series.

ii. Maguire, D. E., & Simmons, C. H. (1983). *Progressive engineering drawing for T.E.C. students*. Hodder and Stoughton.

iii. Pickup, F., & Parker, M. A. (1970). *Engineering drawing with worked examples* (3rd ed.). Hutchinson

18.3.3 BME 2105: Marine Propulsion and Steering

3.00 Credit, 3 hrs. /week.

Aims:

To provide an understanding of the working principle, operation, maintenance and trouble-shooting on steering gear, shafting arrangement and propellers.

Learning Outcomes:

On successful completion of this unit, students will be able to do operation, maintenance and troubleshooting on steering gear, shafting arrangement and propellers.

Syllabus contents:

i. **Steering gears:** Operation and Constructional details of various types of steering machinery. Tele-motor systems, transmitters and receivers, Variable Delivery Pumps used in steering gears, axial and radial displacement types. Hunting action of the Steering gear. Emergency Steering arrangement. Care and Maintenance of Steering Gear Plants.

ii. **Shafting:** Methods of shaft alignment, constructional details and working of Thrust blocks. Intermediate shaft bearing and Stern tube bearing. Oil-water lubricated stern Tubes. Sealing Glands. Stresses in Tail End, Intermediate and Thrust Shafts.

iii. **Propellers:** Various types of propellers and their features, structure and materials for propellers, definition of propeller diameter, pitch, pitch ratio, boss ratio, pressure side, suction side, leading edge, following edge, blade section, blade rake, fixing of propeller on the propeller shaft, highly -skewed (skew back) propeller and its advantage, controllable pitch propeller (CCP) and its mechanism of changing blade angle, the advantages and disadvantages of a controllable pitch propeller in comparison with fixed pitch propeller (FPP), the cavitation of propellers and explains its generating mechanism, propeller singing and explains its generating mechanism and preventive measures.

iv. **Stabilizer and Bow Thrusters:** Different types of ship stabilizer and bow Thrusters.

References:

i. Jackson L. and Morton T.D (1999), Reed's General Engineering Knowledge for Marine Engineers.
ii. H.D McGeorge,1992, General Engineering Knowledge, 3rd Edition, Publisher: Butterworth Heinemaan.
iii. D.A Taylor, 2001, Introduction to Marine Engineering, Publisher: Butterworth and Heinemaan.

18.3.4 BME 2107: Marine Boiler and Steam Engineering

3.00 Credit, 3 hrs. /week.

Aims:

To provide the competences concerned with the operation, maintenance and troubleshooting of steam boiler problems.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Marine Boiler Construction
ii. Boiler Mountings and Steam Distribution
iii. Marine Boiler Operation
iv. Steam Boiler Fuel Atomization and Combustion
v. Steam turbine
vi. Boiler water treatment.

Syllabus Contents:

i. **General Considerations governing the design of Boilers:** Types of marine boilers, comparison of smoke tube and water boilers; Destructive and Nondestructive tests on plates, rivets, welded seams, classification society requirements for boiler construction.
ii. **Smoke Tube Boilers:** Various types in marine use, Principal dimensions and staying off flat surface of multi-tubular cylindrical Boilers. Vertical Auxiliary Boilers.
iii. **Water Tube Boilers:** General description with sketches of principal types of boilers in marine

use, Super-heater, Economizer, Air pre-heater and steam pre-heater; circulation and use of Unheated Down comers in highly rated boilers; Superheat temperature control, Attemperators and De-superheaters.

iv. **Waste heat boilers**: Waste heat recovery calculation, Lamont exhaust gas boiler, Scotch composite Boiler, Cochran exhaust gas and composite boiler, spanner marine exhaust gas and Composite boiler. Forced Water Circulation boiler, Double evaporation Boiler.

v. **Boiler Mountings:** Safety Valves- Improved High Lift, Full lift and full-Bore type: Gauge glass- Ordinary plate type and remote Indicator; Automatic feed regulator, three element High and Low water level alarms, Main Steam stop valves, Retractable type Soot blower etc.

vi. **Operation, Care and Maintenance:** Pre-commissioning procedures, Hydraulic, steam raising and operating procedures, Action in the event of storage of water. Blowing down of boiler, laying up a boiler; General maintenance. External and internal tube cleaning. Tube renewals, etc., maintenance, inspection and survey of boilers.

vii. **Refractory:** Purposes of refractory, types of refractory and reasons for.

viii. **Oil burning:** Procedure of Liquid fuel burning in open furnace, various types of atomizer, Furnace arrangement for oil burning, Boiler Control System, i.e. master control, fuel control, air control and viscosity control.

ix. **Boiler and Associated Auxiliaries, and Steam Systems**: precautions and necessary measures to be taken when getting up steam, soot blow including the function of soot blowers, malfunctions /troubles likely happen to boiler on its operation, precautions for opening high temperature steam valves, how to keep boiler in cold condition while it is out of service, correct procedures for operating steaming boilers in parallel on load, the correct procedures for checking the water level in steaming boilers, the danger of oil entering a boiler with the feed-water, what is meant by "blow-back", how blow-back can be avoided, the need for, and the use of, soot blowers, why the temperature of boiler exhaust gases should be maintained above a minimum value.

x. **Boiler Maintenance:** the need for cleaning the fire side of a boiler and how to do it, how to inspect the fire side of a boiler and perform repair/maintenance, the need for cleaning up the water side of a boiler and how to do it, how to inspect the water side of a boiler and the repair/maintenance

xi. **Boiler water treatment:** Fundamentals; Acidity/Alkalinity; corrosion; Water testing and treatment; effects of salts and gases in feed water;

xii. **Marine Steam Turbine:** Rankine cycle; Basic construction; Operation principles; the impulse turbine; the reaction turbine; Force on blades.

References:

i. Jackson, L., & Morton, T. D. (2019). Reed's general engineering knowledge for marine engineers (8th ed.). London, England: Bloomsbury Publishing.

ii. Jackson, L., & Morton, T. D. (2016). Reeds Vol 8: General engineering knowledge for marine engineers (6th ed.). Bloomsbury.

iii. D.A Taylor, 2001, Introduction to Marine Engineering, Publisher: Butterworth and Heinemaan.

18.3.5 BME 2109: Marine Auxiliary Machineries-II

3.00 Credit, 3 hrs. /week.

Aims:

(i) To provide a basic knowledge on working principle, operation and maintenance of marine refrigeration and air conditioning technology in line with the requirements of the operation level certificate of competency.

(ii) To provide a basic knowledge on working principle, operation and maintenance of Compressed air system.

(iii) To provide a basic knowledge on working principle, operation and maintenance of Fire protection & associated system.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Working principles of refrigeration, air conditioning and ventilation systems;

ii. Characteristics and regulatory requirements of gases, oils in the above system;

iii. System components, maintaining the temperature and humidity, trouble shooting.

iv. Types, System components, operation & maintenance of Compressed air system

Syllabus Contents:

Refrigeration and Air-Conditioning

i. **Refrigeration:** Principles of refrigeration; Marine refrigeration cycle; Refrigerating compressors; Refrigerating system components; Refrigerating system brines; Cold storage spaces, Refrigerants used in marine practice and their justification, Control of temperature in various rooms in domestic Plants.

ii. **Air conditioning and ventilation systems**: Block diagram of an air conditioning system, system components and arrows to indicate flow of refrigeration conditioning system, Operation and maintenance of Plants. Control and Safety equipment States how to control temperature and humidity in the air.

iii. **Machinery and Cargo Ventilation:** Design and constructional details, International requirements, Operation and maintenance of Equipment.

Compressed air system:

i. **Air compressor:** Two and three stage; effects of clearance; volumetric efficiency; filters; pressure relief valves; lubrication; defects; automatic drain, air vessels; cooling systems; distilled water; lubrication oil.

ii. **Air Reservoir:** Classification society requirements, construction, Maintenance and safety.

References:

i. Jackson, L and Morton, T.D. General Engineering Knowledge for Marine Engineers. 5th ed. London, Thomas Reed Publications Ltd 1990. (lSBN 09-47-63776-1)

ii. H.D McGeorge,1992, General Engineering Knowledge, 3rd Edition, Publisher: Butterworth Heinemaan

iii. D.A Taylor, 2001, Introduction to Marine Engineering, Publisher: Butterworth and Heinemaan.

18.3.6 BME 2111: Marine Electrical Machineries

3.00 Credit, 3 hrs. /week.

Aims:

To provide a foundation on 'Marine Electrical Machineries' in regards to working principle, construction, characteristics and maintenance of different types of transformers and motors.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Construction and operational principles of DC generators and DC motors;
ii. Construction and operational principles of AC generators and AC motors;
iii. Construction, operation and performance of transformers; and
iv. Parallel operation of alternators.

Syllabus Contents:

i. **Introduction**: Introduction to marine electrical machineries
ii. **DC generators:** Principle; Construction; Choice of Armature Winding; emf Equation; Types; Losses; Power Stages; Efficiency; Armature Reaction; Characteristics; Parallel Operation
iii. **DC motors**: Principle; Generator Vs Motor Operation; Back emf; Voltage Equation; Power Equation and Condition for Maximum Power; Dc Motor Types; Torque; Speed Regulation; Power Stages; Characteristics; Speed Control; Starter; Application.
iv. **AC generator:** Elementary alternator, Construction, frequency, field, generated emf, alternator characteristics, armature reaction, Alternator on No Load and on Load, alternator regulation, Prediction of Voltage Regulation, windings of alternator.
v. **Parallel operation of alternators:** Requirements, synchronizing, synchronizing lamp, synchronoscope, Field variation, dividing load in parallel operation, hunting.
vi. **Transformer**: Working principle, Construction, Types- (core type and shell type), Elementary theory for ideal transformer, E.M.F. equation, Transformation ratio, three phase transformer- (Operating principle, Different types of connection).
vii. **Transformer Vector diagram and Equivalent circuit**: Transformer with losses but no magnetic leakage, Transformer with winding resistance but no magnetic leakage, Transformer with resistance and leakage reactance, Equivalent circuit of a transformer.

viii. **Transformer test and Performance:** Voltage regulation, Transformer tests- (open-circuit and short-circuit test), Losses in a transformer, Efficiency, All-Day Efficiency condition for maximum efficiency, Instrument transformer- (current and voltage Transformer).

ix. **AC Motor:** Principle; Kinds; Production of Rotating Field (two-phase and three-phase supply) and mathematical proof;

x. **The Induction Motors**: Construction; Theory of Operation; Slip; Rotor Current Frequency; Torque; Torque Slip Characteristics; Speed Regulation; Speed Control; Power Stage; Methods of Starting, Slip ring motors, Synchronous Motor; Universal Motor; etc.

References:

i. Thereja, B. L., & Thereja, A. K. (2014). A textbook of electrical technology (Vol. 2). New Delhi, India: S. Chand Publishing.

ii. Rosenblatt, I., & Friedman, S. (1954). Direct and alternating current devices. New York, NY: McGraw-Hill.

iii. Chapman, S. J. (2012). Electric machinery fundamentals (5th ed.). New York, NY: McGraw-Hill Education.

iv. Hall, D. T. (1984). Practical marine electrical knowledge. London, England: Witherby & Co. Ltd.

v. Kraal, E. G. R. (1985). Basic electro-technology for engineers (3rd ed.). London, England: Thomas Reed Publications Ltd.

18.3.7 BME 2113: Turbocharger and Scavenging Technology

3.00 Credit, 3 hrs. /week.

Aims:

To provide an understanding of the operation, maintenance and troubleshooting of turbochargers, scavenging and associated systems of main and auxiliary engines.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Main and auxiliary engine turbocharger construction, operation, maintenance and troubleshooting.

ii. Two and four-stroke engine scavenging system

iii. Construction, operation and maintenance of the main and auxiliary engine air cooler, scavenge and exhaust manifold.

Syllabus Contents:

i. **Turbocharger:** Gas exchange process, Construction, operation, maintenance, water and washing, lubrication, surging, breakdown, temporary and permanent repair, Condition monitoring, Causes of breakdown, Performance checking, Labyrinth seal arrangements, Rotor balancing, Various parameters & their importances, Vibration of turbochargers etc.
ii. **Bearing:** Turbocharger bearing lubrication types, Properties of bearings, Types of bearings causes of bearing failure etc.
iii. **Scavenging System:** Scavenging arrangements in 2-stroke engines; Air charging and exhausting in 4-stroke engines; Various types of Scavenging in 2-stroke engines; Uni-flow, loop, cross-loop loop and reverse loop scavenging, their merits and demerits; Scavenge pumps for normally aspirated engines; under-piston scavenging, scavenge manifolds, scavenge valves, non-return valves, auxiliary blowers.
iv. **Supercharging arrangements:** Pulse and constant pressure type; their relative merits and demerits in highly rated marine propulsion engines. Air movements inside the cylinders.
v. **Air cooler:** Construction, drawing, Cooling arrangement and maintenance & Trouble shooting etc.
vi. **Scavenge manifold:** Description, Construction, Inspection, Drawing. Safety before entry. Scavenge space inspection report.
vii. **Exhaust manifold:** Inspection and maintenance. Components of Exhaust pipe, Silencer & spark arrester, Exhaust components, operation principle & washing procedure etc.
viii. **Hybrid Turbocharger:** Working principle, description, advantage & disadvantages etc.

References:

i. Morton, T. D. (2013). Reeds Vol 12: Motor engineering knowledge for marine engineers (4th ed.). Bloomsbury Academic.
ii. Taylor, D. A. (2001). Introduction to marine engineering (2nd ed.). Butterworth-Heinemann.
iii. Wharton, A. J. (1991). Diesel engines (3rd ed.). Butterworth-Heinemann.

18.3.8 BME 2102: Maintenance of Machineries-I

1.50 Credit, 3 hrs. /wk.

Aims:

To provide the principles of the practical maintenance of main propulsion and other Auxiliary machineries as installed in the training establishment. They will then be further prepared for training in similar work in real life situations on board ship.

Learning Outcomes:

The students will have sufficient skill on the maintenance and repair such as dismantling, adjustments and reassembling of main machinery components such as cylinder liner, piston, bearings, fuel injection pump, valves, turbocharger and other auxiliary machineries like Boiler, Air compressor etc.

Syllabus contents:

[Minimum Seven (07) jobs/Experiment needed based on the under-mentioned topics]

i. **Diesel Engine**: Dismantles and inspects all parts for wear and deterioration, and assembles including: pistons; rings; liners; bearings; valves; cooling passages; crankshaft alignment; lubrication system; cylinder heads; exhaust valves; air-start valves; fuel injector; relief valve; fuel injection pump; Checks timing and ascertains freedom of movement; Checks condition of lubrication oil; Purges air from fuel system.

ii. **Turbocharger (Supervised Student Activity)**:
   - Dismantles: air filter; air casing; inducer (if fitted); impeller; volute; diffuser; gas inlet grid; nozzle ring; rotor; bearings.
   - Examines all parts for wear and deterioration, paying particular attention to: erosion in the air side; erosion in the turbine nozzles and in the blades; corrosion of the gas casing; hard deposits; damage to balding; condition of bearings; condition of labyrinths; obstructions in the bleed and sealing passages; lubrication system;
   - Reassembles and checks clearances.

iii. **Boiler (Supervised Student Activity**):
   - Explains the need for cleaning the fire side of aboiler and how to do it;Describes how

to inspect the fire side of a boiler and repair/maintenance;

- Explains the need of cleaning up the water side of a boiler and how to do it; Describes how to inspect the water side of a boiler and the repair/maintenance;
- Describes how to restore the boiler after prolong shut down.

iv. **Air Compressors (Supervised Student Activity):** Dismantles, examines and replaces or repairs as found necessary: suction and delivery valves and seats; piston and rings; glands/seals; relief valves and bursting discs coolers and cooling passages; lubricating oil system; drains

v. Thrust block, Stern tube, Shaft bearings, and Shaft sealing equipment.

References:

i. Morton, T. D. (2013). Reeds Vol 12: Motor engineering knowledge for marine engineers (4th ed.). Bloomsbury Academic.

ii. Taylor, D. A. (2001). Introduction to marine engineering (2nd ed.). Butterworth-Heinemann.

iii. Wharton, A. J. (1991). Diesel engines (3rd ed.). Butterworth-Heinemann.

18.3.9 BME 2104: Marine Workshop Practices-III

1.50 Credit, 3 hrs. /week.

Aims:

To provide a theoretical and practical knowledge on lathe, shaper, drill machine, gas cutting and brazing, etc.

Learning Outcomes:

The trainees will acquire skills on:

i. The use of lathes and shaping machines.

ii. The correct procedure for setting up and securing work for given machining operations.

iii. Selecting the appropriate machine tools and machining sequence for any given task.

iv. Hands-on skill on gas cutting and brazing.

Syllabus Contents:

(Study the necessary theory on lathe, shaper, drill machine, gas cutting and brazing, etc. and safety issues about them)

List of Jobs/ Experiments: [Minimum 3 (three) Jobs /experiments must be carried out from the following topic /lists.]

i. **Flange:** To fabricate a flange using a lathe machine and welding equipment. The job involves measuring the MS plate as per given measurement and scribing, cutting of the plate and GI pipe by hacksaw; fixing the plate on the lathe machine chuck; welding of the GI pipe to the plate; and polishing by emery cloth.
ii. **Gear:** Making of gear teeth by lathe machine. The work involves measuring of MS shaft as per given measurement and scribing; cutting of the shaft by power hacksaw machine; to fit the shaft on the lathe machine chuck; continue work on the lathe machine.
iii. **Screw Jack:** To make screw jack on lathe machine. The job involves measuring of MS shaft as per given measurement and scribing; cutting of the shaft by power hacksaw machine; to fit the shaft on lathe machine chuck; continue work on the lathe machine.

References:

i. Bruce J. Black (1982), Workshop processes, practices and materials
ii. Pritchard, R.T. Technician Workshop Processes and Materials. London, Hodder and Stoughton, 1979.

18.4 Year-2, Semester-2

18.4.1 BME 2201: Industrial Chemistry

3.00 Credit, 3 hrs. /wk.

Aims:

The primary aim of this course is to equip students with the knowledge and skills necessary to prevent corrosion and scaling, thereby ensuring the safe, efficient, and reliable operation and extended lifespan of the ship's boiler and steam systems.

Learning Outcomes:

On Completion of the course the students are expected to

i. Have a thorough knowledge of Boiler Chemistry and Feed Water Treatment methods.
ii. Have a knowledge of various Water Hardness analysis procedures

Syllabus Contents:

i. **Fundamentals:**
   - Define an atom;
   - Describe a molecule;
   - Define: chemical elements chemical compounds;
   - Explain the difference between compounds and mixtures and names of: Elements,
   - Compounds, mixtures;
   - Define a chemical reaction;
   - Defines an oxide; Uses as necessary the convention denoting elements, compounds and mixtures by letters and numbers; for example, carbon dioxide represented by CO2;
   - Explain what is meant by: solution, solubility, saturated solution, suspension, precipitation.

ii. **Acidity/alkalinity:**
   - Define the composition of an atom
   - Explain the result of an atom gaining or losing electrons
   - Defines a hydrogen ion

- Defines a hydroxyl ion
- Given pH values, demonstrates whether a solution is alkaline, neutral or acidic, indicating its strength or weakness
- Uses an indicator such as litmus paper to determine whether a solution is acid or alkaline

iii. Corrosion

- Defines how metallic hydroxide is formed when an iron is immersed in an acidic solution
- Defines the effect of dissolved oxygen and high acidity on polarization
- States that boiler water should be alkaline and contain little or no dissolved oxygen
- Explains the fundamental process of corrosion
- Names common engineering materials which produce passive oxide films
- States the main cause of corrosion
- Names the components of a galvanic cell and applies these to the corrosion of a metal
- Defines that seawater is an electrolyte
- Defines an anode
- From a list of common metals, selects relative anodes
- Defines metals as being noble or base relative to each other
- Defines the use of sacrificial anodes
- Recognizes the problems if graphite grease is used when seawater is present
- Defines practical means of reducing galvanic action in the choice of metal and exposed surface area
- Defines pitting corrosion
- Recognizes the process of graphitization of cast iron
- Defines the reasons why corrosion increases when seawater velocity Increases
- Defines the terms and what is meant by stress corrosion and names the metals in which It commonly occurs
- Explains what is meant by dezincification and dealuminification
- Defines how the process in the above objective can be prevented
- Explains what is meant by fretting corrosion
- Defines the factors which increase the rate of fretting
- Defines what is meant by corrosion fatigue

- Identifies the major factors affecting the corrosion process as:
  - differential temperatures
  - stresses within the metal structure
  - variation in crystal structure of the metal
  - distribution/concentration of impurities in the metal crystals
  - flow of oxygen to the cathode
  - flow of carbon dioxide to the anode and cathode
  - hydroxyl ion concentration of the aqueous solution
- Recognizes that some films and coatings on metal surfaces can provide protection so long as they remain intact
- Recognizes that surface preparation prior to the application of protective coatings is very important
- Identifies the important methods of surface protection as:
  - paints
  - chemical films
  - metallic coatings
  - anodizing

iv. **Water testing and treatment**

- Recognizes the importance of controlling the pH value of aqueous solutions within the minimum corrosive range
- Identifies the chemical additives that can be used to obtain the condition required in the above objective
- Knows the importance of maintaining a gas-free condition in the water used to "feed" a steam boiler or to circulate in an engine cooling system
- Identifies the methods in common use for conditioning the water content of marine power plant, e.g. trisodium phosphate, hydrazine
- Explains that natural water supplies contain metallic salts in solution demonstrates the standard method of measuring metallic salt content, i.e. state the actual quantity of metallic salt present in a specified quality of water
- Knows the standard measurement given in the above objective as in units of "parts per million" (ppm) or less accurately in '32's' (seawater density measurement)
- Lists the main metallic salts found in:fresh water, average seawater

- Defines: permanent hardness, temporary hardness
- Defines briefly how scale and sludge are produced in a steam boiler
- Explains the different effects of using seawater, fresh water and distilled water as boiler feedwater
- Defines the principal objects of treatment of boiler feedwater

v. **Water Technology:**

- Water and it's impurities - Significance and estimation - turbidity, color, pH, acidity, solids, chlorides, residual chlorine, sulphates, fluorides, phosphates, iron and manganese, DO, BOD, COD, nitrogen, grease, volatile acids.

vi. **Water Treatment Processes:**

- Lime and Soda treatment, zeolites process and ion exchange (demineralization) - pH treatment, salinometer, use of litmus paper, test for partial, total alkalinity, chloride, sulphite, phosphate test, caustic soda treatment, condensate lime treatment. Desalination of water, reverse osmosis and electro dialysis, and control, effects of salts and gases in feed water.

vii. **Boiler Chemistry:**

- Purpose of water treatment in boilers, scale and sludge formation and prevention, priming and foaming- Boiler corrosion – fretting, pitting corrosion, corrosion fatigue, atoms and ions, electro chemical corrosion, hydrogen and hydroxyl ions, types and causes of corrosion and it's control; chemical and mechanical deareation, methods of chemical deareation, dezincification, stress corrosion.

viii. **Water Hardness Analysis:**

- Hardness, units of hardness, estimation of hardness by EDTA method, treatment for hardness, total dissolved solids, dissolved oxygen test, use of coagulants, typical test valves for smoke and water tube boilers.

ix. Fuels

- Source of supply
- Study of Primary Fuels, Coal, petroleum, natural gas, classification of fuels.
- Treatment of fuels for combustion in marine I.C.E. and steam plants,
- Composition of petroleum**,** distillation process**,**
- Testing of liquid fuel: Density; viscosity; viscosity scales; temperature; flush point; calorific value; pour point; carbon residue; water in oil; fire point; acidity or alkalinity;

octane number; cetane number, ISO specification of marine fuel**,** Combustion of fuel**,** Oil fuel additives

x. Lubricants

- Manufacture of lubricating oil,
- Theories of Lubrication,
- Types of Lubricants and their Properties,
- Suitability of Lubricants for various uses;
- Solid and fluid lubricants.
- Additive Oils and their specific use,
- Terminology used in Lubrication systems.
- Loading pattern of various bearings in marine use and lubrication system adopted.
- Different types of bearings used for marine machinery,
- Factors affecting hydrodynamic lubrication,
- Shipboard lubricating oil test,
- Microbial degradation of lubricating oil, and grease.

xi. Purifier and fuel oil treatment

- Describes the following with the aid of sketches:
  - bowl assembly
  - operating water
  - seal water
  - gravity disk
  - valve cylinder
  - separation disk/plate
- States principles of purifying to eliminate water or dirt particles from oil
- Explains why fuel oil treatment is necessary
- Explains in simple terms, the purification by using gravity force and filters, and centrifugal separation
- Describes the following types of filter, which are used in fuel oil lines:
  - mesh/gauze elements
  - magnetic elements
  - fibre assemblies
- Explains how the force of gravity is used to separate out liquids and solids of different

densities

- Describes the operation principles of an oil purifier
- Explains why the use of centrifugal separation is much faster and more effective than gravity in the separation process
- Describes, with the aid of simple sketches, a bowl separator and a tube separator, showing the main components and the principal differences between the two
- States the rotation speeds used in the equipment described in the above objective

xii. Thermal fluid heating systems

- States the functions of a thermal fluid heating system on board ship
- States the differences between a thermal fluid heating system and an auxiliary steam system
- States the properties of thermal fluids used on board ship
- Describes with the aid of diagrams and sketches the components and their functions, fittings and safety devices of a thermal fluid system
- Explains the need for a minimum flow of the thermal fluid in the system
- Describes the safety precautions and possible dangers when operating a thermal fluid heating system
- Describes the operation of a thermal fluid heating system

References:

i. McGeorge, H. D. (2017). *Marine auxiliary machinery* (9th ed.). Butterworth-Heinemann.

ii. Morton, T. D., & Jackson, L. (2014). *Reed's general engineering knowledge for marine engineers* (7th ed.). Bloomsbury Publishing.

iii. Jackson, L., & Morton, T. D. (2016). *Reeds Vol 8: General engineering knowledge for marine engineers* (6th ed.). Bloomsbury Academic.

iv. Nag, P. K. (2017). *Engineering chemistry* (2nd ed.). McGraw-Hill Education.

18.4.2 BME 2203: Ship Construction

3.00 Credit, 3 hrs. /week.

Aims

The aim of this course is to provide students with a comprehensive understanding of ship construction principles, structural components, and materials used in shipbuilding. The course focuses on ship structural terminology, stress distribution, framing systems, bulkheads, and fore-end and after-end arrangements, enabling students to understand how ship structures are designed to ensure strength, safety, and seaworthiness.

Learning Outcomes

Upon successful completion of this course, the students will be able to:

i. **Explain** fundamental ship construction terminology, classifications of ships, and the structural stresses acting on ship hulls, including the methods used to counteract these stresses.
ii. **Identify and describe** the materials, structural sections, framing systems, shell plating, decks, bulkheads, and deep tank arrangements used in modern ship construction.
iii. **Analyze** the structural arrangements at the fore-end and after-end of ships, including measures to resist panting, collision protection, anchoring systems, and the functional integration of hull components.

Syllabus Contents:

i. **Ships Terms:** Various terms used in ship Construction with reference to Ship's parameter e.g. L.B.P. Moulded Depth, Moulded draught etc. General Classification of Ships.
ii. **Stresses in Ship's structure:** Hogging, Sagging, Racking, Pounding, Panting, etc. and Strength members to counteract the same.
iii. **Sections and materials use:** Type of section like Angles, Bulb Plates. Flanged beams used in ship construction. Riveting & Welding. Testing of welds. Fabricated components.

iv. **Bottom & side Framing:** Double bottoms, Water tight floors, Solid and bracket floors, Longitudinal framing keels, side framing like Tank side brackets, Beam knee, Web Frame, etc.

v. **Shell & Decks:** Planting system for shells, Deck plating & Deck girders, discontinuities like hatches and other openings. Supporting & closing arrangements, mid-ship Section of ships.

vi. **Bulk heads & Deep Tanks:** Water tight bulkheads, Arrangements of plating and stiffeners. Water tight openings through bulkheads for electric cables pipes and shafting. Deep tank for oil fuel or oil cargo corrugated bulk heads.

vii. **Fore-End Arrangements:** Stem construction. Arrangement to resist panting, panting stringers, Forepeak-Collision bulk heads Bulbous bows. Anchor and cable arrangements.

viii. **After-End-Arrangements:** Stem construction. Arrangements to resist panting, panting stringers, Forepeak-Collision bulk heads. Bulbous bows. Anchor and cable arrangements.

References:

i. Eyres, D. J., & Bruce, G. J. (2012). *Ship construction* (7th ed.). Butterworth-Heinemann.

ii. Stokoe, E. A. (2015). *Reed's naval architecture for marine engineers* (Reed's Marine Engineering Series). Bloomsbury Publishing.

iii. Taylor, D. A. (1998). *Introduction to marine engineering*. Butterworth-Heinemann.

iv. Stokoe, E. A. (1985). *Reeds Vol 4: Naval architecture for marine engineers*. Thomas Reed Publications.

18.4.3 BME 2205: Fluid Mechanics and Hydraulics

3.00 Credit, 3 hrs. /week.

Aims:

The objective of this course is to give students an understanding of the nature of the fluid and introduce basic laws and explain the behavior of fluid and flow as well as gas dynamics. Dimensional analysis, hydraulic and pneumatic power system will also be introduced.

Learning outcomes:

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

i. appreciate and understand the influence of fluid mechanics in design

ii. correlate relevant daily events/machines to mechanics of fluids
iii. describe the principles of model testing
iv. analyze and solve related problems.

Syllabus Contents:

i. **Fluid properties**; Fluid statics and kinematics; Continuity; Energy and momentum principles; Energy and hydraulic grade-lines; Laminar and turbulent flows; Control volume and Control surface; Euler ‘s equation, Bernoulli‘s equation and its applications; Flow rate measurement-Venturi meter, Orifice meter and Pitot tube. -Compressible flow: - velocity of sound, mach no and Mach cone. Introduction to boundary layers, drags and wakes; Friction and flow through pipes; Impact of jets; Dimensional analysis; Principles of similitude and model testing; Aero foil and its application; Fundamentals of hydraulic and pneumatic power system; Hydraulic machines: reciprocating and centrifugal pumps; Cavitation.

ii. **Hydraulic Turbines:**

Impulse reaction turbine, Pelton wheel, Francis propeller and Kaplan turbine, effective head, available power and efficiencies for above turbines, draft tube, specific speed of turbine, cavitation, performance characteristics of turbines.

iii. **Gas Dynamics:**

One-dimensional steady flow of compressible fluids, isentropic flow, Effect of Friction, Flow through Nozzles and Differ. Critical condition, Mach number, Subsonic, Sonic and Supersonic Flow. Flow of steam through Nozzle and Diffuses.

References:

i. Fox, R. W., McDonald, A. T., & Pritchard, P. J. (2015). Introduction to fluid mechanics (8th ed.). John Wiley & Sons.
ii. White, F. M. (2016). Fluid mechanics (8th ed.). McGraw-Hill Education.
iii. Munson, B. R., Young, D. F., Okiishi, T. H., & Huebsch, W. W. (2013). Fundamentals of fluid mechanics (7th ed.). John Wiley & Sons.
iv. Fox, R. W., & McDonald, A. T. (2011). Fluid mechanics and hydraulic machines. Tata McGraw-Hill Education.
v. Anderson, J. D. (2017). Modern compressible flow: With historical perspective (4th ed.).

McGraw-Hill Education.

18.4.4 BME 2207: Applied Heat

3.00 Credit, 3 hrs. /week.

Aims:

The objectives of this subject are to develop the fundamental principles and laws of heat transfer and to explore the implications of these principles for system behavior; and to develop the problem-solving skills essential to good engineering practice of heat transfer in real-world ship design applications.

Learning outcomes:

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

i. Understand and describe the fundamental concepts of various heat transfer methods.
ii. Build the necessary theoretical background to understand the heat transfer cases in ship design.

Syllabus Contents:

i. **Introduction**: steady and unsteady state conduction in one dimension, cases of single and composite walls, cylinders and spheres, fins of uniform cross section; Transient heat transfer: system with negligible internal resistance; Hiesler charts; Introduction to two and three dimensional heat conduction and numerical problem.
ii. **Heat transfer and heat exchangers**: Specific heat, Mechanical equivalent, Wate equivalent. Latent heat, fusion, evaporation. Sensible heat. Enthalpy. Conduction, Convection and radiation; combined modes, parallel flow and counter flow. LMTD relationship Heat transfer cases in ship design: insulation in bulkheads refrigerated spaces and numerical problem.
iii. **Reciprocating Air Compressors**: Work done per cycle. Effect of clearance. Multi-stage compression. Free air delivery. Minimum work and numerical problem.
iv. **Refrigeration**: Refrigerants. Working cycle vapour-compression system. Capacity and performance. Coefficient of performance and numerical problem.

v. **Steam**: Enthalpy, wet steam; dry steam; superheated steam; mixing steam and water; throttling of steam; throttling of calorimeter; combined separating and throttling calorimeter and relevant mathematical problems.

vi. **Boilers and combustion**: Capacity and equivalent evaporation. Efficiency. Feed water. Principles of combustion. Calorific value, higher and lower. Air required for combustion. Composition of flue gases. Orsat apparatus. Conversion of gas analyses. Hydrocarbon fuels. Incomplete combustion.

References:

i. *Applied heat for engineers*. Reed's Publications.

ii. Joel, R. (1996). *Basic engineering thermodynamics in S.I. units (5th ed.).* Harlow, England: Longman.

iii. Brijlal, & Subrahmanyam, N. (2005). *Heat and thermodynamics.* New Delhi, India: S. Chand and Company Ltd.

18.4.5 BME 2209: Marine Environment Pollution and Protection

3.00 Credit, 3 hrs. /week.

Aims:

This course aims to prepare students for marine environmental protection, maritime regulatory compliance, and marine pollution response. The specialized knowledge acquired will enable graduates to contribute effectively to safeguarding marine ecosystems and ensuring sustainable maritime operations.

Learning Outcomes:

The student will be able to apply, perform, describe, explain, discuss and analyze:

i. International Convention for the Prevention of Pollution from Ships,73/78 including all
ii. annexes
iii. Understand Permissible Discharges and Emissions
iv. Comply with Operational Requirements

v. Identify and Avoid Deficiencies
vi. Manage Shipboard Waste
vii. Respond to Emergencies
viii. Demonstrate Environmental Stewardship
ix. Explain Responsibilities.

Syllabus Contents:

i. **MARPOL 73/78:** Definition of key terms, Violation and sanctions, Enforcement and Inspection (Port State Control), Reporting Obligations

a. Annex I-Oil:

Key Definitions- Oil, Oily Mixture, Special Area, Segregated Ballast, Instantaneous Rate of Discharge; Surveys and Certification; Discharge Criteria (Outside Special Areas); Regulations in Special Areas; Operational Safeguards: Crude Oil Washing (COW), Ballast Limits, STS Operations; Vessel Response Plan (VRP).

Oily Water Separator: Construction and Components, Pumping and Pressure Principles, Oil Content Meter (OCM) and Safety, Oil Record Book (ORB) Entries.

Oil Record Book (ORB): Provision and Carriage Requirements- Part I (Machinery Space Operations), Part II (Cargo/Ballast Operations); Mandatory Entries for Part I (All Ships); Mandatory Entries for Part II (Oil Tankers Only); Accidental or Exceptional Discharges; Maintenance and Legal Status- Signing, Retention, Inspection.

Shipboard Oil Pollution Emergency Plan (SOPEP): Purpose and Application, Regulatory Framework, Mandatory Contents- Reporting Requirements, List of Contacts, Steps to Control Discharge, National and Local Coordination; Integration with Ship Certification- IOPP Certificate, Verification.

b. **Annex II - Noxious Liquid Substances in Bulk:**

Categorization of Substances; Operational Documentation: Procedures and Arrangements (P&A) Manual, Cargo Record Book (CRB); Discharge and Pumping Requirements; Surveys and Certification.

Shipboard Marine Pollution Emergency Plan (SMPEP)- Application and Purpose, The "Combined Plan" (SMPEP), Mandatory Contents and Guidelines, Certification and Verification.

c. **Annex III - Harmful Substances Carried by Sea in Packaged Forms:**

Scope and Harmful Residues; Labeling and Documentation; Operational Controls and Prohibitions; Notification and Stowage.

d. Annex IV – Sewage:

Scope and Certification-Application, ISPP Certificate, Reception Facilities; Mandatory Shipboard Equipment-Sewage Treatment Plant, Sewage Comminuting and Disinfecting System, Sewage Holding Tank; Discharge Criteria (Distance from Land)- Treated Sewage, Comminuted and Disinfected Sewage, Untreated Sewage; Rate of Discharge; Special area.

e. Annex V – Garbage:

Key Definitions-Garbage, Nearest Land, Special Area; General Prohibitions and Regulations; Special Areas under Annex V; Operational Compliance, Garbage Management Plan, Garbage Record Book.

f. Annex VI - Air Pollution:

Key Definitions- Emission Control Areas (ECAs), Nitrogen Oxide (NOx) Technical Code, Ozone-Depleting Substances, Continuous Feeding, VOCs (Volatile Organic Compounds); Certification and Inspection- IAPP Certificate, Duration, Inspection; Regulation 13: Nitrogen Oxides (NOx); SOx and Fuel Oil Quality (Regulation 14 & 18)- Global Sulphur Cap, SOx Emission Control Areas (SECA), Fuel Quality; Special Areas (ECAs); Shipboard Incineration-incinerator for the disposal of sludge, refuse.

Volatile Organic Compound (VOC) Management Plan: Understanding VOCs, Factors Influencing VOC Emission- Volatility, Temperature, Pressure Control, Vapour Space (Ullage) etc., VOC Management Plan (Reg 15.6), Operational Control Methods.

ii. International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS Convention):

Purpose of Anti-Fouling Systems; The Ban on Organotins (TBT); Key Provisions of the Convention- Prohibition, Sealing Old Paint, Future-Proofing; Timeline and Compliance; International Anti-fouling System Certificate.

iii. Ballast Water Management (BWM) Convention:

Key Definitions-Ballast Water, Ballast Water Management, Sediments; Application and Compliance Documents- International Ballast Water Management Certificate, Ballast Water Management Plan (BWMP), Ballast Water Record Book (BWRB); Management Standards (D-1 and D-2); Ballast Water Exchange (Regulation B-4); The Annex Structure (Sections A–E).

iv. **Conventions and legislations adopted by IMO and various countries:**

London Dumping Convention (LDC); International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969; International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969; International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC 1969); Oil Pollution Preparedness, Response & Cooperation Convention (OPRC) as amended (OPRCHNS Protocol); OPA-90 and other US legislation.

References:

i. IMO: MARPOL 73/78 Consolidated Edition 2011. London: IMO
ii. Jackson, L and Morton, T.D. General Engineering Knowledge for Marine Engineers.
iii. 5th ed. London, Thomas Reed Publications Ltd 1990. (lSBN 09-47-63776-1)
iv. H.D McGeorge,1992, General Engineering Knowledge, 3rd Edition, Publisher:
v. Butterworth Heinemaan

18.4.6 BME 2211: Applied Mechanics

3.00 Credit, 3 hrs. /week.

Aims:

To provide the required knowledge on the fundamentals of Engineering Mechanics.

Learning Outcomes:

Upon completion of this course, the student will gain a comprehensive knowledge of applied mechanics.

Syllabus Contents:

i. **Vector and Vector diagrams:** Resultant and equilibrium, triangle and polygon of Forces, Concurrent and parallel forces, Bow's notation, component of a force, Slings, Jib cranes, reciprocating engine, framed structure, Non-coplanar force,etc.
ii. **Velocity and Acceleration**: Linear and angular velocity, acceleration, Projectiles, Relative velocity, Mass- Accelerating Force etc.
iii. **Work, power and Energy:** Work, Power, Power: Reciprocating engine, Rotary; Transmission of power by chain/belt/gears, Energy, Kinds, Kinetic energy: Rotation, Translation and rotation, etc.
iv. **Centripetal Acceleration:** Centrifugal force, balancing, governor, simple harmonic motion,etc.
v. **Sliding Friction**: Coefficient of friction, inclined planes etc., friction in the horizontal plane and related problems.
vi. **Moments:** First moments, Second moments, related problems about moments, etc.
vii. **Lifting Machines**: Various lifting techniques, etc.
viii. **Stress and Strain:** Stress and strain, strength of material, Working stress and factor of safety, Elasticity, Modulus of elasticity, tensile stress to destruction, Stress and compound bars, elastic strain energy, Suddenly applied and shock loads, stress on oblique plans,etc.
ix. **Strength of Pressure vessels:** Stresses in thin cylinder, working pressure, Effect on seam strength, etc.
x. **Bending of Beams:** Condition of equilibrium, Shearing forces and bending moments with necessary diagram, etc.
xi. **Stresses in Beams:** Stresses in beams, Deflection of beams, etc.
xii. **Torsion:** Torsion, torque and stress, torsional Resilience, Torque and power, maximum and mean torque, transmission of power, deflection of a closely coiled helical spring, Hydraulic steering gear, etc.

References:

i. Embleton, W., & Gunn, J. T. (1994). *Reed's applied mechanics for engineers* (4th ed.). Reed Educational and Professional Publishing.
ii. Hannah, J., & Hillier, M. J. (1995). *Applied mechanics* (3rd ed.). Longman.

18.4.7 BME 2202: Maintenance of Machineries-II

1.50 Credit, 3 hrs. /week.

Aims:

To provide the principles of the practical maintenance of main propulsion and other Auxiliary machinery as installed in the training establishment. They will then be further prepared for training in similar work in real-life situations on board a ship.

Learning Outcomes:

The students will have sufficient skill on the maintenance and repair such as dismantling, adjustments and reassembling of auxiliary machineries like various pumps, valves, heat exchangers, refrigeration systems and Deck machineries, etc.

Syllabus contents:

[Minimum Seven (07) jobs/Experiment needed based on the under-mentioned topics]

i. **Centrifugal Pumps (Supervised student activity)**: Dismantles casing; impeller; wearing, shaft; bearings; gland/seal; air pump; float chamber; Examines and measures all parts for wear and deterioration; Re-fits, checking, clearances; Replaces and adjusts seals
ii. **Reciprocating Pumps (Supervised student activity)**: Dismantles cylinders; piston/buckets; rings; valves; joints; glands; relief valves; Measures wear in cylinders, neck rings and rods; checks ring gaps; Machines and/or grinds in valves and seats; Removes gland packing; Selects and fits new gland packing.
iii. **Screw and Gear Pumps (Supervised Student Activity)**: Dismantles rotors and gears; seals; bearings; relief valve; Examines for wear and deterioration; Re-fits, checking end clearances and backlash; Replaces and adjusts seals.
iv. **Valves (Supervised Student Activity)**: Examines seats, valves, spindles, glands; Machine valves and seats; Bedsin valves on seats, using grinding paste; Removes old gland packing; Selects correct gland packing; Repacks glands.
v. **Heat Exchangers (Supervised Student Activity)**: Dismantles and examines for leakage; for corrosion; for erosion, for fouling; Checks provision for tube expansion; de-scales; replaces tubes; plugs tubes; secures tube tightness in tube plates; checks means of reducing corrosion.

vi. **Refrigeration Maintenance (Supervised Student Activity)**: Compressors; Evaporator; Condenser; Expansion valve; Oil separator.

vii. **Oils, Fuels and Lubricating System Maintenance (Supervised Student Activity)**: Filters; Purifiers; Bearings; Settling-tanks; Tank contents gauges.

viii. **Deck Machinery Maintenance (Supervised Student Activity)**: Lifeboat davits and gear; Mooring winch; Windlass; Winch; Crane.

References:

i. Taylor, D. A. (2001). *Introduction to marine engineering* (2nd ed.). Butterworth-Heinemann.

ii. McGeorge, H. D. (1992). *General engineering knowledge for marine engineers* (3rd ed.). Butterworth-Heinemann.

iii. Jackson, L., & Morton, T. D. (1999). *Reed's general engineering knowledge for marine engineers* (6th ed.). Reed Educational and Professional Publishing.

iv. Wharton, A. J. (1991). *Diesel engines* (3rd ed.). Butterworth-Heinemann.

v. Hall, D. T. (1984). *Practical marine electrical knowledge*. Witherby & Co. Ltd.

18.4.8 BME 2204: Industrial Chemistry Sessional

1.50 Credit, 3 hrs. /week.

Aims:

i. To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.

ii. To acquaint the students with the determination of molecular weight of a polymer by viscometry.

Learning Outcomes:

The students will be equipped with hands-on knowledge in the quantitative chemical analysis of water quality-related parameters.

Syllabus Contents:

[Minimum 7 (Seven) experiments must be carried out from the following lists.]

List of Experiments:

i. Estimation of Chloride ppm in high pressure boiler water sample.
ii. Estimation of P-alkalinity in high pressure boiler water sample.
iii. Determining the phosphate ppm in high pressure boiler water sample.
iv. Estimation of M-alkalinity in high pressure boiler water sample.
v. Determination of DO content of water sample.
vi. Hydrazine testing high pressure boiler water sample.
vii. Estimation of Chloride ppm in Main engine cooling water sample.
viii. Estimation of Nitrite ppm in Main engine cooling water sample.
ix. PH value testing of system water sample.
x. TBN testing of scrap down oil. Lubricating oil of Main & Aux engine system.
xi. Percentage of water testing of scrap down oil. Lubricating oil of Main & Aux engine system.
xii. Iron ppm testing of scrap down oil. Lubricating oil of Main & Aux engine system.
xiii. Stability testing of very low sulfur fuel oil (VLSFO)
xiv. Compatibility testing of Two fuel oil samples.

18.4.9 BME 2206: Industrial Visit

1.50 Credit

Aims:

This course will help the students relate theoretical knowledge in practical fields.

Learning outcomes:

On successful completion of this unit, students should be able to demonstrate an understanding of the maritime field and Marine engineering/offshore industries of abroad.

Syllabus Contents:

The program includes mandatory study tour to major maritime and marine engineering/offshore industries. These visits may include marine design firms, shipyards, dry docks, ports, oil and gas

companies, maritime training institutions, power plants, and other relevant industrial facilities abroad. Such exposure enables students to gain practical insights into global maritime practices, technologies, and professional standards.

Assessment and Evaluation

The distribution of marks for the performance evaluation of each student on the study tour is given below:

a. Tour Attendance: 20%
b. Active Participation: 20%
c. Report Submission: 30%
d. Presentation: 30%

18.4.10 BME 2208: Applied Mechanics Sessional

1.50 Credit, 3 hrs. /week.

Aims:

To provide a practical understanding on the basic concepts, principles and processes of basic engineering science.

Learning Outcomes:

i. Upon completion of this course, the trainees will gain hands on experience on:
ii. Verifying the working principle of various lifting devices including finding out the velocity ratio, mechanical advantage and efficiency.
iii. Calibration of pressure gauge and thermometer including finding out various kinds of error.
iv. Measurement of viscosity and finding out the stability of floating body.

Contents:

List of Experiments: -

i. Measurement of Viscosity;
ii. Stability of a floating body;

iii. Calibration of Pressure gauge;
iv. Calibration of Temperature;
v. Worm and wheel apparatus;
vi. Bearing friction (Flywheel apparatus);
vii. Wheel and differential axle apparatus;
viii. Extension of wire (Searle's Apparatus);
ix. Efficiency of Screw thread apparatus;
x. Efficiency of Spur gear lifting machine;
xi. Calculate the discharge of fluid through fluid measurement apparatus-Venturi meter and Orifice Meter;
xii. Universal Tensile Test Machine: Calculation of Ultimate tensile strength, percentage of elongation and percentage contraction of area.

References:

i. William Embleton & J.T Gunn, Reeds applied Mechanics for Engineers, 4th Edition.
ii. Hannah－Hillier, J. Applied Mechanics. Harlow, Longman 1995.

18.5 Year-3, Semester-1 and 2

18.5.1 BME 3002: On-Board Training

16.00Credit, 12 months/2 semesters

The STCW Convention lays great emphasis on practical competence. Therefore, an important part of any STCW training program is to put into practice what seafarers learned from books or with an instructor in a classroom. However, to gain certain other competencies the best way is to practice them at sea under the supervision of a person with appropriate training and experience. This is why it is extremely important that experienced seafarers take very opportunity to train less experienced seafarers. This is the best way of passing knowledge to new generations of seafarers.

Any training that is carried out on-board as per Regulation III/I of STCW Convention as part of an approved training program must be recorded in a training record book is approved by the

administration. The tasks assigned in this book should be completed by the candidate under the supervision of certified designated Engineer Officers on-board followed by monitoring, when necessary by his/her institute from where they pursued pre-sea training. Training record book should be checked regularly by Chief Engineer.

On completion of all the tasks contained in the record book they will submit it to concerned department for verifying it before submitting to the examiner from administration/authority. Concerned authority will form an exam committee comprises of external, marine professional instructors and assessors (MEO COC-I) qualified in the tasks that are being taught onboard ship. The training program must be approved by the maritime administration.

A training service of not less than 12 months onboard seagoing merchant vessels and should be documented in the Continuous Discharge Certificate (CDC) by Bangladesh Government Shipping Office as part of an approved training program according to the Section A-III/1 of the International Maritime Organization's (IMO) International Convention on the Standards of Training, Certification and Watchkeeping for seafarers (STCW). Upon completion of the required sea time, the engineering cadets have to submit a copy of Bangladesh Department of Shipping (DoS) approved Training Record (TR) book for evaluation which should include completed assignments duly signed by supervising engineers onboard.

The committee will inspect the record book and take an oral and written exam upon paying exam fees by the candidate as a part of evidence to demonstrate that the candidate has achieved the standard of competence in order to qualify for enrolment in the 7th semester of the 4th Academic Year.

The Mark distribution is as follows:

Sl no	**Item**		**Date**	**Marks Full**	**Marks Obtained**	**Remarks**
1	***Line Diagrams of own ships***					
	i	ME F.O. Line		10	0	
	ii	ME F.W. Cooling line		10	0	
	ii	ME S.W. Cooling Line		10	0	
	iv	ME L.O. line		10	0	

	v	ME Starting air Line		10	0	
	vi	E/R Bilge line		10	0	
	vii	Ships Fire line		10	0	
	viii	F.O. Bunker line		10	0	
	ix	Basic Steam line		10	0	
	x	Waste oil line		10	0	
2	***Mandatory Assignments (500 words each)***					
	i	Engine Readiness for starting(M/E).		8	0	
	ii	F.O. Bunkering procedure of your ship.		8	0	
	ii	Safety Drills during your service period.		8	0	
	iv	Emergency equipment of your ship.		8	0	
	v	Steering gear system details.		8	0	
	Aux. Engine Assignments (500 words)					
	vi	Precautions before maintenance(A/E).		10	0	
	vii	Load sharing system of Generators.		10	0	
	viii	Maintenance schedules of A/E.		10	0	
	ix	Problem faced in A/E and remedy.		10	0	
	Boiler Assignments (500 words)					
	x	Type, capacity, working principle		8	0	
	xi	Safety Items of boiler.		8	0	
	xii	Mountings		8	0	

	xiii	Feed water & Circulating system.		8	0	
	xiv	Problem faced & remedy.		8	0	
	Air Compressor Assignments (500 words)					
	xv	Name, type, capacity, press & temp.		16	0	
	xvi	Working principle with diagram.		12	0	
	xvii	Maintenance Schedules.		12	0	
	IOPP system Assignments (500 words)					
	xviii	Working principle including lines.		16	0	
	xix	Bilge water management system.		12	0	
	xx	Problem faced during watch & remedy.		12	0	
3		***Written exam***		100	0	
4		***TAR book***		50	0	
5		***Oral exam***		50	0	
			Total	500	0	

Alternatively:

18.5.2 BME 3004: Ashore Training

16.00 Credit, 12 months/2 semesters

Students may perform 12 months apprenticeship in a Ship management company, Port Authority, Ship Yard, Dry-dock, Power plant, Marine workshop, Engine manufacturer and distribution company or any other similar organization approved by Bangladesh Maritime University (academic council)

(Mark distribution form shall be prepared by concerned institute based on type & Nature of the

training areas.)***

18.6 Year-4, Semester-1

18.6.1 BME 4101: Maneuvering and Associated Systems

3.00 Credit, 3hrs. /week.

Aims:

To provide a basic understanding of the concepts, principles and processes in maneuvering and associated systems.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. The construction, working principle and maintenance of air compressors, air reservoirs, and air starting systems.
ii. Fully conversant with the maneuvering system
iii. Operation of governors and automation in diesel engine plants.

Syllabus Contents:

i. **Air starting system:** Preparing the vessel for maneuvering**;** Classification society requirements regarding air starting system
ii. **Air compressor:** Two and three stage; effects of clearance; volumetric efficiency; filters; pressure relief valves; lubrication; defects; automatic drain, air vessels; cooling systems; distilled water; lubrication oil.
iii. **Air Reservoir:** Classification society requirements, construction, Maintenance and safety.
iv. **Air supply system including control air.**
v. **Maneuvering diagrams:** Description of the system; location and purpose of various filters, valves and actuators; Starting and reversing systems of different Marine Diesel engines with safety provisions; starting air overlap; firing interval; starting air valves; air distributor; general reversing details; lost motion clutch.
vi. Safety devices incorporated in maneuvering system.

vii. Diagnosis and rectification of fault in the maneuvering system.

viii. **Governors:** Functions of governor; various types of Governors; Centrifugal and inertial types of Governors, Sensitiveness; Stability and Hunting of Governors; Governor effort and power Consideration of friction in governors.

ix. **Automation in modern diesel engine plants:** Remote operation, Alarm and fail system, Governors and their basic functions. Constant speed and overspeed governors. Constructional details and hunting of governor.

References:

i. Morton, T. D. (1994). Motor engineering knowledge for marine engineers. Thomas Reed Publications.

ii. MAN B&W Diesel. (n.d.). Operation and maintenance manuals. MAN B&W Diesel.

iii. Taylor, D. A. (2001). Introduction to marine engineering (2nd ed.). Butterworth-Heinemann.

iv. Wharton, A. J. (1991). Diesel engines (3rd ed.). Butterworth-Heinemann.

18.6.2 BME 4103: Deck Machineries and Bridge Equipment

3.00 Credit, 3hrs. /week.

Aims:

To provide an understanding of the basic concepts, working principles and processes relevant to deck machinery, cargo equipment and basic seamanship.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Hydraulic system construction, operation and maintenance i.e. windlass, winch, cranes, remote control valve etc.

ii. Operation, maintenance and maintenance of cargo handling equipment.

iii. Basic seamanship skill.

Syllabus Contents:

Deck Machinery:

i. Hydraulic System: Main Components, Accumulator, Centralised hydraulic powersystem, Axial piston variable stroke pump, Controller & power supply, Spool valve with shut off and direction control, RAM & Rotary Vane Actuators, Open & Closed loop systems, Hydraulic fluid
ii. Windlass, winch, Gypsy, Capstan, Hydraulic Cranes
iii. Remote control valve
iv. Anchors, their use, dropping and weighing anchor, Cable stopper, Air whistle

Cargo Handling Equipment:

i. Operation and maintenance of Crane, hatch cover, Cargo stowage.
ii. Mooring and unmooring.

Bridge Equipment

i. Navigational Lights and Signals: Port and Starboard and aft mast light, Colours and Location. Look out, Precautions and Bad weather, Flags used on ships, Flag etiquette, Morse and Semaphore signaling, Sound signals.
ii. Navigation: General knowledge of principle stars. Sextant, Navigation compasses, Echo Sounder, Log and uses, barometer and weather classification, G.M.T. and Zonal time, wireless Navigational Instruments, Radar satellite Navigation etc.
iii. Operation and maintenance of GPS.
iv. AIS: AIS Concepts, AIS Data, AIS Ship Installation, Use of AIS at sea.
v. GMDSS: Fundamentals of radio systems, Familiarization with radio communication equipment, microprocessors, PC software and hardware, electronic navigation aids, ship-borne radar and ARPA, Maintenance of ship-borne GMDSS equipment.
vi. ECDIS: Legal aspects and requirements, Familiarization with the principal types of electronic chart, ECDIS data, basic navigational functions and settings etc.
vii. Magnetic Compass, Gyro compass, speed logs, eco-sounders: the principle, operation and limitations.

References:

i. Taylor, D. A. (2001). *Introduction to marine engineering* (2nd ed.). Butterworth-Heinemann.

ii. McGeorge, H. D. (1992). *General engineering knowledge* (3rd ed.). Butterworth-Heinemann

iii. Jackson, L., & Morton, T. D. (1999). *Reed's general engineering knowledge for marine engineers* (6th ed.). Reed Educational and Professional Publishing.

iv. Barrass, B., & Derrett, D. R. (2012). *Ship stability for masters and mates* (7th ed.). Butterworth-Heinemann.

v. Witherby Publishing Group. (2018). *Bridge procedures guide* (5th ed.). Witherby Seamanship.

vi. Roberts, P. (1995). *Watch-keeping safety and cargo management in port*. The Nautical Institute.

vii. Maritime and Coastguard Agency. (2009). *Code of safe working practices for merchant seamen* (Consolidated ed.). The Stationery Office.

18.6.3 BME 4105: Marine Electrical Installation and Instrumentation

3.00 Credit, 3hrs./week.

Aims:

This course aims to gain theoretical knowledge on Marine Electrical Installation and Instrumentation

Learning Outcomes:

The student will be able to describe/identify/explain/discus:

i. Marine/ industrial and Domestic electrical services;

ii. Marine Wiring system design, drafting, and estimation;

iii. Design for illumination and lighting;

iv. Electrical installations system design: substation, BBT and protection, air-conditioning, heating and lifts.

v. Design for intercom, public address systems.

vi. Design of security systems, fire Alarm, smoke detector, burglar alarm, and sprinkler system that used in marine domain.

Syllabus Contents:

Marine Electrical/Electrical Installation and Instrumentation related to:

i. **High voltage installation:** Definition of high voltage, characteristics, generation, uses, installation, safety issues.

ii. **Lighting installation:** principle of incandescent lamp, fluorescent lamp, tungsten-halogen lamp, gas discharged lamp, etc.; installation of various lamps. General requirements for places of urgent light, requirements of circuits of navigation lights.

iii. **Wiring and Cable installation:** Distribution and Cable system-D.C. and A.C, Electrical wiring, types of electrical wiring installation, types of cable, material, superconductor, insulation system, insulation handling, dependence of insulation on various parameters, protection, installation of various types of cables, Cable fault diagnosis, flexible cords and cables, means to reduce radio interference, cable runs, joints, splices, etc.

iv. **Earthing and Lightning installation:** Earthing, different types of earthing, insulated and earthed neutral system, Earth faults, earth fault protection, lightning, lightning installation.

v. **Battery installation:** Principle, Design of D.C loads, Battery handling, installation, precautions.

vi. **Transducer:** Electro-pneumatic, Electro-hydraulic transducing system, closed loop and open loop system, Wheatstone bridge system as transducer, variable inductance and capacitance transducer, I-V transducer.

vii. **Measuring system:** Instrument transformer, Clamp meter, Insulation resistance, Megger system, Earth resistance measuring, R.P.M measuring, Continuity test, Multi tester, continuity testing, Multimeter, Diode Test, Live line Tester, etc.

viii. **Electrical Drawing:** Necessary marine Electrical Drawing and diagrams

ix. **Electrical hazards and safety issues:** Review Electricity Act, electrical hazards, safety issues, etc., Explosion Protection--- flame proof, increased safety, intrinsically safe, pressurized, non-sparking, special protection, dangerous or hazardous spaces.

Pump room and battery room lighting, protection of electrical equipment in gas hazardous space.

Electrical testing in hazardous area.

x. **Others**: Knowledge on intercom, public address systems, security systems, fire Alarm, smoke detector, burglar alarm, and sprinkler system.

References:

i. Kraal, E. G. R. (1985). *Basic electro-technology for engineers* (3rd ed.). Thomas Reed Publications.

ii. Hall, D. T. (1984). *Practical marine electrical knowledge*. Witherby & Co. Ltd.

iii. Boyd, G., & Taylor, F. (2020). *Reeds Vol 16: Electrical Power Systems for Marine Engineers* (1st ed.). Bloomsbury Publishing.

18.6.4 BME 4107: Research Methodology

3.00Credit, 3hrs./week.

Aims: Students must understand the concepts and guidelines of research methods in conducting their thesis or any research work. This course will provide them the insights for conducting research work. Furthermore, different qualitative and quantitative research techniques will help them craft their research work and achieve research objectives.

Course Outcomes:

Students will be able to:

i. Describe research problems clearly and precisely.

ii. Develop a theoretical framework for a research project.

iii. Apply appropriate research design and methods.

iv. Conduct critical analysis of research in the various fields of business.

v. Write a well-structured research proposal, demonstrating originality and ethical responsibility.

Syllabus Contents:

i. **Introduction to Research Methodology:** Introduction; Overview of research types: qualitative, quantitative and mixed methods; Research design and framework.

ii. **Formulating Research Problems:** Techniques for identifying and formulating research questions; Defining research scope, objectives, and hypothesis; Importance of problem statement and justification for research.

iii. **Literature Review:** Purpose of Literature Review; Data sources; Searching for literature; Evaluating the literature; Documenting the literature review.

iv. **Research Design and Methodology:** Types of Research Designs: Descriptive, exploratory, experimental, etc.; Selecting the right research design; Qualitative, Quantitative and Mixed Method Research.

v. **Sources and Collection of Data:** Primary and Secondary Data collection method; advantages, challenges; Sampling Techniques: Probability and non-probability sampling; Selecting an appropriate sample size for validity and reliability.

vi. **Data Analysis Techniques:** Quantitative Data Analysis: Using Software for Data Analysis: Introduction to SPSS, Excel, and other data analysis tools. Performing basic data analysis using these tools. Qualitative Data Analysis: Coding and categorizing qualitative data (thematic analysis).

vii. **Research Ethics:** Importance of Research Ethics; How to avoid Plagiarism; Ethical Guidelines for Data Collection; AI in research.

viii. **Citation and Referencing:** Importance of Proper Citation; Different citation styles (APA, MLA, Chicago, Harvard); Referencing Tools and Techniques: Using reference management software (Mendeley, Zotero, EndNote); How to correctly cite books, journal articles, websites, and other sources.

ix. **Writing a Research Proposal:** Components of a Research Proposal: Title and abstract, introduction, Literature Review, Research Methodology; Writing the Proposal: Writing style and structure, Logical Flow; Finalizing the Research Proposal.

x. **Writing the Research Report:** Structure of a Research Report**:** Introduction, methodology, results, discussion, and conclusion.

xi. **Presenting Research:** Preparing Oral Presentations: Crafting effective presentations with PowerPoint slides; Preparing for Peer Review: improvements based on feedback.

References:

i. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
ii. Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Age International Publishers
iii. Bryman, A. (2016). *Social research methods* (5th ed.). Oxford University Press.
iv. Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). SAGE Publications.
v. Thiel, D. V. (2014). *Research methods for engineers*. Cambridge University Press.

18.6.5 BME 4109: Ship Building Technology

3.00 Credit, 3hrs. /week.

Aims:

To provide an understanding of the basic concepts, principles and processes relevant to ship

Dry-docking and ship building technology.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. The basic principles in dry-docking including all the activities carried out in dry-dock and floating berth.
ii. Ship building technology including mechanical and electrical works carried out in ship yard.

Contents:

Dry-docking (Ship Repair):

i. Purpose and types of dry-docking

ii. Docking plans

iii. Types of blocks

iv. Time period and budget for dry-docking

v. Safe dry-docking procedures

vi. Lay period and list of repairs

vii. Docking and undocking meetings

viii. Vessels' stability

ix. Incident, accident, risk assessment and emergency preparedness

x. Role of Classification society in dry-dock.

Ship Building:

i. Type of ships: Commercial Vessel, Govt. Vessel, Research vessel -Their functions and geometric property.
ii. Ship design: GA, Lines plan, Stability, Longitudinal stability, Transverse Stability, Tank model test, speed, etc.
iii. Detail Production Design: Shop drawings, nesting, modeling, part list, profile bending, material record, and Block division.
iv. Fabrication of steel ships: Welding procedure, reading of production drawings, subassembly, assembly, block lifting, erection of blocks, outfitting etc.
v. Quality control: Inspection and test plan, NDT plan, tank test, dimension control etc.
vi. Shipbuilding technology: Structural arrangement, Foundations of machineries, Definition of shipbuilding structural items and their construction; Structural strength, Load analysis, Material properties etc.
vii. Installation of Ship machineries: Windlass, Capstan, Bollard, Anchor, Mast, gen set, Main Engine, Propeller, shaft, rudder, Steering gear, ventilation, motor, pumps, galley equipment, navigational equipment
viii. Paint selection
ix. Launching procedure
x. Sea Trial

xi. Project management: Ship building project management.

References:

i. Kemp, J. F., & Young, P. (1986). *Ship construction notes and calculations*. Butterworths.
ii. Reid, W. (1978). *Ship construction for engineers*. Brown, Son & Ferguson.
iii. Pursey, H. I. (1983). *Merchant ship construction*. Brown, Son & Ferguson.
iv. Eyres, D. J., & Bruce, G. J. (2012). *Ship construction* (7th ed.). Butterworth-Heinemann.
v. Mandal, N. R. (2011). *Ship construction and welding*. Oxford University Press.
vi. House, D. J. (2007). *Dry-docking and shipboard maintenance: A guide for industry*. Elsevier Butterworth-Heinemann.

18.6.6 BME 4111: Control Engineering

3.00 Credit, 3 hrs. /week.

Aims:

i. To provide the basic knowledge and understanding on pneumatic P, PI and PID control system including the measurements and mechanism of sensing process values and relevant instrumentation.
ii. To provide an understanding on the basic concepts, principles, processes and procedures used in 'Electronic Control Engineering' including design of automation system.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Various temperature, pressure and level measuring instruments;
ii. Operational principles of various control systems including positioner;
iii. Various process control systems including M/E L.O, C.W, Boiler water level control system;
iv. Maintenance of control system.

Syllabus Contents:

i. **Fundamentals of Automatic Control**:

- Definition of automatic control and its purpose
- Devices in control systems and their roles: sensing unit, controller, controlled variable, manipulating variable, and controlled object.
- Devices included in the sensing unit.
- Variety of controllers: electronic (PID, PLC, computer) and pneumatic.
- Definition of setting value, input value, deviation and output value/controlled variable in the controller
- Types of devices used as manipulators.
- Types of controlled objects.
- Automatic controls in ship propulsion machinery, e.g., temperature and level systems, including parameters: time lag, time constant, dead time, first/second-order lag, disturbance, offset.

ii. **Various Automatic Controls:**

- Systematic classification of automatic controls by methodology
- Definition of optimal control
- Overview of feedback and feedforward control
- Overview of ON-OFF, sequential, PID, and program control
- Application of automatic controls in control systems
- Overview of program control and its implementationApplications of program control in ship propulsion machinery

iii. **ON-OFF Control:**

- Characteristics of ON-OFF control
- Utilization of ON-OFF control
- Components of an ON-OFF control system
- Examples of ON-OFF control applications

iv. **Sequential Control:**

- Definition and Characteristics of sequential control

- Utilization of sequential control
- Components of a sequential control system
- Examples of sequential control applications

v. Proportional-Integral-Derivative (PID) Control:

- Principles/theory of PID control
- P, I, and D actions available electrically/pneumatically with example circuits and pneumatic diagrams
- PID control as a classical and fundamental method for process control
- PLC and computer controllers mimic analog PID control in managing process variables
- P, I, D, PI, PD, and PID actions using step or ramp input
- Characteristics of P action as well as proportional band (PB)
- Characteristics of I and D actions
- Contribution of P, I, and D actions in control systems: P for control strength, I for accuracy, D for speed
- Step response test to PID action and what can be understood by its results
- Determination of P, I, and D parameters for optimal control
- Components comprising PID control systems including sensing unit, transducer, manipulator and controller

vi. Measurement of Process Value:

- Temperature;
- Electrical;
- Pressure;
- Level (Direct methods and Inferential methods);
- Flow

vii. General Measurement of Processes:

- Principles of a tachometer
- Principles of A.C. and D.C. electric tachometers
- Principles of a torque meter based on stress in a magnetic field
- Application of torque meter principles to measure power
- Principal features of a viscometer
- application of a photoelectric cell to: an oil-in-water, a smoke-density detector, an oil-mist

detector, a flame detector

- common types of fire detector
- principal features of:
  - an explosive-gas detector
  - a vibration monitor
  - an oxygen analyser
  - a CO2 analyser
  - a relative humidity metre
  - salinity measurement
  - a dissolved-oxygen metre
  - a pH metre
- Routine setup, testing, and maintenance of the measuring devices above

viii. Transmission of Signals:

- Transmitters;
- Controlling Elements- pneumatic, electrical, Receivers;

ix. Manipulator Elements:

- Pneumatic;
- Electrical Servomotors;
- Hydraulic Servomotor

x. Introduction to Mechatronics:

- Introduction to Mechatronics:
  - Systems;
  - Concepts of Mechatronics approach;
  - Need for Mechatronics;
  - Emerging areas of Mechatronics;
  - Classification of Mechatronics.
- Sensors and Transducers: Static and dynamic characteristics of:
  - Sensor
  - Potentiometers
  - LVDT

- Capacitance sensors
- Strain gauges
- Eddy current sensor
- Hall effect sensor
- Temperature sensors
- Light sensors

- Introduction to Integrated circuit **(**555 timer I.C, OP-Amp741)
- Microprocessors,
- Micro- controllers & Programmable Peripheral Interface.

xi. **P.L.C:** Ladder programming.

xii. CAD, CAM:

- Construction of CAM profile for a radial cam displacement, velocity, acceleration, uniform velocity.

xiii. Design process-stages of design process:

- Traditional and Mechatronics design concepts
- Case studies of Mechatronics systems
- Pick and place Robot
- Engine Management system.
- Artificial intelligence; Factory, Office and Home automation; Future trend.

References:

i. Jackson L. and Morton T.D (1999), Reed's General Engineering Knowledge for Marine Engineers.

ii. Taylor, D.A. Introduction to Marine Engineering. 2nd ed. London, Butterworth. 1990

iii. Morton, TD Motor Engineering Knowledge for Marine Engineers, 1999, London: Thomas Reed Publications Ltd, 1994 (ISBN 09-01-2856-5)

iv. A.J Wharton, 1991, Diesel Engines, 3rd edition Publisher: Butterworth and Heinemaan.

18.6.7 BME 4113: BME 4205: Industrial Engineering

3.00 Credit, 3hrs. /week.

Aims:

i. To introduce students to the principles of industrial engineering and their application in the maritime industry.
ii. To equip students with skills in process optimization, quality management, and productivity improvement.
iii. To provide an understanding of modern industrial engineering tools and techniques used for efficient engineering operations.

Learning Outcomes:

Students will be able to describe, identify, explain, discuss, and analyze:

i. The fundamental concepts of industrial engineering and their relevance to marine engineering.
ii. Methods for optimizing manufacturing and maintenance processes in the maritime sector.
iii. Techniques for quality control and productivity improvement in engineering operations.
iv. Principles of ergonomics and human factors engineering in a marine environment.
v. Strategies for implementing lean manufacturing and continuous improvement.
vi. The role of industrial automation and robotics in modern engineering practices.

Syllabus Contents:

i. **Introduction to Industrial Engineering**:
    - Definition and scope of industrial engineering.
    - History and development of industrial engineering principles.
    - Application of industrial engineering in the maritime industry.
ii. **Work Study and Time Management**:
    - Techniques for work measurement and method study.
    - Time-motion studies and their applications in ship maintenance and repair.
    - Strategies for reducing downtime and improving maintenance scheduling.

iii. **Process Optimization and Productivity Improvement**:
   - Principles of process optimization in engineering.
   - Bottleneck analysis and production line balancing.
   - Techniques for improving productivity in shipyards and maritime anufacturing facilities.

iv. **Quality Control and Total Quality Management (TQM)**:
   - Concepts of quality assurance and quality control.
   - Statistical process control (SPC) techniques.
   - Total Quality Management (TQM) principles and ISO standards in marine engineering.

v. **Ergonomics and Human Factors Engineering**:
   - Introduction to ergonomics and its importance in marine operations.
   - Human factors engineering and its impact on safety and performance.
   - Design considerations for reducing human error in ship operation.

vi. **Lean Manufacturing and Six Sigma**:
   - Introduction to lean principles and waste reduction techniques.
   - Tools of lean manufacturing: 5S, Kaizen, Kanban, and value stream mapping.
   - Overview of Six Sigma methodology for process improvement.

vii. **Industrial Automation and Robotics**:
   - Role of automation in the maritime industry.
   - Introduction to robotics and its applications in shipbuilding and maintenance.
   - Basics of control systems and programmable logic controllers (PLCs).

viii. **Supply Chain Management in Engineering Operations**:
   - Concepts of supply chain management and logistics.
   - Inventory management techniques: JIT (Just-In-Time) and MRP (Material Requirements Planning).
   - Case studies on supply chain challenges in the maritime sector.

ix. **Engineering Economics and Cost Analysis**:
   - Basics of engineering economics and cost-benefit analysis.
   - Depreciation methods, lifecycle costing, and breakeven analysis.
   - Investment analysis and decision-making in engineering projects.

x. **Safety Engineering and Risk Management**:

- Principles of safety engineering in industrial operations.
- Risk assessment techniques and hazard control.
- Safety regulations and compliance for marine engineering practices.

xi. **Project Management in Engineering**:

- Fundamentals of project management and planning.
- Tools for scheduling, resource allocation, and progress tracking.
- Application of project management in shipyard projects and marine installations.

xii. **Case Studies and Practical Applications**:

- Real-world examples of industrial engineering applications in the maritime industry.
- Analysis of productivity improvement projects and quality initiatives.
- Case studies on successful lean and automation projects in marine engineering.

References:

i. M. P. Groover (2016). *Automation, Production Systems, and Computer-Integrated Manufacturing* (4th ed.). Pearson.

ii. Thomas E. Vollmann, William L. Berry, D. Clay Whybark, & F. Robert Jacobs (2005). *Manufacturing Planning and Control for Supply Chain Management* (5th ed.). McGraw-Hill Education.

iii. Breyfogle, F. W. (2003). *Implementing Six Sigma: Smarter solutions using statistical methods* (2nd ed.). Wiley.

iv. Kerzner, H. (2022). *Project management: A systems approach to planning, scheduling, and controlling* (13th ed.). Wiley.

18.6.8 BME 4115: Maritime Law & Policy

3.00 Credit, 3hrs. /wk.

Aims:

This course aims to introduce students to the principles of maritime law and the international conventions that regulate global shipping.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. The basic principles of maritime law within the wider context of law and legal systems
ii. The basics of public international law, including law of the sea and the law of treaties
iii. The legal framework of regulatory and private maritime law including the general law of contract, tort, property and remedies, and commercial maritime law, ship acquisitions, ownership and mortgages.

Syllabus Contents:

i. **Principles of Maritime Administration and International Institutions:** The role of government in policy formulation and the administration of maritime affairs. An overview of the various international institutions involved in shipping and maritime affairs, including UN agencies and inter-governmental and non-governmental organizations and their interrelationships.
ii. **Law of the Sea:** The international legal framework for the oceans, including the regimes of maritime zones under the UN Convention of the Law of the Sea (UNCLOS) from the perspective of maritime administrations and their particular interests.
iii. **Maritime Safety and Security:** International Convention for the Safety of Life at Sea (SOLAS)- General Provisions, Subdivision and Stability, Machinery and Electrical Installation, Fire Protection, Fire Detection and Fire Extinction, Life-Saving Appliances and Arrangements, Carriage of Grain, Carriage of Dangerous Goods, ISM and ISPS Code.
iv. **Maritime Human Element:** The relevant IMO and ILO instruments, including the MLC2006, relating to maritime labour and welfare, and in particular the rights and expectations of seafarers in relation to occupational safety.
v. **Maritime Commercial Law:** Commercial law and policy, including marine insurance and

general average, carriage of goods by sea under charter parties and bills of lading, and international trade law. To provide an understanding of the law relating to the maritime claims and their enforcement, arrest of ships, and liens and mortgages.

vi. **Law and Policy Related to the Marine Environment:** The public and private law of marine pollution including UNCLOS and various public, regulatory and private law conventions, the penal law of marine pollution, and the laws of wreck and salvage, towage and pilotage.

References:

i. Hill, C., & Kulkarni, Y. (2017). Maritime law (6th ed.). Taylor & Francis.
ii. Gold, E., Chircop, A., & Kindred, H. M. (2003). Maritime law. Irwin Law.
iii. Baatz, Y. (2011). Maritime law (6th ed.). Informa Law.
iv. Mahon, A. A., & Boyle, A. (2021). Birnie, Boyle, and Redgwell's international law and the environment (4th ed.). Oxford University Press.
v. Rothwell, D. R., & Stephens, T. (2023). The international law of the sea. Bloomsbury Publishing.

18.6.9 BME 4102: Marine Electrical Installation and Instrumentation Sessional

1.50 Credit, 3hrs./week.

Aims:

To provide a practical understanding on the basic concepts, principles and processes and procedures of electrical installation of equipment and various measuring devices, calibration processes and concepts used in Electrical Machines.

Learning Outcomes:

The student will be able to describe/identify/explain/discus with practical demonstration that used in marine domain:

i. Marine/ industrial and Domestic electrical services;
ii. Marine Wiring system design, drafting, and estimation;
iii. Design for illumination and lighting;
iv. Constructions and operational principles of AC generators and AC motors.
v. Construction, operation and performance of transformers; and

vi. Parallel operation of alternators.

Syllabus contents:

List of Experiment: [Minimum Seven(07) jobs/Experiment needed from the list of experiment]

i. To learn about wire size estimation and calculation.
ii. To learn about electrical earthling and neutral wiring system.
iii. Familiarization with the symbol of electrical wiring, fitting and fixture and conduit layout.
iv. Connections of three phase transformer: Y-Y, Y-Y,Y- Δ, Δ-Δ
v. Characteristics of single phase induction motor: (i). No load and (ii) Load Operating.
vi. Characteristics of separately excited ac & dc motors in regards to torque/speed.
vii. Characteristics of of shunt excited dc motors in regard to torque/speed.
viii. Operating characteristics of DC series motors.
ix. Parallel Operation of synchoronous machines.

References:

i. B.L. Thereja & A.K. Thereja. (2014). A textbook of electrical technology (Vol. II). S. Chand & Company.
ii. Stephen J. Chapman. (2012). Electric machinery fundamentals (5th ed.). McGraw-Hill Education.
iii. Hall, D. T. (1984). Practical marine electrical knowledge. London: Witherby & Co Ltd.
iv. Kraal, E. G. R. (1985). Basic electro-technology for engineers (3rd ed.). London: Thomas Reed Publications Ltd.
v. B.L. Theraja & A.K. Theraja. (2011). Electrical technology: Principles and applications (Vol. II, 23rd ed.). S. Chand & Company.

18.6.10 BME 4104: Control Engineering Sessional

1.5 Credit, 3hrs./week.

Aims:

i. To provide a practical understanding of the basic concepts, principles, processes and procedures used in 'Electronic Control Engineering' including the design of automation system.
ii. To provide a general understanding to verify practically the theories learned in Basic Mechatronics.

Learning Outcomes:

i. Students will perform experiments to verify practically the theories and concepts used in 'Electronic Control Engineering and students will design simple systems using the principles learned in 'Electronic Control Engineering'.
ii. The student will be able to describe/identify/explain/discuss/analyze practically the engineering technologies, such as mechatronics, robotics and automation, which presume professional abilities to integrate, conduct and lead complex engineering projects integrating ICT and hardware technologies for solving practical problems.

Syllabus contents:

Minimum Seven (07) jobs/Experiments needed from the list of experiments:

i. Familiarization with necessary resources of Digital Electronics Sessional.
ii. Familiarization with different Logic Gates and Implementation of basic logic gates by diodes, transistor sand resistors.
iii. Implementation of Boolean function by basic logic gates.
iv. Introduction to P.L.C and Relay switching.
v. Familiarization with counter circuit.
vi. Astable operation of pneumatic piston.
vii. Automatic Synchronizing and Interlocking operation of pneumatic piston.
viii. P.L.C Micro-controller based hydraulic and pneumatic devices operation demonstration.
ix. Tachometer based speed control.

x. Automatic boiler control process design by P.L.C/Microcontroller.
xi. Rudder angle control by P.L.C/Microcontroller.
xii. Introduction to Simulation Software.
xiii. Study of various types of transducers.
xiv. Study of hydraulic, pneumatic and electro-pneumatic circuits.
xv. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
xvi. Speed control of DC motor.
xvii. Stepper motor interface.
xviii. Servo motor interface.
xix. Lift control mechanism.
xx. CNC machine operation.
xxi. CNC machine control system.
xxii. Ignition system control of engine.
xxiii. Automobile controlling system.
xxiv. Different types of links and joints used in robots.
xxv. Sensors interfacing to a device.
xxvi. Electronic governor control as per load.
xxvii. Others experiments/Jobs(if needed) based on the theory course "Control Engineering and Mechatronics".

References:

i. Jackson L. and Morton T.D (1999), Reed's General Engineering Knowledge for Marine Engineers.
ii. Taylor, D.A. Introduction to Marine Engineering. 2nd ed. London, Butterworth. 1990
iii. Morton, TD Motor Engineering Knowledge for Marine Engineers, 1999, London: Thomas Reed Publications Ltd, 1994 (ISBN 09-01-2856-5)
iv. A.J Wharton, 1991, Diesel Engines, 3rd edition Publisher: Butterworth and Heinemaan.

18.6.11 BME 4106: Engine Room Simulator Sessional

1.5 Credit, 3 hrs. /week.

Aims:

This Course is essentially a practical one, consisting of a series of exercises structured around the operation of a ship's machinery installation and carried out in conjunction with an engine-room simulator.

Learning Outcomes:

The student will be able to describe/identify/explain/discus with practical demonstration:

i. Engine room equipment familiarization
ii. System layout and flow diagrams
iii. Control system and automation, Alarm and safety system
iv. Watch-keeping and troubleshooting
v. Emission control and fuel economy management
vi. Energy management
vii. Emergency operations
viii. Vessel resource management.

Syllabus contents

Simulator Experiments: [Minimum Seven (07) jobs/Experiment needed from the list of experiments]

i. Description of basic engine functions and their simulation study of Engine running under simulated conditions.
ii. Manual method of engine operation from engine room station.
iii. Engine Operation from Remote stations -i.e. engine control room and Navigation bridge.
iv. Safety and interlocks in UMS-ships and effect of malfunction of main engine auxiliaries.
v. Electronic logic circuits in remote control stations. Simulation of engine functions in logic circuits.
vi. Study and adjustments of logic circuits for remote control operation of main engine and trouble shooting. Interfacing input/output interfacing and pneumatic interfacing in the system.

vii. Role of classification societies with reference to UMS-ships.
viii. Trouble shooting of engine malfunctions.
ix. Other experiments as required.

References:

i. Morton, T. D. (1999). *Motor engineering knowledge for marine engineers (3rd ed.).* London: Thomas Reed Publications.
ii. Taylor, D. A. (2001). *Introduction to marine engineering (2nd ed.).* London: Butterworth-Heinemann.
iii. Wharton, A. J. (1991). *Diesel engines (3rd ed.).* London: Butterworth-Heinemann.
iv. MAN B&W. (Latest edition*). Engine manufacturer's operations manual*. [Manufacturer: MAN B&W].
v. Critchley, D., & Pyle, S. (2010). *Marine auxiliary machinery (3rd ed.).* London: Butterworth-Heinemann.

18.7 Year-4, Semester-2

18.7.1 BME 4201: Energy Efficiency and Alternative Fuel

3.00 Credit, 3hrs. /week.

Aims:

This course aims to equip students with the knowledge, skills, and competencies to ensure safe, compliant, and sustainable ship operations with particular focus on decarbonization, new fuels (ammonia, biofuels), regulations (IMO), technology, and socio-economics for a sustainable future.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Key regulatory instruments from the IMO, such as the Energy Efficiency Design Index (EEDI), the Ship Energy Efficiency Management Plan (SEEMP), the Energy Efficiency Operational Indicator (EEOI), the Carbon Intensity Indicator (CII), and the IGF Code for alternative fuels.

ii. Various technologies, including hull form optimization, anti-fouling coatings, waste heat recovery systems, hybrid propulsion systems, and shore power connections.
iii. Chemical properties, advantages, disadvantages, and safety considerations of alternative fuels like LNG, methanol, ammonia, hydrogen, and biofuels.
iv. Safety features of alternative fuel systems onboard (e.g., fuel containment, ventilation, emergency shutdown systems) and develop maintenance plans for this equipment.
v. Comprehensive risk assessments (HAZID, HAZOP) for alternative fuel operations to mitigate potential hazards.

Syllabus Contents:

i. **Energy-Efficient Ship Design and Operation:**
   - Innovation in maritime industry: Ship design and innovation, Energy efficiency and emissions
   - Relevant legislation, governance for energy management
   - Sulphur reduction targets and abatement technologies, SECA and ECA
   - Energy efficiency and ship resistance; hull form optimization, air lubrication, patterned surfaces
   - Energy efficiency and ship propulsion; Hull-propeller interaction, PIDs, propeller coating, flow improvement devices
   - Advanced marine vehicles; Hydrofoils, SWATHs, Catamarans
   - Energy efficient ship operations; trim optimization, weather
   - routing, ballast water management, systems planning, e-navigation

ii. Energy Management:

- **Regulatory Framework**
  - IMO's MARPOL Annex VI (EEDI, EEXI, SEEMP, CII).
  - Understanding carbon intensity reduction targets.
  - Ship Energy Efficiency Management Plan (SEEMP) Parts I, II, III
- **Operational Efficiency**
  - Voyage Optimization and weather routing
  - Trim and Ballast Optimization
  - Hull and Propeller Maintenance (cleaning, coatings).

- Engine Room Management (auxiliary power, waste heat recovery).
- Cargo Operations (optimizing loading/unloading).

- **Technical Solutions and Technology**
  - Propulsion upgrades (e.g., energy-saving devices)
  - Air Lubrication Systems (drag reduction)
  - Alternative Fuels and Energy Sources (batteries, fuel cells, solar)
  - Energy Management Systems (ISO 50001 principles)
- **Management and Systems**
  - Developing and implementing SEEMP
  - Data Collection & Monitoring (fuel consumption, operational efficiency)
  - Port Interface Efficiency (ship-port collaboration)

iii. **Key elements of IMO Strategy on renewable and alternative fuel:**

- Net-Zero Framework,
- Global Fuel Standard,
- Well-to-wake approach,
- Global Economic Measure,
- Sustainable Fuel Certification Framework,
- Collaborative approach,
- Mid-term measures,
- Training and Capacity Building.

iv. Introduction to Energy and Sustainability in the Maritime Sector:

- Overview of global energy resources and the transition to clean energy.
- Conventional marine fuels and their environmental impact.
- Principles of sustainable development and the role of marine renewable energy within global sustainability objectives.
- Energy efficiency and conservation methods in marine operations.

v. **Marine Renewable Energy Resources and Assessment:**

- Resource Assessment: Methods for collecting and analyzing data for
- marine energy resources (wind, wave, tidal, OTEC).
- Oceanography and Meteorology: Understanding the marine
- environment, including wave theory, tidal flows, and wind
- characteristics.

- Site characterization and mapping for potential projects.

vi. **Renewable Energy Conversion Technologies:**

- Offshore Wind Energy: Principles, turbine configurations, aerodynamics, site assessment, planning, and design considerations.
- Wave Energy: Technologies such as oscillating water columns, point absorbers, and overtopping devices.
- Tidal Energy: Tidal barrages, lagoons, and marine current turbines.
- Other Sources: Ocean Thermal Energy Conversion (OTEC) and salinity gradient energy systems.

vii. Alternative and Low Carbon Energy Sources:

- **Liquefied Natural Gas (LNG):**
  - Introduction – LNG Marine Fuels
  - Evolution of LNG
  - LNG Properties
  - LNG Composition
  - LNG Advantages and Disadvantages
  - LNG and Marine Infrastructure Requirements
  - LNG Primary Marine Systems Overview
- **Hydrogen and Marine Systems**
  - Types of Hydrogen
  - Hydrogen Production
  - Production of Hydrogen Using a Steam Methane Reformer
  - Hydrogen Associated with Marine Systems
  - Hydrogen Advantages and Disadvantages
  - Hydrogen Fire Protection and Extinguishing Systems
  - Hydrogen: The Future
- **Methanol and Marine Systems**
  - Production of Methanol
  - Advantages and Disadvantages of Methanol
  - Hazards Associated with Methanol
  - Methanol Fire Protection and Extinguishing Systems

- **Biomethane (Biogas)**
  - What is Biomethane?
  - The Production of Biomethane
  - Biogas/Biomethane – Fuel for Ships
  - Advantages and Disadvantages of Biomethane
  - Hazards of Biomethane
  - Biomethane – Firefighting
- **(Bio) Ethanol**
  - The Difference between Ethanol and Bioethanol
  - Production of Bioethanol and Descriptive Overview
  - Bioethanol as a Fuel for Ships
  - (Bio) Ethanol Advantages and Disadvantages
  - Hazards of (Bio) Ethanol
  - Firefighting and Fire Protection
- **Bio-diesel**
  - Biodiesel as a Fuel for Ships
  - Biodiesel Advantages and Disadvantages
  - Marine Propulsion Systems – Biodiesel Hazards
  - Biodiesel Fire Protection and Extinguishing Systems
- **Ammonia**
  - Types of Ammonia
  - Ammonia Advantages and Disadvantages
  - Hazards of Ammonia as an Alternative Marine Fuel
  - Ammonia Fire Protection and Extinguishing Systems
- **Battery-Powered Marine Systems**
  - Types of Batteries
  - Types of Hybrid (Battery) Propulsion Systems
  - Marine Propulsion Batteries Advantages and Disadvantages
  - (Li-ion) Battery Hazards
  - Battery Fire Protection and Extinguishing Systems
  - The Future of Batteries

References:

i. Hodge, B. K. (2010). *Alternative energy systems and applications*. Wiley.
ii. Sabonnadière, J. C. (Ed.). (2012). *Renewable energy technologies*. Wiley-ISTE.
iii. Rao, S. S., & Parulekar, B. B. (2015). *Sustainable energy systems and applications*. Wiley India.
iv. International Maritime Organization. (2020). *Fourth IMO greenhouse gas study 2020*. IMO Publishing.
v. McGill, R., Remley, W., & Winther, K. (2013). *Alternative fuels for marine applications*. International Council on Clean Transportation (ICCT).
vi. Wärtsilä. (2021). Sustainable fuels for shipping. Wärtsilä Marine Solutions.

18.7.2 BME 4203: Power System Protection

3.00 Credit, 3 hrs. /week.

Aims:

To provide a foundation for the appreciation of electrical power system protection device used on board the ship in line with the operational level certificate of competency.

Learning Outcomes:

The student will gain sufficient understanding of 'Power System Protection' in regards to switchgear, fuse and relay, circuit breakers and breaker ratings; transformer, generator, motor, bus and transmission line protection; static, digital and numerical relay.

Syllabus Contents:

i. **Introduction to Switchgear**: Purpose of power system protection, Introduction to Switchgear, circuit interruption and protection. Criteria for detecting faults and requirements of protective devices, Terminologies and general characteristics of relays and circuit breaker.
ii. **Fuse and Relay**: Fuse and its types, Relays: over-current, differential, directional, distance. Electromechanical relay.
iii. **Circuit breakers**: control systems, Trip circuit, arc extinction methods, Types of circuit breaker, Different types of protective devices used in Switchgear.

iv. **Circuit breaker ratings**: circuit breaker ratings, recovery voltage, TRV, Switching in a capacitive circuit, Current chapping. Air, Oil, air blast, SF6, vacuum and high voltage DC circuit breaker, Selection criteria, testing of circuit breakers.

v. **Transformer protection**: Different types of faults in Transformer, different types of protection scheme in transformer, Buocholz Relay etc. Integrated HV transmission line protection, Combined Transformer and Bus bar protection.

vi. **Generator and Motor protection**: Introduction, Different types of faults in Generator and motor, different types of protection scheme, Overload protection—thermal relays, magnetic relays, temperature sensing devices—Thermistor, thermocouple, thermostat, Single phasing, 3.3KV motor and 6.6 KV motor, High vacuum contractors.

vii. **Bus and Transmission line protection**: Bus bar arrangement, Pilot-wire and carrier current protection, different types of Bus and Transmission line protection scheme, Over voltage protection, lightning and lightning arresters, Grounding.

viii. **Static and digital/numerical relay**: definition, features, Operation, application, Block diagram and types, Microcontroller and Microprocessor based protection.

References:

i. Kraal, E. G. R. (1985). Basic electro-technology for engineers (3rd ed.). London, UK: Thomas Reed Publications Ltd.

ii. Hall, D. T. (1984). Practical marine electrical knowledge. London, UK: Witherby & Co. Ltd.

iii. Mehta, V. K., & Mehta, R. (2011). Principles of power system (4th ed.). New Delhi, India: S. Chand & Company Ltd.

iv. Blackburn, J. L., & Domin, T. J. (2003). Protective relaying: Principles and applications (3rd ed.). Boca Raton, FL: CRC Press.

v. Rao, S. S. (2011). Switchgear and protection. New Delhi, India: Khanna Publishers.

vi. Ravindranath, B., & Chander, M. (2011). Power system protection and switchgear. New Delhi, India: New Age International Publishers.

vii. Davis, T. (1998). Protection of industrial power systems. New York, NY: McGraw-Hill.

18.7.3 BME 4205: Ship Operation and Management

3.00 Credit, 3hrs. /week.

Aims:

i. To provide in-depth knowledge on the management and operation of ships as part of the maritime supply chain.
ii. To develop an understanding of legal, commercial, and operational aspects associated with the shipping industry.
iii. To equip students with skills in planning, decision-making, and compliance for effective ship management.

Learning Outcomes: Students will be able to describe, identify, explain, discuss, and analyze:

i. The supply chain in the shipping industry, including the ownership and chartering of vessels.
ii. Freight rates, types of shipping, and the principal shipping organizations.
iii. Legal aspects such as the bill of lading, carriage of goods by sea, and charter parties.
iv. Marine insurance principles, including underwriting and loss adjustment for marine cargo.
v. Operational planning, sailing schedules, and voyage estimates for efficient ship management.
vi. Compliance with safety regulations, port procedures, pollution control, and emergency response.

Syllabus Contents:

i. **Introduction to Ship Operations**: Overview of shipping as a part of the global supply chain. Types of shipping (liner, tramp, bulk, container, etc.). Ownership structures and operational strategies in the shipping industry.
ii. **Freight Rates and Chartering**: Freight rate formulation and influencing factors. Types of charter parties: time, voyage, and bareboat charters. Key clauses in charter parties and negotiation practices.
iii. **Legal Aspects of Shipping**: The bill of lading and its significance. International conventions on carriage of goods by sea. Survey and protest procedures. Merchant shipping ordinance and acts, with a focus on Bangladesh.

iv. **Marine Insurance**: Hull policy, marine cargo insurance, and related clauses. Underwriting principles and risk assessment. PandI (Protection and Indemnity) clubs and their roles. Loss adjusting and claims handling procedures.

v. **Role of Classification Societies**: Functions of classification societies in ship safety. Survey requirements and periodic inspections.

vi. **Ship Financing and Economics**: Capitalization and financial considerations for new and second-hand tonnage. Impact of subsidies and government policies on ship acquisition. Economics of ship operation and lifecycle cost analysis.

vii. **Operational Planning and Voyage Management**: Factors affecting sailing schedules and voyage estimates. Economic and environmental considerations in voyage planning. Commercial shipping practices, including ship registration and flagging.

viii. **Crew Management and Welfare:** Manning regulations and compliance. Seafarer welfare and rights under international conventions. Training requirements and certification.

ix. Port Procedures and Regulations: Port entry requirements, clearance, and pilotage. Documentation and ship's papers. Handling port state control inspections.

x. **Pollution Control and Emergency Response**: Duties regarding pollution prevention and response. Handling shipping casualties: collision, explosion, and fire. Assistance to vessels in distress.

xi. **Case Studies and Practical Applications:** Analysis of real-world shipping scenarios. Regulatory compliance case studies. Economic analysis of different operational strategies.

References:

i. Branch, A. E. (2014). *Elements of shipping* (9th ed.). Routledge.

ii. Stopford, M. (2009). *Maritime economics* (3rd ed.). Routledge.

iii. Hill, C. (2016). *Maritime law* (6th ed.). Informa Law from Routledge.

iv. The Institute of Chartered Shipbrokers (ICS). (2023). *Introduction to shipping*. Witherby Publishing Group.

v. The Institute of Chartered Shipbrokers (ICS). (2023). *Ship operations and management*. Witherby Publishing Group.

vi. Goss, R. (2013). *Shipping and port management* (2nd ed.). Routledge.

18.7.4 BME 4207: Thesis

6.00 Credit

Aims: In-depth study on maritime topics to demonstrate skill in research, writing and analysis

Learning Outcomes:

The students will gain hands-on research experience through completing a research project, starting with hypothesis development (if applicable), literature searching, experimental design, data collection, analysis, and interpretation. Students will also gain experience in written and oral scientific communication by submitting several written components including a research proposal, a progress report, and final thesis for evaluation as well as presenting the results of their research in a public oral presentation

Eligibility for Thesis Course

i. Students shall be eligible to undertake the Thesis Course if they have achieved a Semester Grade Point Average (SGPA) of 3.50 or above in the first two academic years (Pre-Sea Training).
ii. However, students with an SGPA below 3.50 who wish to pursue the thesis option may also apply by submitting a detailed research proposal. The Board of Undergraduate Studies and Research (BUGSR) may consider such applications based on the merit and satisfactory quality of the submitted proposal.

Syllabus Contents:

i. Students will engage in independent research, to produce an original thesis on maritime topics. This may take the form of a paper or report with supporting documentation, images and notes. Research may consist of archival investigation and/or fieldwork, including personal interviews, site reports, and condition assessments.
ii. The process of writing and submitting a thesis will provide students with understanding and competence in research and writing about conservation and preservation issues, which will be of use in the professional field.
iii. Students shall submit at least three thesis titles with a brief summary through the department

to BUGSR for approval in the 4th year, first semester. A list of desirable supervisor(s) with relevant expertise can also be proposed.

iv. Students will be assigned a thesis supervisor(s), with whom they will communicate regularly.

v. BMU thesis guideline available online can be followed for word limits, font style and size, line spacing and other formatting requirements.

vi. An evaluation board approved by BMU will decide the thesis grade. Students will present their final thesis to this panel for a defense. This will be a 20-minute presentation and a 10-minute oral discussion about the thesis, where students will receive feedback.

vii. There should be a schedule and a deadline, including a progress report and a progress meeting to submit the thesis paper by the department and research supervisor.

The marks distribution is as follows:

Content	Marks
Thesis Report	60%
Presentation	30%
Oral Exam	10%

18.7.5 BME 4202: Seminar/Workshop

1.5 Credit, 2 hrs. /week.

Aims:

This course will help the students on developing their presentation and personal communication skills.

Syllabus Contents:

1. Techniques/tools of well presentation/modern presentation.
2. Techniques/tools of good communication/modern communication.
3. Related theory study on presentation and communication.

The distribution of marks for the performance evaluation of each student on the study tour is given below:

a. Attendance: 10%

b. Handling Questionnaires: 20%

c. Paper Submission: 30%

d. Presentation: 40%

18.7.6 BME 4204: Welding Technology

1.50 Credit, 3hrs. /week.

Aims:

To provide the theoretical and practical knowledge on different types of welding technology including metal arc welding, gas tungsten arc welding, gas cutting.

Learning Outcomes:

After successful completion of this course the students will have theoretical and practical knowledge on:

i. Shielded Metal Arc Welding (SMAW) on tee, lap, corner, and butt joints to trade specifications in the flat, horizontal, vertical, and overhead positions.
ii. Gas Tungsten Arc Welding (GTAW) on tee, lap, corner, and butt joints in flat and horizontal positions with applicable filler rod on mild steel, stainless steel, and aluminum.
iii. Gas Metal Arc Welding on tee, lap, corner, and butt joints in flat, horizontal, and vertical positions using various filler wires on mild steel, stainless steel, and aluminum.
iv. Different type of welding defect.
v. Theoretical and practical Knowledge about Cutting Process

Syllabus contents:

i. Different types of welding and their equipment and Welding principle
ii. Types of power sources and their characteristics
iii. Welding methods: MMAW, GMAW, SAW, Electro-slag welding, TIG
iv. Types of welding joints. Welding symbols
v. Welding sequence in shipbuilding
vi. Common defects in ship welding
vii. Safety and health when welding

viii. Welding distortion monitoring and control
ix. Inspection and testing of welded specimen.
x. Non-destructive testing. Methods and principles of cutting.

References:

i. Little, R. L. (1998). Welding and welding technology. McGraw-Hill.
ii. Unitor Group. (2002). Unitor welding handbook. Unitor ASA.
iii. Glizmanenko, D., & Yevseyev, G. (1971). Gas welding and cutting. Mir Publishers.
iv. Flood, C. R. (1981). Fabrication, welding and metal joining processes. Butterworth.

18.8 Elective Courses

18.8.1 BME 4209: Power Plant Technology

3.00 Credit, 3hrs. /week.

Aims:

To provide a foundation on 'Power Plant and Electrical Energy' in regards to working principle, construction, characteristics and economics of different types of Power Stations.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Importance of Electrical Energy over Any Other Types;
ii. Schematic Arrangement, Equipment, Efficiency and Site Selection of different types of Power Station;
iii. Important Terms and Factors of Power Station and
iv. Power Plant Economics in regards to cost of Electrical Energy Determination, Tariff for Consumers, Importance of Power Factor Improvement and Economics of Power Transmission.

Syllabus Contents:

i. **Introduction:** Importance of Electrical Energy, Generation of Electrical Energy, Sources of Energy, Comparison of Energy Sources, Units of Energy, Relationship among Energy Units, Efficiency, Calorific value of fuels, Advantages of Liquid Fuel over Solid Fuels, Advantages of Solid Fuels over Liquid Fuels

ii. **Generating Stations:** Schematic Arrangement, Equipment, Efficiency and Site selection for Thermal Power Station, Hydroelectric Power Station, Diesel/HFO based Power Station, Nuclear Power Station and Gas Turbine Power Station, Comparison of the Various Power Stations

iii. **Variable Load on Power Stations:** Structure of Electric Power System, Effects of Variable load on Power Station, Plotting and Analysis of Load Curves, Load Duration Curve. Connected Load, Maximum Load, Demand Factor, Average Load, Load Factor, Diversity Factor, Plant Capacity Factor, Plant Use Factor. Types of Loads, Load Forecasting and Selection of Generating Units, Load Shearing, Base Load and Peak Load Power Plants, Use of Load Curves to Distribute Load among Units.

iv. **Power Plant Economics:** Cost of Electrical Energy, Methods of Determining Depreciation, Importance of High Load Factor.

v. **Tariff:** Desirable Characteristics of Tariff, Tariff Design

vi. **Power Factor Improvement:** Power Factor, Power Triangle, Causes and Disadvantages of Low Power Factor, Power Factor Improvement Equipment, Calculation of Power Factor Correction, Importance of Power Factor Improvement, Most Economical Power Factor

vii. **Supply Systems:** Typical AC Power Supply Scheme, Advantages of High Transmission Voltage, Elements of Transmission Line, Economics of Power Transmission, Economic Choice of Conductor Size and Transmission Voltage.

References:

i. Nag, P. K. (2014). *Power plant engineering (4th ed.)*. McGraw-Hill Education.

ii. Arora, S. C., & Domkundwar, S. (2012). *A course in power plant engineering (7th ed.)*. Dhanpat Rai & Co.

iii. El-Wakil, M. M. (1984). *Power plant technology*. McGraw-Hill.

iv. Wood, A. J., Wollenberg, B. F., & Sheblé, G. B. (2013). *Power generation, operation,*

and control (3rd ed.). John Wiley & Sons.

v. Gupta, J. B. (2011). *A course in power systems (2nd ed.).* S. K. Kataria & Sons.

18.8.2 BME 4211: Advanced Oil Tanker Cargo Operation

3 Credit, 3 hrs. /week.

Aims:

To provide advanced, specialized training for those on board oil tankers who have immediate responsibility for loading, discharging and care in transit or handling of oil cargoes.

Learning Outcomes:

After successful completion of this course, the students will have sufficient knowledge on:

i. The equipment, instrument and controls used for cargo handling on a tanker;
ii. The need of proper planning, the use of checklists and the scales involved in the various cargo handling operations;
iii. Appling proper and safe procedures at all times when carrying out the various operations on board an oil tanker;
iv. Identifying operational problems and solving them;
v. Making decisions which promote safety and protect the marine environment; and
vi. Plan and co-ordinate actions during emergencies.

Syllabus Contents:

i. Knowledge of oil tanker design, systems and equipment.
ii. Knowledge of pump theory and characteristics, including types of cargo pumps and their safe operation.
iii. Proficiency in tanker safety culture and implementation of safety-management system.
iv. Knowledge and understanding of monitoring and safety systems, including the emergency shutdown
v. Loading, unloading, care and handling of cargo.

vi. Knowledge and understanding of oil cargo related operations.
vii. Development and application of cargo-related operation plans, procedures and checklists
viii. Ability to calibrate and use monitoring and gas-detection systems, instruments and equipment.
ix. Ability to manage and supervise personnel with cargo-related responsibilities.
x. Knowledge and understanding of the physical and chemical properties of oil cargoes.
xi. Knowledge and understanding of safe working practices, including risk assessment and personal shipboard safety relevant to oil tankers:
xii. Knowledge and understanding of oil tanker emergency procedures.
xiii. Actions to be taken following collision, grounding, or spillage.
xiv. Knowledge of medical first aid procedures on board oil tankers.
xv. Understanding of procedures to prevent pollution of the atmosphere and the environment Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended, and other relevant IMO instruments, industry guidelines and port regulations as commonly applied.
xvi. Case Studies.

References:

i. International Maritime Organization (IMO). (2014). *International safety guide for oil tankers and terminals (ISGOTT)* (6th ed.). London: Witherby Publishing Group.
ii. International Maritime Organization (IMO). (2015). *Advanced training for oil tanker cargo operations* (Model Course 1.02). IMO Publishing.
iii. Adams, R. (2012). *Oil tanker operations: A practical guide* (2nd ed.). London: Lloyd's Practical Shipping Guides.

18.8.3 BME 4213: Fishing Vessel Technology

3.00Credit, 3hrs./wk.

Aims:

The objective of this course is to familiarize the students with fishing vessel technology.

Learning Outcomes:

On successful completion of this unit, students should be able to understand the technologies associated with fishing vessel

Syllabus Contents:

i. Types of sea fish for human consumption.
ii. Fishing methods and gear types: active and passive gears, advantages and disadvantages.
iii. Fish finding and communication equipment.
iv. General arrangement and space requirement of fishing craft.
v. Stability, propulsion systems and sea keeping characteristics of fishing craft.
vi. Fish hold architecture.
vii. Fish processing and preservation.
viii. Fishing harbor design.
ix. Fisheries economics.

References:

i. Bhattacharya, S. (2011). *Fishing vessel design and construction*. New Delhi: Central Institute of Fisheries Education.
ii. Jensen, J. R., & Lien, I. (2007). *Modern fishing vessel technology*. London: Springer.
iii. FAO. (2018). *Fishing vessel technology: Safety, operations, and design*. Rome: Food and Agriculture Organization of the United Nations.
iv. Yakhnenko, V., & Popov, I. (2005). *Marine engineering and fishing vessel systems*. Moscow: Nauka Publishing.
v. Herrmann, B. (2010). *Fishing vessel stability and seaworthiness*. Oxford: Elsevier.

18.8.4 BME 4215: Maritime Economics

3.00 Credit, 3hrs./wk.

Aims:

This course introduces students to the economic principles, theories, and applications in the maritime sector. The students will explore shipping economics, port management, international trade, policy frameworks, environmental impacts, and emerging trends like digitalization and sustainability.

Learning Outcomes:

By the end of the course, students will be able to:

i. Understand and apply economic concepts to the maritime transport industry.
ii. Analyze global shipping markets, including freight rates, demand, and supply.
iii. Assess the role of ports and maritime infrastructure in global trade.
iv. Examine the impact of trade policies, environmental regulations, and technological innovations on shipping.
v. Understand the economic, social, and environmental sustainability challenges facing maritime transport.

Syllabus Contents:

i. **Introduction to Economics:**
   - **Definition of Economics:** Scarcity and choice, Microeconomics vs. Macroeconomics, Importance of studying economics, Scope of economics.
   - **Demand and Supply**: Law of demand, Law of supply, Market equilibrium.
   - **Market Structures**: Perfect Competition, Monopoly, Oligopoly, and Monopolistic Competition**.**
   - **Production & Costs:** Factors of production- Land, labor, capital, entrepreneurship, Short-run and long-run costs, Economies of scale and scope.

ii. **Introduction to Maritime Economics:** Overview of Maritime Economics, Definition and scope of maritime economics, Importance of shipping in the global economy, Factors of production: Land, Labor, Capital & Organizations, and their characteristics.

iii. **Demand for sea transport & the supply of shipping services:** Definition, Determinants of demand for sea transports, Distance and the concept of Ton-miles, Elasticity of demand, Definition, Determinants of supply of sea transports, The concept of elasticity of supply.

iv. **Shipping Cost analysis and economies of scale:**

- **An outline of basic cost concepts:** The behavior of total costs and output in the short run, The concept of marginal, or incremental cost.
- **The conventional analysis of vessel operating costs:** Capital Cost, Direct Operating Cost and Voyage Cost, Cost of running ships.
- **Long-run vessel costs**: economies of scale and optimal ship size.
- **Freight Rates and Cost Structures**: Components of freight rates: operating costs, capital costs, fixed vs. variable costs.
- **Factors influencing freight rates**: fuel prices, distance, port charges, vessel types, how freight rates fluctuate in response to market conditions.

v. **Shipping and international trade:** Introduction, The growth and pattern of world trade, Trade and economic growth, Economic models of trade flows: Absolute advantage, comparative advantage. The product life cycle theory, Heckscher-Ohlin model, Leontief Paradox, Free trade vs protectionism, methods of protection.

vi. **Financing ships and shipping companies:** Ship finance and shipping economics, How ships have been financed in the past, The world financial system and types of finance, Financing ships with equity, Financing ships with debt, Finance for new buildings, Leasing ships.

vii. **The economics of shipbuilding and scrapping:** Role of the merchant shipbuilding and scrapping industries, Regional structure of world shipbuilding, Shipbuilding market cycles. The economic principles of the shipbuilding production process, shipbuilding costs and competitiveness. The ship breaking industry, Hongkong Convention & Green shipping

viii. **Contemporary issues:** Blue Economy & Maritime Economics relevant issues, if any.

References:

i. Samuelson, P., & Nordhaus, W. (2010). Economics (19th ed.). New York, NY: McGraw-Hill.
ii. Salvatore, D. (2006). Microeconomics (4th ed.). New York, NY: Oxford University Press.
iii. Stopford, M. (2009). Maritime economics (3rd ed.). London: Routledge.
iv. Hoar, J. (2010). The economics of sea transport and international trade. London: Routledge.
v. Talley, K. W. (2013). Port economics. London: Routledge.
vi. Elbeltagi, E. (2015). The shipping economics. London: Palgrave Macmillan.
vii. Ma, S. (2012). Economics of maritime business. London: Springer.

18.8.5 BME 4217: Environmental Science

3.00 Credit, 3 hrs. /week

Aims:

To understand how the natural world works, determine how humans interact with and impact the environment, and develop solutions for environmental problems to live more sustainably. This involves studying ecological systems, identifying human effects like pollution and climate change, and finding ways to mitigate these impacts through conservation, policy, and resource management.

Learning Outcomes:

The student will be able to describe/identify/explain/discuss/analyze:

i. Know Fundamentals of Environmental Science related to environment, Environmental Hazards and Disaster Management.
ii. Learn how the environment and its various physical, chemical, and biological components function and interact.
iii. Find ways for humans to live more sustainably by creating solutions for environmental problems, managing resources efficiently, and protecting biodiversity.
iv. Use scientific knowledge to inform public policy and decision-making to promote environmental protection and sustainability.

Syllabus Content:

i. **Global Environmental Issues**: Concept of Deforestation, Basic concept of urban & industrial pollution, concept of Ecological footprints and carrying capacity, Climate change, Ozone layer depletion, Loss of biodiversity.

ii. **Biogeochemical cycles**: Carbon cycles; oxygen cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; nutrient cycle models; ecosystem input of nutrients.

iii. **Atmospheric chemistry**: Photochemical reactions in atmosphere; Smog formation, aerosols; chemistry of acid rain, chemistry of NOx and Sox; free radicals and ozone layer depletion, role of CFCs in ozone depletion.

iv. **Environmental Pollution**, Definition & types of pollution; air, water, and land (soil), but there are several other categories, including noise, light, thermal, radioactive, and plastic pollution.

v. **Biodiversity:** Threats to biodiversity, Natural and anthropogenic disturbances; habitat loss, habitat degradation, and habitat fragmentation; climate change; pollution; hunting & over-exploitation; deforestation; invasive species; overgrazing; man-wildlife conflicts; consequences of biodiversity loss; Mass Extinction events.

vi. **Conservation of biodiversity**, Importance of biodiversity patterns in conservation; In-situ conservation, Ex-situ conservation. Role of IUCN in global biodiversity conservation.

vii. **Soil erosion and Land degradation**: Type and causes of soil erosion; deforestation, desertification; habitat loss, loss of biodiversity; range land degradation; land salinization; human population pressure, poverty, socio-economic and institutional factors, loss of ecosystem services; effects on farming , effects on food security; effects on nutrient cycles; future effects of soil degradation.

viii. **Natural hazards:**

- **Earthquake**: seismic waves, Volcanoes: types, causes of volcanism, geographic distribution.
- **Floods:** types and nature, reasons, frequency of flooding.
- **Drought:** types of droughts- meteorological, agricultural, hydrological, and famine;
- **Landslides:** Morphology of landslide, Causes and types of landslides, Landslide analysis, Glacial Lake Outburst Floods (GLOF); Tornadoes, cyclone & hurricanes.
- **Tsunamis:** causes and location of tsunamis; Slow onset hazards: Coastal erosion, sea level

changes and its impact on coastal areas and coastal zone management.

- Epidemics & Pandemics causes and reasons of spread, Covid.

ix. **Anthropogenic or human-induced hazards**: Impacts of anthropogenic activities such as rapid urbanization, injudicious ground water extraction, sand mining from riverbank, deforestation, mangroves destruction.

x. **Disaster Management & Mitigation:** Disaster Management cycle. Change in Concept of Disaster Management to Disaster Risk Reduction. Concept of mitigation; types of mitigation: structural and non-structural mitigation. Community Based Disaster Management. Management of Earthquake, Landslide, Volcanism, Tsunami, GLOF, Flood, Cyclone, Wildfire and Fire disasters.

xi. **Environmental Management Plan:** Principle and components of EMP. Synchronization of EMP with the project cycle, Importance of EMP.

References:

i. Chauhan, A. (2020). *Environmental science*. Khanna Publishers.

ii. Garg, S. K. (2015). *Ecology and environmental studies* (4th ed.). Khanna Publishers.

iii. Mitra, A., & Chaudhuri, T. R. (2020). *Basics of environmental science*. New Delhi, India: New Central Book Agency.

18.8.6 BME 4219: Recycling of Ships

3.00 Credit, 3 hrs. /wk.

Aims:

This course will teach the students science, technology and engineering that is involved in ship recycling. The international and national regulations regarding ship recycling will also be taught in this course.

Learning Outcomes:

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

i. Stay abreast of the international and national regulations regarding ship recycling

ii. understand the science, technology and engineering that is involved in ship recycling
iii. acknowledge the importance of implementing green ship recycling in Bangladesh.

Syllabus Contents:

i. **Regulatory Framework and Compliance**
   - The Hong Kong Convention (HKC): Requirements, implications, surveys, and certification.
   - IMO Guidelines: MEPC resolutions on Ship Recycling Facility Plans (SRFP), Inventory of Hazardous Materials (IHM), and facility authorization.
   - National and Regional Laws: Local legislation (e.g., Bangladesh Ship Breaking Act), EU regulations, ISO 30000 Standard, Flag State responsibilities, and classification societies.

ii. **Ship Recycling Processes and Technologies**
   - Types of ships and end-of-life assessment.
   - Recycling methods: beaching, dry-dock, dismantling sequences.
   - Material identification and recovery: metals, components, hazardous waste, and circular economy principles.
   - Ship Recycling Facility Plan (SRFP) and Ship Recycling Plan (SRP): Development, implementation, and monitoring.

iii. **Health, Safety, and Environmental Hazards (HSE)**
   - Identification and mitigation of hazards: asbestos, PCBs, heavy metals (lead, mercury), VOCs, fire, confined spaces, working at heights, PPE usage.
   - Risk assessment and management strategies for workers and environment.

iv. **Hazardous Materials Management**
   - Inventory of Hazardous Materials (IHM) requirements and reading reports.
   - Safe removal, handling, and disposal of asbestos, PCBs, PAHs, organotins, and other toxic substances.
   - Standard operating procedures (SOPs) for hazardous waste management.

v. **Emergency Preparedness and Response**
   - Firefighting, first aid, spill response, emergency drills, and incident reporting.
   - Effective response to unexpected events on-site.

vi. **Sustainable Practices and Green Ship Recycling**
   - Principles of green recycling, resource efficiency, waste minimization, and marine

ecosystem protection.

- Implementation of environmentally conscious procedures and circular economy approaches.

vii. Management Systems and Corporate Social Responsibility (CSR)

- ISO 30000: Framework for ship recycling management systems.
- Corporate social responsibility and ethical practices.
- Market overview: industry trends, economic considerations, and competitiveness.

viii. Practical Components

- Site visits to ship recycling facilities (e.g., Chittagong, Bangladesh) for hands-on understanding of processes.
- Observing ship lift systems, dismantling sequences, and material handling in practice.
- Case studies: recycling high-speed ferries, glass reinforced polyester (GRP) ships, and FRP-sandwich hulls.
- Implementation of the Green Passport and safety protocols in real operations.

References:

i. Talens, K. (2014). *Ship Recycling: International Law and Practice*. London: Informa Law.

ii. Mahon, A. A., & Boyle, A. (2010). *Marine Pollution: International Law and Policy* (2nd ed.). Oxford: Oxford University Press.

iii. IMO. (2019). *International Maritime Organization Guidelines on Ship Recycling (MEPC.269(68))* [PDF]. London: International Maritime Organization.

iv. Poulsen, R., & Smith, R. (2016). *Green Ship Recycling: Principles and Practice*. Cambridge: Woodhead Publishing.

v. Chowdhury, M. A., & Alam, M. (2018). *Ship Breaking and Recycling in Bangladesh: Environmental, Safety, and Economic Aspects*. Dhaka: Bangladesh Maritime University Press.

18.8.7 BME 4221: Ship Operation and Management

3.00 Credit, 3hrs. /week.

Aims:

i. To provide in-depth knowledge on the management and operation of ships as part of the maritime supply chain.
ii. To develop an understanding of legal, commercial, and operational aspects associated with the shipping industry.
iii. To equip students with skills in planning, decision-making, and compliance for effective ship management.

Learning Outcomes:

Students will be able to describe, identify, explain, discuss, and analyze:

i. The supply chain in the shipping industry, including the ownership and chartering of vessels.
ii. Freight rates, types of shipping, and the principal shipping organizations.
iii. Legal aspects such as the bill of lading, carriage of goods by sea, and charter parties.
iv. Marine insurance principles, including underwriting and loss adjustment for marine cargo.
v. Operational planning, sailing schedules, and voyage estimates for efficient ship management.
vi. Compliance with safety regulations, port procedures, pollution control, and emergency response.

Syllabus Contents:

i. **Introduction to Ship Operations**: Overview of shipping as a part of the global supply chain. Types of shipping (liner, tramp, bulk, container, etc.). Ownership structures and operational strategies in the shipping industry.
ii. **Freight Rates and Chartering**: Freight rate formulation and influencing factors. Types of charter parties: time, voyage, and bareboat charters. Key clauses in charter parties and negotiation practices.
iii. **Legal Aspects of Shipping**: The bill of lading and its significance. International conventions on carriage of goods by sea. Survey and protest procedures. Merchant shipping ordinance and acts, with a focus on Bangladesh.
iv. **Marine Insurance**: Hull policy, marine cargo insurance, and related clauses. Underwriting

principles and risk assessment. PandI (Protection and Indemnity) clubs and their roles. Loss adjusting and claims handling procedures.

v. **Role of Classification Societies**: Functions of classification societies in ship safety. Survey requirements and periodic inspections.
vi. **Ship Financing and Economics**: Capitalization and financial considerations for new and second-hand tonnage. Impact of subsidies and government policies on ship acquisition. Economics of ship operation and lifecycle cost analysis.
vii. **Operational Planning and Voyage Management**: Factors affecting sailing schedules and voyage estimates. Economic and environmental considerations in voyage planning. Commercial shipping practices, including ship registration and flagging.
viii. **Crew Management and Welfare:** Manning regulations and compliance. Seafarer welfare and rights under international conventions. Training requirements and certification.
ix. Port Procedures and Regulations: Port entry requirements, clearance, and pilotage. Documentation and ship's papers. Handling port state control inspections.
x. **Pollution Control and Emergency Response**: Duties regarding pollution prevention and response. Handling shipping casualties: collision, explosion, and fire. Assistance to vessels in distress.
xi. **Case Studies and Practical Applications:** Analysis of real-world shipping scenarios. Regulatory compliance case studies. Economic analysis of different operational strategies

References:

i. Stopford, M. (2019). *Maritime Economics* (3rd ed.). London: Routledge.
ii. Talley, K. W. (2014). *Port Economics* (2nd ed.). New York: Routledge.
iii. Hoar, J. (2010). *The Economics of Sea Transport and International Trade*. London: Routledge.
iv. Emad Elbeltagi. (2018). *The Shipping Economics*. London: Informa Law.
v. Ma, S. (2017). *Economics of Maritime Business*. Singapore: Springer.
vi. Paul, S., & Nordhaus, W. (2010). *Economics* (19th ed.). New York: McGraw-Hill Education.
vii. Salvatore, D. (2012). *Microeconomics* (4th ed.). New York: Oxford University Press.

18.8.8 BME 4223: Ship Chartering and Brokering

3.00 Credit, 3hrs. /week.

Aims:

The aim of a ship chartering and brokering course is to equip students with the essential knowledge and practical skills to connect ship owners with cargo owners, manage contracts, analyze markets, and handle the commercial, legal, and operational aspects of moving goods by sea, focusing on negotiation, risk management, voyage estimation, lay time/demurrage, and industry regulations for optimizing revenue and efficiency.

Learning Outcomes:

By the end of this course, students will be able to:

i. Understand the principles and practices of ship chartering and the role of shipbrokers in the shipping market.
ii. Analyze and apply different types of charter parties, laytime, demurrage, and contractual clauses.
iii. Perform voyage estimation and calculation, including fuel, port charges, and revenue optimization.
iv. Apply commercial management strategies to optimize voyage performance and fuel usage.
v. Utilize digital tools, market intelligence, and case studies to support decision-making in ship chartering and brokering.

Contents:

i. **Introduction to Ship Chartering**

- Overview of chartering
- Role in shipping
- Types of charters

ii. **Types of Charter Parties**

- Voyage charter
- Time charter

- Bareboat charter
- Contract clauses

iii. **Shipbroking**

- Role and functions
- Shipbrokers' duties
- Market intermediaries

iv. **Freight Market and Chartering Economics**

- Freight rates
- Supply & demand
- Voyage calculation

v. **Lay Time and Demurrage**

- Calculation
- Exceptions
- Charter party clauses

vi. **Bills of Lading & Documentation**

- Charter party documents
- Bills of lading
- Cargo documentation

vii. **Negotiation and Fixture Process**

- Steps
- Communication
- Terms
- Confirmation

viii. **Contractual Aspects**

- Legal framework
- Standard charter forms (GENCON, NYPE, Baltime, etc.)

ix. **Voyage Estimation and Calculation**

- Voyage costs
- Fuel consumption
- Port charges
- Revenue estimation

x. **Commercial Management in Chartering**

- Voyage optimization
- Bunker strategies
- Fuel management

xi. **Digitalization and Market Analysis**

- Shipping indices
- Digital platforms
- Market intelligence

xii. **Case Studies & Industry Best Practices in Chartering and Brokering.**

References:

i. Cheng, V. (2018). *Shipbroking and chartering practice*. Routledge.
ii. Plomaritou, E., & Papadopoulos, A. (2018). *Shipbroking and chartering practice* (8th ed.). Routledge – Informa Law.
iii. Clarksons Research Services. (2018). *Shipping market reports, chartering indices, and fixtures analysis*. Clarksons.
iv. BIMCO. (2018). *Standard charter forms, voyage estimation guidelines, bunker adjustment factor (BAF)*. BIMCO Publications.

18.8.9 BME 4225: Marine Surveying and Accident Investigation

3.00 Credit, 3hrs. /week.

Aims

This course aims to provide comprehensive understanding on various Survey on board ship and also accident investigation.

Learning Outcome:

Upon completion of this course, participants will be able to:

i. Analyze the role and responsibilities of a marine surveyor, explain national and international standards and conventions that govern marine surveying practices, conduct inspections of ship structures, design and create professional documentation and reports following a survey, ensuring objectivity and compliance with legal requirements.
ii. Understand the objectives of maritime accident investigation, initiate and manage an investigation, identify technical, operational, human, and organizational factors contributing to accidents, compile a comprehensive, objective investigation report.

Contents:

i. **Introduction to Marine Survey:**

- Inspection and assessment of vessels and cargo to determine condition, safety, and value.
- Evaluation of structure, machinery, and equipment for compliance, damage assessment, and expert opinions.
- Technical surveys include hull surveys, load line surveys, and stability tests.

ii. **Key Aspects of Marine Surveying**

- **Inspections:** Thorough checks of vessels and equipment including navigation, safety, and engine systems.
- **Damage Assessment:** Inspection and reporting of vessel/cargo damage for insurance or salvage purposes.
- **Valuation:** Appraisal of vessel market value for sales or financial transactions.

- **Compliance:** Verification of vessels and equipment against standards, specifications, and regulatory requirements.
- **Expert Witness:** Acting as expert witnesses in legal hearings related to accidents or fraud.

iii. **Relationship Between Surveyors and Clients**

- Built on trust, clear communication, and mutual understanding of project goals.
- Managing client expectations, providing transparent updates, and aligning technical expertise with client objectives.

iv. **Business Skills for Surveyors**

- Communication, project management, problem-solving, client management, time management, teamwork, professional attitude, financial literacy, negotiation, and presentation skills.

v. **Laws and Conventions Relating to Marine Survey**

- International treaties: SOLAS Convention (safety standards), MARPOL protocols (pollution prevention).
- National regulations: e.g., Marine Order 503 (Australia).
- Harmonized System of Survey and Certification (HSSC) standardizes survey and certification processes.

vi. **Surveyors' Role in Incident and Accident Investigation**

- Scene assessment, cause and extent determination, neutral reporting, insurance claim settlement, evidence for legal proceedings, and damage prevention.

viii. **Naval Architecture for Marine Surveyors**

- Understanding design, construction, stability, structural integrity, and safety regulations.
- Assessing vessel condition, compliance, and impact of modifications, repairs, or damage.

ix. **Marine Engineering and Systems for Surveying**

- Inspection of ship systems including propulsion, electrical, and auxiliary machinery.

- Ensuring safety, compliance, and seaworthiness.

x. **Hull and Structural Survey**

- Comprehensive inspection of hull and supporting structures.
- Assessing integrity, detecting damage, ensuring regulatory compliance, repair planning, and loss investigation.

xi. **Safety and Security Survey**

- Assessment of vessels and facilities for safety of life, property, and environment.
- Reviewing security plans, identifying vulnerabilities, and ensuring compliance with international and national regulations.

xii. **Cargo Survey**

- Inspection and verification of goods before or after transport.
- Assessing condition, verifying weight, checking for damage, and ensuring regulatory compliance.

xiii. **Marine Environmental Survey**

- Assessment of marine ecosystems, biodiversity, water quality, seabed topography, and pollution.
- Methods: habitat mapping, sediment/water sampling, remote sensing technologies like side scan sonar or ROV.

xiv. **International Safety Management (ISM) Survey**

- Verification of ship compliance with ISM Code for safe operation and pollution prevention.
- Office and shipboard audits to ensure effective implementation of safety procedures.

xv. **Marine Warranty Survey**

- Third-party inspection of high-risk marine operations for safety and regulatory compliance.

- Review of plans, verification of equipment, and on-site oversight during operations.

xvi. **Marine Offshore Drilling Unit Survey**

- Inspection of mobile offshore drilling units (MODUs) for structural integrity, safety, and operational readiness.
- Compliance with IMO MODU Code and offshore safety/environmental standards.
- Includes Offshore Vessel Inspection database inspections and surveys during lay-up or reactivation.

References:

i. Suhrawardy, G. (2015). *Marine surveyors handbook*. Dhaka, Bangladesh: Marine Academy Press.
ii. Chowdhury, B. K. (2012). *Marine survey handbook: Theory and practice*. Kolkata, India: Marine Education Publishers.
iii. Harland, J. (2011). *Marine accident investigation* (2nd ed.). London, England: Witherby Publishing Group.
iv. ITOPF. (2018). *Oil tanker spill statistics and incident reporting* (Report No. 21). London, England: International Tanker Owners Pollution Federation Ltd.
v. McLaughlin, D. (2016). *Guide to maritime accident investigation procedures*. Oxford, England: Elsevier.

18.8.10 BME 4227: Renewable Energy Sources and Application

3.0 Credit, 3hrs. /wk.

Aims:

To provide students' knowledge of various renewable technologies (like solar, wind, and hydro), understand their economic and environmental implications, and develop the skills to analyze, design, and implement renewable energy projects. Courses also aim to foster an understanding of energy policy, market trends, and how to transition to a sustainable, low-carbon energy system.

Learning Objective:

The student will be able to describe/identify/explain/discuss/analyze:

i. Differentiate between renewable and non-renewable energy sources and their characteristics.

ii. Identify and describe the principles behind various renewable energy technologies such as solar, wind, hydro, and biomass.

iii. Explain the environmental impacts, strengths, and limitations of different energy sources.

iv. Understand the fundamentals of different renewable energy sources (like solar, wind, and hydro), analyzing their environmental impacts and limitations, evaluating and comparing their performance, and developing skills to design and implement sustainable energy systems

Syllabus Content:

i. **Introduction:** Overview of energy needs, present and future demands, and the role of renewable energy.

ii. **Solar Energy:** Solar radiation, collectors, solar cells (photovoltaics), and applications.

iii. **Wind Energy:** Wind power density, site selection, and wind power plants.

iv. **Biomass Energy:** Biomass conversion, biogas, and biomass power plants.

v. **Geothermal Energy:** Geothermal resources, technology, and applications for electricity and heating.

vi. **Ocean Energy:** Tidal energy, wave energy, and Ocean Thermal Energy Conversion (OTEC).

vii. **Other Sources:** Hydropower and potentially other sources like hydrogen.

viii. **Environmental and Economic Aspects:** Analysis of environmental impacts, safety, and economic issues related to each renewable source.

ix. **Systems and Integration:** Technical generation systems, grid integration, and sustainable energy systems.

x. **Alternative fuel:** Hydrogen, ammonia etc.

Reference Texts:

i. Alternative Energy Systems & Applications by B.K.Hodge, Wiley,
ii. Renewable Energy Technologies, edited by J.C.Sabonnadiere,
iii. Sustainable Energy Systems and Applications.

18.9 Non-credit Courses

Minimum any Three needs to be taken

18.9.1 Course Title: Basic Ancillary Course on Personal Survival Technique (PST)

Syllabus Contents:

With reference to IMO convention model course, this training is intended to meet the requirements set out in Table A-VI/1-2 of the STCW Code.

Introduction, Safety and Survival, Safety guidance, Emergency Situations. Types of emergencies, Evacuation, Abandoning ship – last resort, Survival Craft and Rescue Boats, Lifeboats, Personal Life-saving Appliances (Demonstrations), Lifebuoys.

18.9.2 Course Title: Basic Ancillary Course on First Aid (EFA)

Syllabus Content:

With reference to convention IMO model course, this training is intended to meet the requirements set out in Table A-VI/1-2 of the STCW Code.

Applying immediate first aid in the event of an accident/injury on board ship, actions on discovering a casualty, cardiopulmonary resuscitation, recovery position, fractures, spinal injuries, examination of a casualty, medical conditions including heart attack, choking and asthma.

18.9.3 Course Title: Basic Ancillary Course on Fire Prevention and Fire Fighting (FPFF)

Syllabus Contents:

With reference to convention IMO model course, this training is intended to meet the requirements set out in Table A-VI/1-2 of the STCW Code.

This module will provide sufficient knowledge for a person intending to go to sea, the essential basic knowledge of the ways in which fires are caused and the precautions to be taken to minimize the risk of fire in ships, on successful completion of this module, the trainee should be able to:

a. Maintain a state of readiness to respond to emergency situations involving fires aboard ship

b. Fight and extinguish fires using firefighting apparatus and appliances provided on board c. Act as a member of a fire party, including use of self-contained breathing apparatus.

18.9.4 Course Title: Ancillary Course on Personal Safety and Social Responsibility (PSSR)

Syllabus Contents:

With reference to convention IMO model course, this training is intended to meet the requirements set out in Table A-VI/1-2 of the STCW Code.

Background knowledge, shipboard organization/general shipboard terms., Emergency procedures, observe safe working practices, understand and take necessary actions to control fatigue, Pollution prevention, shipboard duties and responsibilities, Social responsibility.

18.9.5 Course Title: Basic Tanker Course (Oil, Chemical and Gas)

Syllabus Contents:

Contribute to safe cargo operation of GAS tankers, knowledge of liquefied gas tanker design, systems, and equipment, contribute to Loading, unloading, care and handling of cargo, take precautions to prevent hazards and safety relevant to liquefied gas tankers, proficiency to calibrate and use of monitoring and gas-detection systems, instruments and equipment, contribute to safe operation of deck equipment and machinery, apply occupational health and safety precautions and measures, apply precautions and contribute to the prevention of pollution of the marine environment, carry out fire fighting operations, respond to emergencies, take precautions to prevent pollution of the environment from the release of gas in accordance with maritime industry

standards, basic knowledge of liquefied gas and Oil tankers, basic knowledge of cargo operation, knowledge and understanding of tanker safety culture, function and proper use of gas measuring instruments and similar, fire Safety and firefighting operations.