# Curriculum of
# BSc in Naval Architecture and Offshore Engineering Programme

**Revision-1**

**Department of Naval Architecture and Offshore Engineering**

**Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh**
**4th Batch onward**

# AUTHOROTY OF PUBLICATION

1. A committee, formed vide memorandum no. BSMRMU/VC Secretariat/Admin-11/20/32 dated 20 February 2020 drafted the first revision of the curriculum of BSc in Naval Architecture and Offshore Engineering (NAOE). The committee comprises of the following members:

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2. The final draft of curriculum proposed by curriculum committee was discussed and recommended by the Academic Council with some modifications/suggestion (33rd meeting held on 15 November 2021. Item no- 14)

3. After incorporation the suggestion of Academic Council, the curriculum was presented to the syndicate (29th meeting held on 10 January 2022 Item no- 06). The syndicate approved the curriculum with some amendments/suggestion.

4. Based on the amendment /suggestion the curriculum was finalised and published here by.

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# 1 Introduction to the University

## 1.1 Background

The victory over maritime boundary delimitation with neighbouring countries opened a new window in the maritime arena of Bangladesh. Vast sea area along with scarcity in land based resources has made it imperative to boost up our economy through effective exploration of sea resources. Keeping this in perspectives honourable Prime Minister Sheikh Hasina outlined the concept of blue economy and underscored the importance of effective manpower in the maritime sector.

In order to create effective human resources, the first ever specialized university Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh (BSMRMU) was established in 2013 after the name of the Father of the nation Sheikh Mujibur Rahman. Our motto is "We strive for Maritime Excellence". The University aims at bringing all maritime professional to a common platform to share knowledge and carryout research for the advancement of maritime sector and developing effective human resources in this sector.

## 1.2 Vision

Vision of the University is to promote and create a learning environment for higher maritime education with excellence, through state-of-the-art facilities and gadgets, competent faculty and staff, expanded frontier of research based knowledge and international standards supportive of the new horizons in diverse fields by 2021.

## 1.3 Mission

BSMRMU is committed to provide quality education based on state of the art technological support responsive to the emerging challenges at home and abroad. The university is dedicated to nurture and develop world class professionals, who would serve the mankind with strong sense of ethical values and competence and ready to face the competitive world of maritime business, service and employment.

## 1.4 Goals

Goals of the University are as follows:

- Achieve sustainable development and progress of the university through mutual cooperation with other related universities/ institutions.
- Continue to upgrade educational services and facilities responsive to the demands and requirements of the nation.
- Bring all types of marine professionals on a common platform to share knowledge and perform research and development works for the advancement of country's maritime sector.
- Enhance research consciousness in the maritime sector in discovering new dimensions with the upcoming challenges.
- Accelerate the participation of alumni students and professionals with educational programs and development of projects designed to expand and improve academic standards.
- Teach students on marine science and technology and guide them towards research to enhance contribution to the maritime profession.
- Conduct various educational programmes and research works for sustainable development of the maritime service and industrial sector of the country.
- Educate students on different subjects of maritime management, law and security and strategy and conduct research on allied fields.
- Create conducive environment for students to prepare themselves to serve the nation as future planners/ policy makers/ leaders in maritime sectors in coordination with national and international organizations including International Maritime Organization (IMO).

### 1.5 Faculties and Institutes

The university aspires to have seven teaching faculties and four research institutes. The name of faculties and institutes is following:

- Faculty of Maritime Governance and Policy (FMGP)
- Faculty of Shipping Administration (FSA)
- Faculty of Earth and Ocean Science (FEOS)
- Faculty of Engineering and Technology (FET)
- Faculty of General Studies (FGS)
- Faculty of Computer Science &Informatics (FCSI)
- Faculty of Maritime Business Studies (FMBS)

Research institutes are: Institute of Professional Language, Institute of Bay of Bengal & Bangladesh Studies, Institute of Renewable Energy & Marine Resource and Institute of Disaster management.

## 2 Introduction to the Faculty

The objective of the Faculty of Engineering and Technology (FET) is to provide outstanding engineering education directed at enriching the quality of life in an emerging knowledge-based society. The mission of the faculty is to produce highly competent engineering graduates, who can conduct internationally recognized research and provide quality professional services.

Faculty of Engineering and Technology comprises of the following departments-

- Offshore Engineering
- Naval Architecture and Ocean Engineering
- Marine Engineering
- Harbour and River Engineering
- Electrical and Electronics Engineering
- Telecommunication Engineering
- Control Engineering & Mechatronics

## 3 Introduction to the Department

Offshore engineering is increasingly vital in the search for energy resources in context of Blue Economy. However, Bangladesh is yet to have any formal education in this sector. To fill this gap, the only specialized public maritime university BSMRMU has introduced the Department of Offshore Engineering. The department will help the nation to meet the engineering needs of the maritime and offshore industries by providing specialized knowledge pertinent to these industries.

The department will conduct both undergraduate and post graduate programmes in Naval Architecture and Offshore Engineering (NAOE).

## 4 Introduction to the Programme

Bachelor of Science in Naval Architecture and Offshore Engineering (NAOE) programme is a 4 year full time regular undergraduate programme. Graduates from this programme will be able to develop their career as Offshore Engineer, Naval Architects, Structural Engineer, Subsea Engineer, Drilling Engineer, Marine Engineer, System Engineer and Project Manager in the relevant discipline. In their challenging career, they will need to design, plan and manage the construction, installation, operation and maintenance of ships, offshore platforms and subsea systems.

The programme is divided into 8 semesters of six months each (2 semesters in each year). Total credit hours of this programme is 160 including 6 credit hours for thesis. Besides regular courses, workshops, seminars,

guest lectures and certificate courses on contemporary issues are arranged frequently for the students. The programme also includes one industrial attachment at the end of the 3rd year. The duration of each semester is 26 weeks. Each semester is distributed as follows:

a. Classes 15 weeks

b. Mid Term Examinations 02 weeks

c. Preparatory Leave 02 weeks

d. Final Examination 03 weeks

e. Recess 04 weeks

In the first two years, students will study humanities, science and allied engineering courses. It will also include courses on basic offshore engineering and naval architecture, fluids, materials, structures, etc. In 3rd and 4th years, students will specialize in both the Naval Architecture and Offshore Engineering theme, such as marine structures, dynamics, marine hydrodynamics, ship resistance and propulsion, marine engineering systems, offshore standards, maritime rules and regulation, ship and offshore design and analysis. Students will also conduct research project and thesis aimed at solving engineering challenges for the industry.

# 5 Programme Outcome

In general, the programme will enable its graduates to engineer shallow and deep-water structures from offshore jackets to semisubmersibles, including mastering the design and building procedure of different types of floating structures and ships. On completion of the programme, graduates will be able to:

a. Apply knowledge of mathematics, science, and engineering in the field of Naval Architecture and Offshore Engineering
b. Formulate engineering problems and develop practical solutions
c. Interpret the results of engineering experiments appropriate for Naval Architecture and Offshore Engineering
d. Design and analyze products and processes applicable to Naval Architecture and Offshore Engineering
e. Work effectively in teams and provide leadership.
f. Understand the impact of engineering decisions in a global/societal/environmental context
g. Understand the managerial, professional and ethical responsibility
h. Recognize the need to engage in lifelong learning
i. Acquire a broad education necessary to contribute effectively beyond their professional careers
j. Effectively communicate orally, graphically and in writing.
k. Use the techniques, skills and modern engineering tools necessary for engineering practices

# 6 Admission Information

## 6.1 Admission Criteria

Eligibility for admission in NAOE programme are as follows:

a. Applicants who have passed HSC or equivalent examination in the current or previous year are eligible to apply.

b. Applicants must have passed HSC/equivalent examination and SSC/equivalent examination from science group with minimum GPA 4.00.

c. In HSC/equivalent examination, applicants must have obtained minimum 'A' grade in any two subjects from Mathematics, Physics, Chemistry and English with minimum 'B' grade in rest of the subjects.

d. Applicants with GCE must have passed minimum five subjects in O-Level including Mathematics, Physics and Chemistry and minimum two subjects in A-Level including Mathematics and Physics. However, an applicant having more than two 'C' grades in O-Level and/or more than one 'C' grade in A-Level will be ineligible for admission.

### 6.2 Admission Procedure

The procedure for admission in BSc in NAOE programme are as follows:

a. **Admission Circular**: BSMRMU will invite applications from interested candidates for admission in BSc in NAOE programme by publishing advertisements in the national dailies and BSMRMU website.

b. **Written Admission Test:** An eligible candidate will have to sit for a written admission test on Mathematics, Physics, Chemistry and English.

c. **Syllabus of the Admission Test:** Syllabus of the admission test will be on the current HSC Syllabus.

d. **Final Selection:** Candidates will be selected finally on the basis of their combined marks obtained in the written admission test, HSC/equivalent examination and SSC/equivalent examination. Weightage will be written test 50%, HSC/equivalent examination result 30% and SSC/equivalent examination result 20%. Final merit list along with waiting list will be published on BSMRMU notice board as well as on BSMRMU website.

### 6.3 Registration in the Programme

After final selection, the selected candidates will be registered under the programme in accordance with the procedures as laid down by BSMRMU. The candidates have to go through a medical checkup at BSMRMU designated Medical Centre to ascertain their medical fitness. The selected candidates have to collect Admission Form from the Admission Section, and complete admission and registration formalities within the given time frame by paying the required fees. The following rules will apply in this regard:

a. If any candidate fails to complete admission formalities within the prescribed date and time, the candidate's selection will be cancelled automatically

b. If any student does not attend the class within two weeks of commencement of classes, the student's admission will be cancelled automatically.

## 7 Teaching Strategy

The teaching strategy of the programme is mainly lecture based for theoretical courses and demonstration for lab courses. Other teaching strategy includes case study, group discussion, workshop, seminar and field work learning etc.

### 7.1 Assignment of Credits

a. For theoretical courses, one lecture of 60 minutes per week per term is equivalent to one credit hour.

b. For laboratory courses, 120 minutes per week per term is equivalent to one credit hour.

c. Credit hours are also assigned to study tour, industrial attachment, project and thesis work taken by the students. The amount of time assigned to such work may vary depending on the requirements.

### 7.2 Conduct of Courses

The following guidelines will be followed for conducting the courses:

a. At the beginning of the term, the course teacher will prepare a course outline incorporating the course syllabus, performance evaluation and grading system (as laid down in the policy), list of suggested text books/references, and a tentative schedule of classes, examinations and events.

b. Project and thesis work will be assigned, either individually or in groups on any issue pertaining to the course.

c. A number of individual and group assignments, presentations, etc. will be assigned to students as per the course requirements.

## 8 Assessment Strategy

### 8.1 Grading System

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

| Letter Grade | Grade points | Numerical Markings |
|---|---|---|
| A+ | 4 | 80% and above |
| A | 3.75 | 75% to below 80% |
| A- | 3.5 | 70% to below 75% |
| B+ | 3.25 | 65% to below 70% |
| B | 3 | 60% to below 65% |
| B- | 2.75 | 55% to below 60% |
| C+ | 2.5 | 50% to below 55% |
| C | 2.25 | 45% to below 50% |
| D | 2 | 40% to below 45% |
| F | 0 | below 40% |
| X | Thesis/Project continuation | - |

### 8.2 Performance Evaluations

#### 8.2.1 Theory Courses

Forty percent (40%) marks of theoretical course will be allotted for continuous assessment, i.e. quizzes, class tests, assignments, class evaluation, class participation, mid-term exam etc. Term Final Examination is conducted centrally by BSMRMU. Term Final Examination will be normally of 3-hour duration and comprise of 60% marks. Distribution of marks for a given course is as follows:

a. Class Attendance : 05%

b. Class Participation/Observation : 05%

c. Term Paper/Assignment : 05%

d. Class Tests/Quiz : 10%

e. Mid Term Examination (01 Exam) : 15%

f. Term Final Examination : 60%

The number of quizzes/class tests of a theory course will be n+1, where n is the number of credit hours of the course. Evaluation of performance in quizzes/class tests will be on the basis of the best n quizzes. 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).

### 8.2.2 Lab Courses

The distribution of marks for Lab courses is given below:

a. Attendance : 10%

b. Class Performance / Observation : 10%

c. Assignment / Report : 20%

d. Viva/Presentation : 20%

e. Quiz : 40%

### 8.2.3 Industrial Attachment

The distribution of marks for industrial attachment is given below:

a. Continuous Assessment : 40%

b. Task Book Evaluation : 20%

c. Report Submission : 20%

d. Presentation : 20%

### 8.2.4 Study Tour

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

a. Attendance : 20%

b. Participation : 20%

c. Report Submission : 30%

d. Presentation : 30%

### 8.2.5 Project and Thesis

The distribution of marks for the performance evaluation of project and thesis is given below:

a. Report Submission : 50%

b. Presentation : 30%

c. Oral Examination : 20%

### 8.2.6 Co-curricular Courses

Assessment for credited co-curricular courses is to be carried out continuously by the Co-ordinator of the registered club.

Assessment Criteria shall include: Active participation, competence and contribution to the club.

## 8.3 The requirements for promotion to the next semester

The requirements for promotion to the next term are as follows:

a. A student has to take the required courses for a particular semester as per the syllabus of the programme.

b. A student will be promoted to the second semester of each year, irrespective of his/her results in the first term of the year.

## 8.4 The requirements for promotion to the next year

The requirements for promotion to the next term are as follows:

a. A student has to take the required courses for a particular year as per the syllabus of the programme.

b. A student will be promoted to the next year, provided he/she does not have 'F' grades in more than two subjects including backlog subjects (if any).

## 8.5 The reexamination of failed subjects

Normally the re-examination of the failed subjects (section 8.4b) will be conducted at the beginning of the following academic year. A short term may be conducted for them during year ending recesses. However, students may also opt to register the failed subjects and appear the examination with next batch.

## 8.6 Credit Earned

The courses in which a student has obtained 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained 'F' grade will not be counted towards his/her earned credits. 'F' grade must be cleared within the designated period.

## 8.7 Degree Requirements

Degree requirements are as follows:

a. Completion of courses required for fulfilling the minimum credit hours of 160 in a maximum period of 6 (six) academic years.

b. Appearing at the final examination in all the required courses as per curriculum of the programme.
c. Successful defence of thesis paper.

d. Successful completion of 3 Degree ++ courses.

e. Scoring a CGPA 2.20 or above.

## 9 Course Designation System

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

a. The first digit corresponds to the year in which the course is normally taken by the students.
b. The second digit corresponds to the semester in which the course is normally taken by the students.
c. 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.

## 10 Curriculum Structure

BSc in NAOE Programme consists of total 64 courses excluding non-credit courses and divided into the following categories:

| Category | No. of Theory Courses | No. of Lab/practical Courses | No. of non-credit courses | Credit Hours |
|---|---|---|---|---|
| **Core Courses (NAOE)** | 25 | 11 | - | 88.5 |
| **Optional Course (NAOE)** | 3 | - | - | 9 |
| **Allied Engineering Courses** | 4 | 3 | - | 16.5 |
| **Basic Science** | 6 | 2 | - | 21 |
| **Humanities/Social Science** | 5 | 1 | - | 13.5 |
| **Project** | - | 1 | - | 4 |
| **Thesis** | - | 1 | - | 6 |
| **Industrial Attachment** | - | 1 | - | 1.5 |
| **Co-curricular** | - | - | 1 | |
| **Industrial Study Tour** | - | - | 2 | - |
| **Degree ++** | - | - | 3 | - |
| **Total** | **43** | **20** | **6** | **160** |

## 11 Course Schedule

| Year-1: Semester-1 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 1101 | Introduction to Naval Architecture and Offshore Engineering | 3 |
| CHEM 1101 | Chemistry | 3 |
| MATH 1101 | Differential and Integral Calculus | 3 |
| HUM 1101 | English | 3 |
| HUM 1103 | Bangladesh Studies | 2 |
| HUM 1105 | বাংলাদেশের অভ্যুদয়ের ইতিহাস | 1 |
| **Practical** | | |
| ME 1100 | Mechanical Drawing and CAD Lab | 1.5 |
| CHEM 1102 | Chemistry Lab | 1.5 |
| HUM 1102 | English Lab | 1.5 |
| **Total** | | **19.5** |

| Year-1: Semester-2 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 1203 | Hydrostatics and Stability | 3 |
| ME 1201 | Thermal Engineering | 3 |
| EEE 1201 | Electrical Engineering Principles | 3 |
| PHY 1201 | Physics | 3 |
| MATH 1203 | Ordinary and Partial Differential Equation | 3 |
| HUM 1207 | বাংলা ভাষা ও সাহিত্য | 3 |
| **Practical** | | |
| ME 1202 | Thermal Engineering Lab | 1.5 |
| PHY 1202 | Physics Lab | 1.5 |
| **Total** | | **21** |

| Year-2: Semester-1 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 2101 | Fluid Mechanics | 3 |
| NAOE 2103 | Ship Design | 3 |
| NAOE 2105 | Numerical Methods in Engineering | 3 |
| MATH 2101 | Linear Algebra, Statistics and Probability | 3 |
| EEE 2101 | Electrical and Electronic Technology for Marine Application | 3 |
| **Practical** | | |
| NAOE 2102 | Fluid Mechanics Lab | 1.5 |
| NAOE 2104 | Ship Design Lab-I | 1.5 |
| NAOE 2110 | Workshop Practices | 1.5 |
| EEE 2102 | Electrical and Electronic Technology for Marine Application Lab | 1.5 |
| **Total** | | **21** |

| Year-2: Semester-2 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 2207 | Mechanics of Structure | 3 |
| NAOE 2209 | Theory of Machines | 3 |
| NAOE 2211 | Resistance and Propulsion | 3 |
| ME 2201 | Heat Transfer | 3 |
| MATH 2203 | Fourier Analysis, Laplace Transformation and Complex Variable | 3 |
| **Practical** | | |
| NAOE 2204 | Ship Design Lab-II | 1.5 |
| NAOE 2208 | Mechanics of Structure Lab | 1.5 |
| NAOE 2214 | Numerical Methods in Engineering Lab | 1.5 |
| COCR 2202 | Co-curricular | 0 |
| **Total** | | **19.5** |

| Year-3: Semester-1 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 3101 | Ship and Offshore Structures | 3 |
| NAOE 3103 | Marine Engines and Fuels | 3 |
| NAOE 3105 | Materials in Marine Environment | 3 |
| NAOE 3107 | Ship and Offshore Production Technology | 3 |
| NAOE 3109 | Marine Hydrodynamics | 3 |
| **Practical** | | |
| NAOE 3110 | Marine Hydrodynamics Lab | 1.5 |
| NAOE 3114 | Ship Design Lab-III | 1.5 |
| NAOE 3000 | Project | 2 |
| **Total** | | **20** |

| Year-3: Semester-2 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 3211 | Computational Fluid Dynamics | 3 |
| NAOE 3213 | Navigation and Maritime Regulations | 3 |
| NAOE 3215 | Finite Element Methods | 3 |
| NAOE 3217 | Maritime Transportation | 3 |
| HUM 3201 | Economics and Accounting | 3 |
| **Practical** | | |
| NAOE 3210 | Computer Programming for Engineers | 1.5 |
| NAOE 3000 | Project | 2 |
| NAOE 3200 | Industrial Attachments | 1.5 |
| **Total** | | **20** |

| Year-4: Semester-1 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 4101 | Marine Engineering Equipment and Systems | 3 |
| NAOE 4103 | Ship and Offshore Dynamics | 3 |
| NAOE 4105 | Design of Offshore Structures | 3 |
| NAOE 4107 | Dredger and Dredging Technology | 2 |
| NAOE 4109 | Research Methodology | 1 |
| NAOE 4117 | Professional Engineering Practices | 1.5 |
| | Optional - 1 | 3 |
| **Practical** | | |
| NAOE 4000 | Thesis | 3 |
| | | |
| **Total** | | **19.5** |

| Year-4: Semester-2 | | |
|---|---|---|
| **Code** | **Course Name** | **Credit** |
| **Theoretical** | | |
| NAOE 4217 | Offshore Survey, Drilling and Production | 3 |
| NAOE 4219 | Riser and Mooring Systems | 3 |
| NAOE 4221 | Engineering Management | 3 |
| | Optional - 2 | 3 |
| | Optional - 3 | 3 |
| **Practical** | | |
| NAOE 4200 | Safety and Survival Training | 1.5 |
| NAOE 4000 | Thesis | 3 |
| **Total** | | **19.5** |

**Grand Total: 160 Credits**

## List of Optional Courses:

(Students will take 3 optional courses in the final year – one optional course in the 1st semester and two optional courses in the 2nd semester)

| Category | Course Code | Course Name |
|---|---|---|
| For Optional – 1 | NAOE 4111 | Theory of Hydrofoils |
| | NAOE 4113 | Vibrations of Marine Structures |
| | NAOE 4115 | Offshore Renewable Energy |
| For Optional – 2 &3 | NAOE 4223 | Recycling of Marine Structures |
| | NAOE 4225 | Ship Performance |
| | NAOE 4227 | Design of Special Ships |
| | NAOE 4229 | Port and Harbor Engineering |
| | NAOE 4231 | Marine Pollution and Prevention |
| | NAOE 4233 | Control Engineering |
| | NAOE 4235 | Composite Materials |
| | NAOE 4237 | Machine Design |
| | NAOE 4239 | Optimization Methods in Ship Design |

**Study Tour:** There will be two Study Tours (ST) in year-1: semester-2 and year-2: semester-2 respectively.

## List of Degree++ Courses:

Each student shall have to register minimum 3 (Three) degree++ courses as a part of requirement of the degree. A list of probable degree++ courses are given below:

- Ship Design Software Training
- Structural Analysis Software Training
- Offshore Structure Design and Analysis Software Training
- Supply Chain Management
- E-procurement
- Project Management
- Maritime English

# 12 Course Profile

## 12.1 Core Courses (NAOE)

### 12.1.1 NAOE 1101: Introduction to Naval Architecture and Offshore Engineering

3.00 Credit, 3 hrs. /wk

**Objectives:**

This subject introduces students to basic naval architectural knowledge e.g. naval architectural terms and concepts and ship components. It also enables students to familiarize themselves with various offshore engineering sectors including basic knowledge on types of offshore structures and their functions. Guest lectures by experts from ship and offshore industry will give the students an overview of naval architecture and offshore engineering.

**Learning outcomes:**

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

- appreciate the shipbuilding industry in Bangladesh
- acquire the naval architectural principles and concepts
- describe in detail a number of different offshore facility concepts, including the advantages and disadvantages of each
- understand the various types of fixed and floating offshore platforms, including key design, fabrication and installation issues, as well as areas of applicability
- describe in detail a number of ships from recreational to naval, small to big, operating on or under the sea
- acquire the basic knowledge of mooring systems and subsea technology
- appreciate the potential of offshore industry in Bangladesh

**Contents:**

Overview of naval architecture; Basic naval architectural terms and concepts; Types of ships; Form coefficients; Major ship structural items: Bottom structure, Shell plating Framing systems, Bulkheads, Decks, Superstructures; Shipbuilding industry in Bangladesh.

Overview of offshore engineering; Types and functions of offshore structures: fixed and floating; Types of offshore vessel; Fabrication, transportation and installation of offshore platforms; Mooring systems; Subsea technology: risers, under water pipelines and equipment; Offshore renewable energy; Prospect of offshore industry in Bangladesh.

### 12.1.2 NAOE 1203: Hydrostatics and Stability

3.00 Credit, 3 hrs. /wk

**Objectives:**

This course will enable students to undertake hydrostatics, trim and stability calculations.

**Learning outcomes:**

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

- calculate the hydrostatic properties based on areas, volumes and centroids
- understand metacentric theory and ship stability

- understand concepts of initial and static stability
- present stability information
- evaluate ship stability

**Contents:**
Basic hydrostatic quantities; Numerical integration: Simpsons First, Second and Third Rules; Calculation of area first and second moments or area; Calculation of volume and centroids; Calculation of waterplane area, LCF, transverse and longitudinal second moment; Calculation of displaced volume, KB and LCB.

Metacentric theory and stability; Calculation of metacentric height and righting lever; Inclining experiment; Longitudinal stability and trim; Draught analysis; the layer correction.

Introduction to static stability, the Wall Sided formula, Atwood's Formula; Tanks and free surface effect; Cross curves of stability, curves of static stability; Stability evaluation: IMO criteria; Damage stability; Floodable length calculations; Added mass and lost buoyancy methods; The stability booklet.

### 12.1.3 NAOE 2101: Fluid Mechanics

3.00 Credit, 3 hrs./wk.

**Objectives:**

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

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

- appreciate and understand the influence of fluid mechanics in design
- correlate relevant daily events/machines to mechanics of fluids
- describe the principles of model testing
- analyze and solve related problems

**Contents:**
Fluid properties; Fluid statics and kinematics; Continuity; Energy and momentum principles; Energy and hydraulic grade-lines; Laminar and turbulent flows; 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.

### 12.1.4 NAOE 2102: Fluid Mechanics Lab

1.50 Credit, 3 hrs./wk.

**Objectives:**
The objective of the course is to increase the knowledge of the students related to fluid flow phenomena in pipes, hydraulic machineries etc. through various lab experiments.

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

- understand the fluid phenomena
- apply the knowledge of fluid flow phenomena in pipes, hydraulic machineries etc.

**Contents:**

Fluid Mechanics lab is based on NAOE 2101 course and may consists of the following experiments.

a. Determination of location of center of pressure for submerged plane surface.
b. Study of stability of a floating body.
c. Verification of Bernoulli's Equation.
d. Calibration of Triangular notch (V notch).
   (ii) Calibration of a Rectangular notch.
e. Determination of Head Loss due to Pipe friction.
f. Performance test of Centrifugal Pumps Connected in Series and Parallel Conditions.
g. Study of flow through a circular pipe.
h. (i) Determination of state of flow and critical depth in open channel flow.
   (ii) Study of Hydraulic jump.
i. Study of flow through an Orifice meter
j. Study of flow through a Venturi meter

### 12.1.5 NAOE 2103: Ship Design

3.00 Credit, 3 hrs. /wk.

**Objectives:**

The objective of this course is to familiarize the students with complete ship design process. It also covers the fundamental technical knowledge and calculations that are necessary for the design process.

**Learning outcomes:**

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

- relate engineering design concepts with ship design process
- perform preliminary design calculations to satisfy owner's requirements and related legislations
- apply the relevant knowledge and design tools accurately

**Contents:**

Engineering design philosophy; Various design stages: concept design, basic designs, preliminary designs, contract designs, detailed designs; Design spiral; Cargo routes; Economic criteria and evaluation; Estimation of dimensions; hull form and displacement; Preliminary G. A. plan; Calculation of freeboard.

Depth and volume; Capacity plan; Scantling of structural members; Mid-ship section; Classification Societies and use of Rule Books; Estimation of lightweight and cargo deadweight; Stability and cross curves; Inclining test; Machinery and outfit; Resistance and power calculations; Case studies of typical merchant ships.

### 12.1.6 NAOE 2104: Ship Design Lab-I

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course will help the student to understand how to draw GA plan, lines plan and capacity plan of ships, and also how to carryout structural and stability calculations through hands on exercises.

**Learning outcomes:**

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

- apply the relevant knowledge to design ship GA and lines plan

- determine ship structural members dimensions through scantling calculations
- calculate and develop midship section of ship

**Contents:**
Preliminary G. A. plan, Lines Plan; Scantling of structural members; Mid-ship section drawings.

### 12.1.7 NAOE 2105: Numerical Methods in Engineering

3.00 Credit, 3 hrs. /wk.

**Objectives:**

This course introduces students to the formulation, methodology, and techniques for numerical solution of engineering problems.

**Learning outcomes:**

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

- analyze and solve numerical problems related to engineering
- apply numerical analysis methods in Naval Architecture and Offshore Engineering Problems

**Contents:**

Numerical Solution of Algebraic and Transcendental Equation; Matrices; Solution of Systems of Linear Equations; Curve Fitting by Least Squares; Finite Differences; Divided Differences; Interpolation; Numerical Differentiation and Integration; Numerical Solution of Differential Equations; Applications to Naval Architecture and Offshore Engineering Problems.

### 12.1.8 NAOE 2110: Workshop Practices

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course will help the students to develop their knowledge and skills related to various manufacturing process through hands on exercises.

**Learning outcomes:**

On successful completion of this unit, students should be able to acquire the basic knowledge and skills of manufacturing processes

**Contents:**

The module is practice oriented with classroom lectures complemented by practical sessions involving the creation of specially designed work pieces.

Metal removing process: drilling, turning, milling, grinding, shaping.

Casting: casting design & defects, moulding and assembly.

Welding and cutting process used in shipbuilding; Welding practice and testing welds.

### 12.1.9 NAOE 2204: Ship Design Lab-II

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course will help the student to understand how to carryout resistance and power calculations and design propulsion and maneuvering system through hands on exercises.

**Learning outcomes:**

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

- produce various structural drawings
- estimate ship's lightweight and deadweight
- perform stability calculations to satisfy standard stability criteria

**Contents:**

Capacity plan; Estimation of lightweight and cargo deadweight; Stability calculation; Checking compliance with standard stability criteria; Trim calculations; Damage stability calculations; Longitudinal construction and shell expansion drawings.

### 12.1.10 NAOE 2207: Mechanics of Structure

3.00 Credit, 3 hrs. /wk.

**Objectives:**

Objective of this course is to familiarize the students with the fundamental concepts of structural mechanics with applications to marine, civil, and mechanical structures.

**Learning outcomes:**

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

- understand the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior
- apply the systematic methods for solving engineering problems in solid mechanics
- 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
- build the necessary theoretical background for further structural analysis and design courses

**Contents:**

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; Introduction to stiffness and strain analysis; Stress and strain in thin walled shells.

### 12.1.11 NAOE 2208: Mechanics of Structure Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

Objective of this course is to develop an understanding of the fundamental concepts of mechanics of deformable solids through laboratory tests.

**Learning outcomes:**

On successful completion of this unit, students should be able to understand and apply the fundamental concepts of mechanics of deformable solids.

**Contents:**

Mechanics of Structure lab is based on NAOE 2207 course and may consists of the following experiments.

a. Study and calibration of a universal Testing machine
b. Tensile test of mild steel specimen
c. Hardness test of metal specimen
d. Impact test of metal specimen
e. Support reactions for a point-loaded, simply supported beam
f. Column test of mild steel specimen
g. Compression test of concrete specimen

### 12.1.12 NAOE 2209: Theory of Machines

3.00 Credit, 3 hrs/wk.

**Objectives:**

The objectives of the course are to introduce the approaches and mathematical models used in kinematic and dynamic analysis of machinery and also to introduce vibration of marine systems.

**Learning outcomes:**

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

- understand the basic statics and dynamics of machines
- analyze and solve problems of applied mechanics for marine vehicles as required by a marine technologist

**Contents:**

Statics: Use of free body diagrams; Equilibrium; Friction.

Dynamics: Newton's second law for linear and rotating marine systems; Compatibility equations; Moment of inertia and radius of gyration; Parallel axes and perpendicular axes theorems; Introduction to vibration of marine systems.

Mechanics of machines: Introduction to the kinematics and dynamics of marine gear drives; Elementary kinematic analysis of linkages by means of velocity diagrams and acceleration diagrams.

### 12.1.13 NAOE 2211: Resistance and Propulsion

3.00 Credit. 3 hrs/wk.

**Objectives:**

This course introduces students to fundamentals of ship resistance and its components, theories related to marine propulsions and propeller design methods.

**Learning outcomes:**

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

- understand physical phenomena and relevant theory of resistance and propulsion
- estimate the hull resistance
- perform basic propeller design
- predict the power requirements in the preliminary design stage

**Contents:**

Phenomena resisting the motion of ships; Resistance due to friction; Wave making; Form; Appendage; Wind and waves; Squat; Blockage and willow water effects; Estimation of powering using methodical series and statistical methods; Advantageous effects of hull form changes - bulbous bows; Asymmetric sterns and optimum trim for ships in ballast;

Screw propeller geometry; Momentum and blade element theories; Propellers in open water; Propeller coefficients and design charts; Hull propeller interaction – wake, thrust deduction and relative rotative efficiency; Propeller cavitation; Propeller blade strength; Screw design according to circulation theory for uniform and non-uniform wake; Speed trials and service performance analysis.

### 12.1.14 NAOE 2214: Numerical Methods in Engineering Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This lab course will help the students to learn how to solve numerical problems using software tools

**Learning outcomes:**

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

- solve numerical problems related to engineering using software tools
- apply numerical analysis methods in Naval Architecture and Offshore Engineering Problems

**Contents:**

Exercise problems are based on NAOE 2105 course and need to be solved using software tools. Course teacher will select the exercise problems at the beginning of the course.

### 12.1.15 NAOE 3101: Ship and Offshore Structures

3.00 Credit, 3 hrs/wk.

**Objectives:**

The course deals with the load-carrying functionality, load-effect analysis and design of ships and offshore structures.

**Learning Outcomes:**

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

- identify and select ship structural components and materials in structural design and analysis
- understand the global response of ship as a beam in still water and poised on a wave
- aware of structural and related principles and concepts
- undertake ship structural design and analysis

**Contents:**

Introduction to Ship and Offshore Structures; Longitudinal Strength - Buoyancy & Weight, Murray's Method and Direct Integration, Wave Bending Moments, Inclined Bending and Section Modulus; Beam Theory; Solving Beam Equations; Indeterminate Beams; Hull Girder Shear Stresses - Shear Stresses in Multi-Cell Sections and Shear Flow in Adjacent Closed Cells; Torsion in Ships and Offshore Structures; Shear Center and Shear Lag in Ship and Offshore Structures; Hooke's Law, Mohr's Circle and von-Mises Stress; Plate Bending; Introduction to Elastic Buckling; Buckling of Longitudinal and Transverse Plate Panels.

### 12.1.16 NAOE 3103: Marine Engines and Fuels

3.00 Credit. 3 hrs/wk.

**Objectives:**

This course will enable the students to understand the function of various components of marine engines and. Students will also learn about various fuel types for marine engine as well as renewable energy sources.

**Learning outcomes:**

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

- identify various marine engine components and state their functions
- select fuel solution for marine engines
- explore renewable energy sources for marine application

**Contents:**

Marine engines; Features; Systems; Components.

Marine fuel: types, grading, testing, treatment methods, blending, catalytic cracking etc. HSD, IFO and heavy fuel engines.

Combustion chamber: open and divided, combustion chamber in marine diesel engines; Turbo-charging: thermodynamics, principle, types and design limitations. Vessel type and engine choice.

Performance of Marine Engines.

Sources of energy including renewable energy; Gas turbines; Nuclear power plants.

### 12.1.17 NAOE 3105: Materials in Marine Environment

3.00 Credit, 3 hrs. /wk.

**Objectives:**

This course teaches students to understand the role of materials in the offshore environment and the particular challenges that this environment poses to the selection of materials.

**Learning outcomes:**

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

- develop an appreciation of the materials and material properties that are important in the marine and offshore environment
- establish a relationship between materials selection, design and failure of engineering structures.
- understand the role of microstructure and processing on material properties
- appreciate the role of the material engineer in the workplace

**Contents:**

Materials in marine engineering: Overview of metals; Polymers and composites used in the marine environment.

Fundamentals of materials: Bonding in solids including atomic structure and interatomic bonding; Crystalline structures and defects.

Mechanical properties: Concepts of stress, strain and ductility; Shapes of stress-strain curves for different materials; Tensile properties; Hardness and toughness; Appropriate testing methods.

Fatigue and fracture: Fatigue failure and fatigue testing; Discussion of major failure modes of fracture (ductile and brittle); Fatigue illustrated with case studies; Mechanisms for controlling or preventing failure in marine structures.

Microstructure and microstructural control in metal: Introduction to phase diagrams, including alloys, solid solutions and phases; Use of phase diagrams for the Fe-C system to investigate structure/property relationships; Strengthening processes in metals.

Polymers and polymer composites: Main uses and classes of polymer and polymer composites including basic structures and bonding; Polymerization; Cross linking; Thermoplastics and thermosets; Applications of composites in the marine environment.

Manufacturing processes: Introduction to manufacturing with metals and composites; Effects of processing on properties.

Corrosion and corrosion control: Principles of corrosion in marine and atmospheric environments; Mechanisms for controlling corrosion including painting systems and cathodic protection.

### 12.1.18 NAOE 3107: Ship and Offshore Production Technology

3.00 Credit, 3 hrs. /wk.

**Objectives:**

The objective of this course is to prepare the students with the basic knowledge and exposure on construction, repair and conversion process of ship & offshore structures.

**Learning Outcomes:**

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

- draw the production/construction flow Chart for ship and offshore structure and explain individual process involved
- determine the factors for selecting location and layout of shipyard
- list down facilities of a modern Ship and offshore construction yard
- work in group effectively during class discussion and in solving some of the class assignment given
- state down clearly the important aspects of ship and offshore construction, repair and conversion process

**Contents:**

Ship and offshore structures construction process; Construction process flow chart; Surface preparation and cutting process; Welding Process; Checking and inspection of welding quality; Nondestructive testing (NDT); Sub and block assembly process; Pre-outfitting, Erection and launching, transporting and upsetting.

Selection of suitable location for ship and offshore construction; Yard layout and production flow; Workshops and its facilities; Calculation of yard area and machinery utilization.

Introduction to production systems and its importance; Production planning and control systems; Critical path analysis and project scheduling; Introduction to quality control systems; Computer integrated manufacturing in shipyards; Survey, repair & conversion process of ship and offshore structure.

### 12.1.19 NAOE 3109: Marine Hydrodynamics

3.00 Credit, 3 hrs. /wk.

**Objectives:**

The objective of this course is to give students an understanding of the characteristics of the flow of ideal and real fluid and introduce various equations of motion and theorems related to fluid and flow.

**Learning outcomes:**

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

- appreciate and understand influence of marine hydrodynamics in marine technology
- correlate relevant daily problem to marine hydrodynamics
- be creative and innovative engineers
- appreciate the importance of the theory of marine hydrodynamics and model testing
- analyze and solve hydrodynamics related problem

**Contents:**

Flow of an ideal fluid - Equation of continuity; Streamlines, streak lines and path lines; Two-dimensional flow patterns; Rotational and irrotational flows; Vorticity; Velocity potential functions; Stream functions; Euler's equation of motion; Bernoulli's equation; Velocity and pressure distribution; Uniform flow; Irrotational vortex; Circulation; Source, sink and doublet; Flow past a half body; Cylinder and rankine body; Virtual mass and Magnus effect.

Conformal transformation - Analytic functions; Singularities; Cauchy-Riemann equations; Complex potential;

Application of conformal transformation to some flow cases; Joukowski's hypothesis; Lift of an infinite aerofoil; Theorems of Green, Stokes, Cauchy and Blasius and their application to some hydrodynamic problems.

Flow of a real fluid - Navier-Stokes equations; Displacement, momentum and energy thickness of the boundary layer; Characteristics of flow around a ship hull.

Hydrodynamics of slender bodies - Slender body in an unbounded fluid; Slender bodies in waves; Strip theory for ship motions.

### 12.1.20 NAOE 3110: Marine Hydrodynamics Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

The objective of this course is to teach the students how to solve fluid flow related problems related to marine applications.

**Learning Outcomes:**

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

- identify various fluid flows patterns
- determine ship stability
- solve fluid flow related problems

**Contents:**

Marine Hydrodynamics Lab is based on NAOE 3109 course and may consists of the following experiments:

a) Determination of the exact section of the one tube
b) Determination of the flow speed profiles in a tube
c) Measure error determination using the pitot tube
d) Determination of ship stability
e) Cavitation Phenomenon Demonstration
f) Determination of Impact against a flat, curve and semispherical surface
g) Study of forced vortex without discharge orifice
h) Observation of laminar, transition and turbulent flow
i) Ideal flow around a submerged flow
j) To demonstrate the phenomenon associated to the flow in an open channel

### 12.1.21 NAOE 3114: Ship Design Lab-III

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course will help the student to understand how to carryout resistance and power calculations and design propulsion and maneuvering system through hands on exercises.

**Learning outcomes:**

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

- design ship propulsion and maneuvering system
- carryout ship resistance and power calculations

**Contents:**

Resistance and power calculations; Selection of machinery and outfit; Rudder design and drawing; Steering arrangement; Shafting and propeller arrangement; Propeller drawing; Main engine foundation, Launching calculation.

### 12.1.22 NAOE 3210: Computer Programming for Engineers

1.50 Credit, 3 hrs. /wk.

**Objectives:**

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:

- write and execute computer programs to solve engineering problems
- develop computer programs from flowcharts and implement these programs in advance software programming language
- generate, edit, compile, and debug computer programs
- generate graphical solutions or representations of given engineering problems

**Contents:**

Introduction to Computer programming; Flow chart and algorithm; Variables and operators; Functions; Sequential, Selective and Repetitive Structures; Arrays; Subprograms; Applications in Naval Architecture and Offshore Engineering.

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

### 12.1.23 NAOE 3211: Computational Fluid Dynamics

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to enrich the knowledge of fundamental theories of Computational Fluid Dynamics and their application to naval architecture and offshore engineering problems.

**Learning Outcomes:**

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

- demonstrate a knowledge of the fundamental theories of Computational Fluid Dynamics
- apply CFD methods in naval architecture and offshore engineering problems

**Contents:**

Introduction. Governing equations of fluid flow. Green’s theorem, Boundary integral methods and its application to radiation and diffraction problems, Discretization schemes: finite difference methods, finite

volume methods, finite element methods, spectral methods etc. Grid generation. Flow visualization and frictional resistance computation for double body flows using Navier-Stokes equations.

Free surface flow, free surface computation with linear and fully nonlinear conditions. Numerical treatment of fluid-body interface, turbulence modeling. CFD application to free surface flow past ship shape objects using Reynolds Averaged Navier Stokes Equation (RANSE).

### 12.1.24 NAOE 3213: Navigation and Maritime Regulations

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to make the students aware about national and international maritime laws, conventions, legislations and safety rules. It will also increase their knowledge related to navigation.

**Learning Outcomes:**

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

- demonstrate an understanding of the basic aspects of ship navigation and the various navigational aids on board a ship
- stay abreast of the latest developments in national and international maritime laws, conventions, legislations and safety rules.
- apply the rules and regulations of different maritime organizations like DOS, BIWTA, BIWTC and IMO

**Contents:**

Outline of navigation; Navigational aids and aids to navigation; Lifesaving appliances and firefighting equipment.

Shipping laws and safety rules; Inland shipping ordinance (ISO) of Bangladesh; Safety of life at sea (SOLAS); International load line convention (ILLC); Role of IMO; Registration and survey of ships; Marine personnel; Accident enquiries; International marine conventions; Collision regulations; Legislations of marine pollutions; Outline of laws at sea.

### 12.1.25 NAOE 3215: Finite Element Methods

3.00 Credit. 3 hrs/wk.

**Objectives:**

This course will enable the students to understand the basis for finite element analysis of structures. Students will also learn how to carry out basic finite element calculations as well as critically assess the calculation results.

**Learning outcomes:**

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

- able to identify and state clearly the fundamentals of FEM
- perform basic FEM calculation
- formulate stiffness matrix for beam and shell element

**Contents:**
General introduction, historical background and review of matrices; Analysis of simple one dimensional structure (direct method); Analysis of springs; Stiffness concept; Member stiffness matrix; Assembly of global structural stiffness matrix; Characteristics of stiffness matrice.

Potential energy approach: 1-D bar elements virtual work and potential energy; Formulation of equilibrium equations using the energy approach; Derivation of stiffness matrix for linear two-force elements (bars); Coordinate transformations and truss stiffness matrices.

Prismatic beam elements; Bending of prismatic beams; Stiffness matrix for the beam element; Load vector for distributed loads; Coordinate transformation and stiffness matrix for frame elements; Analysis of continuum structures in two dimensions: CST Elements.

Basic concepts: nodes and elements; Shape functions; Derivation of stiffness matrices for plane stress and plane strain elements; Generalized formulation approach; Rayleigh-Ritz method and variational approach (overview); Method of weighted residuals; Galerkin's method; Integration by parts; Application to simple 1-D field problems.

### 12.1.26 NAOE 3217: Maritime Transportation

3.00 Credit, 3 hrs. /wk.

**Objectives:**
The objective of the course is to enrich knowledge of maritime transportation and economics related to the process of selecting vessels, shipping and optimum port operations so that they make the right decisions in a project or operation within the marine transport industry.

**Learning Outcomes:**

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

- understand the marine transport market and the role of the marine technologists in it.
- identify the international factors that result in seaborne trade.
- show how ships are operated to fulfil that demand.
- emphasize the need for efficient operation

**Contents:**
Marine transport market and the role of marine technologists in it; World trade; Freight markets and demand for ships; Major bulk commodities; General cargo and liner trade; Freight rates and operating economics; Choice of ship types; Service performance of ships; Ports.

### 12.1.27 NAOE 4100: Professional Engineering Practices

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course will help the students to prepare themselves as professional engineers and to be aware of the laws and ethics related to engineering discipline.

**Learning outcomes:**

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

- demonstrate an understanding of their duties and responsibilities as professionals through gaining knowledge of the philosophies of ethics, professional practice, and world culture
- apply the engineering code of ethics in the context of engineering practice of Bangladesh
- apply basic project management concepts and tools to a design project
- work effectively as part of a team
- communicate effectively in both written and oral form, including using the appropriate academic conventions of the discipline

**Contents:**

Ethics and professionalism; Moral reasoning and codes of ethics; Code of ethics by Institution of Engineers, Bangladesh (IEB); Engineering professional practice laws.

The role of engineers in society; The engineering method: systems thinking and decision making; Project management; Group work skills, such as effective meetings and dispute resolution; Sustainable engineering; Global and cultural considerations.

Professional Skill Development: Effective cover letters and resumes writing; Preparation and enhancement of portfolio to meet professional standard as well as development of presentation skills; Improvement of job-seeking techniques.

### 12.1.28 NAOE 4101: Marine Engineering Equipment and Systems

3.00 Credit. 3 hrs./wk.

**Objectives:**

The objective of the course is to familiarize the students with the basic concepts and understanding of the overall construction, operating principles, and characteristics of a marine/offshore power plant and its associated systems. Emphasis is made on designing common marine and offshore engineering auxiliary systems, machinery and components.

**Learning Outcomes:**

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

- draw general layout of typical machinery spaces
- explain the basic working principles of various types power plants used in ships and offshore structures and their associated systems
- describe common shipboard auxiliary systems and equipment
- explain the fire prevention, detection and extinguishing systems

**Contents:**

Introduction - Introduction to marine and offshore engineering systems; General layout of typical machinery spaces; Safety arrangements for personnel; Types of power plant and components of various types of power plants used in ships and offshore structures; Operational systems.

Auxiliary Systems and Equipment - Bilge; Ballast; Main sea water; Domestic and sanitary hydrophore; Compressed air; Refrigeration; Heating; Ventilation; Air-conditioning; Steering; Propulsion shafting; Stabilizing; Desalination plant; Gearing; Deck machinery; Safety equipment.

Fire - Dangers of fires on ship and offshore structures; Types of fires; Fire prevention measures; Fire detection system; Portable firefighting equipment; Fixed fighting installations; Inert gas generation and distribution.

### 12.1.29 NAOE 4103: Ship and Offshore Dynamics

3.00 Credit. 3 hrs./wk.

**Objectives:**

This course will enrich the knowledge of students related to seakeeping and estimation of vessel's motions due to ocean waves. Students will also learn vessel's maneuvering and directional stability.

**Learning Outcomes:**

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

- predict the wave and motion induced forces acting on a ship hull and an offshore structure.
- calculate natural heave, pitch and roll frequencies as well as heave motions of a ship and an offshore floating structure in regular and irregular waves.
- assess maneuvering characteristics of ships.
- predict turning ability and course-keeping qualities of a given ship design

**Contents:**

Introduction to sea keeping. Recapitulation of gravity waves. Wave record analysis. Rayleigh distribution. Spectral representation of the seaway. Directional spectra. Motions in regular waves- Response amplitude operators. Motions in irregular sea. Slamming and deck wetness.

Introduction to maneuverability, Motion stability criterion, ITTC maneuvering standards.

### 12.1.30 NAOE 4105: Design of Offshore Structures

3.00 Credit. 3 hrs./wk.

**Objectives:**

The objective of this course is to familiarize the students with fundamental technical knowledge and calculations that are necessary for the design process of various offshore structures.

**Learning Outcomes:**

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

- explain and apply the basic design concepts for fixed and floating offshore oil and gas platforms.
- describe the factors influencing the dynamic behaviour of fixed and floating offshore platforms.
- predict the dynamic motion and structural response of fixed and floating offshore platforms
- use statutory regulations and appreciate their influence on design

**Contents:**

Overview of basic design concepts for fixed and floating offshore oil and gas platforms; Environmental design considerations - wind, current and wave conditions for different return periods. Field development and

concept selection; Design features, considerations and issues of fixed offshore structures - jacket structures, jack-up structures, and compliant tower structures; Design features, considerations and issues of floating offshore structures - FPSO systems, semi-submersibles, TLPs, and Spars.

### 12.1.31 NAOE 4107: Dredger and Dredging Technology

2.00 Credit. 2 hrs./wk.

**Objectives:**

The objective of this course is to increase the knowledge of the fundamental topics of dredging and to developed analytical and problem solving skills related to dredging.

**Learning Outcomes:**

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

- demonstrate a knowledge of the fundamental topics of dredging
- analyze dredging and relevant environmental applications
- identify various dredgers and their components
- apply highly developed analytical and problem solving skills related to dredging

**Contents:**

Introduction to dredging methods; Hydraulic and mechanical dredger types: drilling pontoon, deeper dredger, backhoe method, bucket dredger, grab dredger, cutter suction dredger, trailing suction hoper dredger, dustpan dredger, special purpose dredger etc.; Cutter suction dredger: design features, types of cutter, design of ladder, performance parameters, positioning system.

Dredging calculation: estimating discharge-head, effect of dredge material characteristics, pump performance characteristics, estimation of output of various types of dredging; Special features of dredge pump; Types of floaters; Pipeline fittings; Brief review of dredging operation; dredging need in Bangladesh.

### 12.1.32 NAOE 4109: Research Methodology

1.00 Credit. 1 hr./wk.

**Objectives:**

The objective of this course is to introduce students to the research methods used by the engineers including research planning, data collection process, presenting research findings and report preparation.

**Learning Outcomes:**

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

- identify a research problem
- understand and apply the knowledge of the overall process of designing a research study from its inception to its report

**Contents:**

Introduction to research methodology: meaning, objectives, types of research, methodology vs. methods, research process, qualities of a good research; problems of research in Bangladesh; selecting and defining a research problem; Techniques of defining a problem.

Design of research plan: meaning of research design, need for research design, various research design;

Sampling strategies and methodology design of sampling programs.

Data collection (Primary Method): Collection of data through questionnaires; Collection of data through Schedule; Difference between Questionnaires and Schedules; constructing questionnaire and schedule; Data collection (Secondary Method): Various Methods of Secondary data collection; Case study Method.

Accuracy of results: Types of errors and their control, Replication and standard samples, Degrees of accuracy, calculations and level of significance.

Presentation of research findings: Data processing, data analysis, graphical representation; Manuscript preparation (thesis/dissertation); Writing techniques of research proposal for funding; Monitoring and evaluation of research projects; Research report preparation; Research extension processes (seminar, symposium, workshop, training program, popular and scientific paper publication).

### 12.1.33 NAOE 4200: Safety and Survival Training

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course introduces students to the various important aspects of marine industry safety and personal safety and survival techniques on board ship and offshore structures.

**Learning outcomes:**

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

- use appropriate hand held portable fire extinguisher, small bore fire hose reel and fire blanket
- apply appropriate self-rescue techniques
- take precautions to prevent pollution of the marine environment
- describe the ship security plan and contingency plans
- present maritime security policy and the national and international legislation
- quote responsibilities of the Government, the Company (CSO), the ship (SSO and his team) and Port Facility (PFSO) related to protection

**Contents:**

a. Fire Prevention and Fire Fighting
b. Personal Survival Technique
c. Personal Safety and Social Responsibility
d. Elementary First Aid
e. Security Awareness Training
f. Designated Security Duties

### 12.1.34 NAOE 4217: Offshore Survey, Drilling and Production

3 Credit, 3 hrs. /wk.

**Objectives:**

The course will introduce the students with the offshore energy resources survey technique, offshore oil/gas production covering marine drilling, and types of drilling rig and production systems.

**Learning Outcomes:**

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

- describe the procedure of offshore seismic survey
- address the conflicts during seismic surveys
- explain and understand the drilling systems and equipment
- identify components of an oil well and drilling system.
- identify tools used for straight and directional drilling
- describe the working principles of the offshore topsides systems

**Contents:**

Introduction to seismic survey; Procedure of Seismic survey; Equipment used for offshore seismic survey; survey vessel; Environmental protection and minimizing conflict during seismic surveys.

History of oil well drilling; Drilling systems; Drilling rig; offshore drilling and recent developments; The operation and commissioning of various equipment processes and systems involved in the drilling.

Introduction to offshore oil production - Separators; Gas-treatment; Gas flaring; Enhanced recovery using water and gas injection; Produced water treatment, utility systems, storage and export systems.

The working principles of the offshore topsides systems in the oil and gas upstream process; Fundamental organic chemistry; Basic production process plant; Equipment and utilities to support the processing of oil and gas; Technical consideration of FPSO conversions; Subsea product on systems flow lines and risers; Remote-operated vehicles (ROV).

### 12.1.35 NAOE 4219: Risers and Mooring Systems

3.00 Credit. 3 hrs./wk.

**Objectives:**

This course will provide student with deeper understanding in the mooring and deep-water risers systems in offshore oil and gas production.

**Learning Outcomes:**

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

- explain the static, quasi-static, and dynamic mooring and riser analyses.
- describe and apply theories and concepts for designing subsea pipelines, riser and mooring system of marine vehicles and floating structures.

**Contents:**

Station keeping systems; Permanent and mobile mooring systems; Mooring configurations: single-leg mooring, spread mooring, turrent mooring. Mooring components: wire ropes, synthetic fibre ropes, chains, clump weights, drag and suction anchors, piles; winches and windlass; Single component and multi-component catenary equations; Soil-mooring interaction; mooring failure modes; static, quasi-static, and dynamic mooring analyses; mooring design criteria and considerations

Deep-water risers and umbilical; Flow assurance and system design; Introduction to design of subsea pipelines and risers, Riser components, Riser failure modes; Structural riser analysis; Static and dynamic riser analyses; riser design criteria and considerations.

### 12.1.36 NAOE 4221: Engineering Management

3 Credit, 3 hrs. /wk.

**Objectives:**

The objectives of this course is to offer a broad managerial perspective emphasizing the strategic impact of operations decisions and the interfaces between operations and the other functional areas of organizations, including of supply chain, finance and marketing.

**Learning Outcomes:**

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

- perform the Management Functions;
- compare selected Theories of Management;
- handle crisis and conflicts for optimum utilization of human resourses;
- make decision for capital investments;
- perform the functions in the Marketing Mix;
- develop and lead effective teams and projects;
- appreciate the need for life-long learning and personal development

**Contents:**

Management: Principles of management: evolution of management thought; characteristics of good managers; management levels; Philosophical similarities between engineering and management.

Organization and management: classical quantitative and behavioral schools; interactions between organizations and their environment; management functions; organization structure; development of organization theory; study of various types of organization and management information systems; concepts and scope of application.

Human Resource Management (HRM): Definition, importance, objectives and scope of HRM; HR operative functions (induction, training &development, compensation, integration, maintenance and separation); HR cycle; leadership; group dynamics; job evaluation and merit rating; Incentive systems and performance appraisal; Bangladesh Labour code 2006; ILO guide lines.

Organizational structures: co-ordinations and spans of control, the informal organization, authority delegation and decentralization, groups and committees, managing organizational change and conflict.

Motivation: Definition, mechanism, productivity and satisfaction; Maslow's Need Hierarchy Theory; Other theories of motivation.

Financial management: Time value of money; performance analysis of enterprises; capital investment techniques; investment appraisal and schedule; criteria of investment; measures of merits for project evaluation

Operations management: Types of production; forecasting, inventory management, scheduling, maintenance management, Quality management, Layout planning, Management information system.

Marketing management: core concept of marketing; marketing mixes (4 Ps and 4 Cs), marketing concept philosophies (Production concept, product concept, selling concept, marketing concept and societal marketing concept), industrial selling, channel decisions, advertising decisions, new product strategy.

Supply chain management: role and importance; forward and backward supply chain; product life cycle.

Technology management: human and technology interaction; technology transfer; adaptation of technology for management.

## 12.2 Optional Courses (NAOE)

### 12.2.1 NAOE 4111: Theory of Hydrofoils

3.00 Credit, 3 hrs. /wk.

**Objectives:**

This course will help the student to learn design and analysis process of the hydrofoil sections and their application to high-speed craft, control surface and propeller.

**Learning Outcomes:**

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

- demonstrate an understanding of the theory and design of hydrofoil sections
- explain the application of hydrofoils to high-speed craft, control surface and propeller

**Contents:**

Definition and geometry of hydrofoils; Analytic investigation of flow past a hydrofoil; Theory of thin hydrofoils; Theory of hydrofoils having arbitrary shapes; 2-D and 3-D hydrofoils; Design and analysis of hydrofoil sections; Cavitating hydrofoils; Application of hydrofoils to high-speed craft, control surface and propeller.

### 12.2.2 NAOE 4113: Vibrations of Marine Structures

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to familiarize the students with basic theories related to vibration in marine structure, consequences and ways of reducing vibration in case of marine structures.

**Learning Outcomes:**

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

- demonstrate an understanding of basic theories related to vibration in marine structure
- understand and explain the consequences of vibration in different types of vessels
- describe various ways of reducing vibration in case of marine structures

**Contents:**

Vibration induced in marine structures due to wave, propeller and machinery; Free and forced vibration of single, two and multi-degree of freedom systems; Transverse vibration of beams; Added mass of hull girder vibration; Empirical formulae for calculating hull frequencies; Torsional, flexural and longitudinal vibrations of propeller shafting system.

Measurement of ship and offshore structures vibration; Allowable limits of vibration in a marine structure; Consequences of vibration in different types of vessels; Reduction of vibration by propeller and machinery selection, suppression, isolation and insulation

### 12.2.3 NAOE 4115: Offshore Renewable Energy

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to familiarize the students with offshore renewable energy sectors and their prospects in Bangladesh.

**Learning Outcomes:**

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

- Demonstrate understand the various technologies that have been developed and proposed for harnessing offshore wind energy, wave energy and tidal stream energy
- identify and apply the science, technology and engineering that is directly transferable from the offshore oil and gas industry to the offshore renewable energy sector
- benefit from an awareness of present research and technical developments in this field

**Contents:**

Wind turbines: Design; Mounting/Mooring arrangements; Installation; Failure mechanisms; Design of wind environment; Aerodynamic characteristics of horizontal and vertical axis wind turbines; Boundary element method; Momentum method; Boundary element momentum method.

Wave energy: Energy within water wave; Description and operation of various systems proposed and in use for inshore and offshore application; Design of wave environment; Maximum power absorption from ocean waves; Hydrodynamic characteristics of wave energy converters; Response of floating structures; Fluid-structure interactions; Time and frequency domain numerical methods both in two and three dimensions.

Tidal energy: Current stream devices; Barrage systems; Hydrodynamics characteristics of tidal devices; Wave and current effects; Fluid-structure interactions; Time and frequency domain numerical methods both in two and three dimensions.

Energy storage, transmission and distribution: Issues and solutions. Prospects of offshore renewable energy sectors in Bangladesh.

### 12.2.4 NAOE 4223: Recycling of Marine Structures

3.00 Credit. 3 hrs/wk.

**Objectives:**

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

**Learning Outcomes:**

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

- stay abreast of the international and national regulations regarding ship and offshore structure recycling
- understand the science, technology and engineering that is involved in marine structure recycling
- acknowledge the importance of implementing green ship recycling in Bangladesh

**Contents:**
International and national regulations and their enforcement, industry guidelines and voluntary codes of practice; The IMO's work on ship recycling; Shore based ship recycling; The standard contract for recycling of ships; Ship recycling in Bangladesh; Knowledge data base to support establishment of ship recycling; Safety and health in shipbreaking; Safer ship dismantling facilities; The use of shiplift systems in recycling yards; Recycling high speed ferries and ideas for the future; Recycling of ships made of glass reinforced polyester; Environmental friendly recycling of FRP-sandwich ship hulls.

The Green Passport: Its implementation and important safety issues; Putting procedures into practice.

### 12.2.5 NAOE 4225: Ship Performance

3.00 Credit. 3 hrs/wk.

**Objectives:**

This course introduces various ways and methods of improving ship performances including the design and performance of propellers.

**Learning Outcomes:**

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

- understand the manner in which the propulsion plant transmits its power to overcome different components of a ship's resistances
- calculate and analyze all the components of resistances
- comprehend the effects of hull and propeller roughness on propulsive performance
- understand factors affecting the sea keeping and maneuverability of ships in a seaway
- demonstrate the speed losses at different sea states

**Contents:**
Hull roughness: measurement, bottom condition and speed loss, propeller roughness; propeller and hull interaction; various factors for speed loss. Methods of predicting resistance increase due to hull and propeller roughness.

Momentum analysis of flow round hull: leading to wave pattern, viscous and induced resistance components; Wave resistance from wave pattern measurements, methods of wave analysis; Measurement of resistance due to surface shear stress and measurement of pressure drag.

Maximizing the propulsive efficiency of ships, advances in ship performance, control of the fluid flow around the hull creating resistance, interaction of the hull wake with the propulsor and optimization of the propulsor based on the operational profile of the ship.

On-going advances of the International Towing Tank Conference Wake: methods of measurement, detailed wake surveys, mean wake and radial distribution; wake scale effects. Tangential wake components; influence on blade velocity diagram. Influence of tangential wake variations on propeller loading.

Propeller design: Review of theoretical approaches to propeller design including lifting surface approaches, panel methods and blade-element-momentum theories; blade-element-momentum theory; Goldstein correction factors, flow curvature effects and corrections to section design, optimum radial loading; propeller

performance at design and the use of computational fluid dynamic based approaches.

Wake adapted propellers; Water jet efficiency; Design examples using Cavitation Erosion.

Added resistance due to ship motion; wave reflection, wind, yawing and drift; rudder resistance; speed loss of a ship in a seaway.

### 12.2.6 NAOE 4227: Design of Special Ships

3.00 Credit. 3 hrs/wk.

**Objectives:**

This course will teach the students design features and calculations procedure with respect to hull, propulsion and auxiliary machinery of special types of ships.

**Learning Outcomes:**

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

- compare between conventional vessels and special vessels as a ship designer or a shipbuilder
- perform hydrostatic, resistance and power calculations addressing all peculiarities for the special requirements of the vessel
- comprehend the different loading conditions and stress concentrations due to gun firing, missile launching, air craft landing and taking off
- understand and describe submarine design features and calculations procedure with full range of operational depth
- understand and explain the effects of using multi hull instead of mono hull

**Contents:**

Identification and common features of special ships.

Design features and calculations with respect to hull, propulsion and auxiliary machinery of special utility ships such as trawlers, tugs, container ships, ro-ro ships, tankers, and ice breakers.

Design features and calculations with respect to hull, propulsion and auxiliary machinery of war ships such as Patrol craft, Corvette, Frigate, and Destroyer.

Design features and calculations with respect to hull, propulsion and auxiliary machinery of war ships such as Patrol craft, Corvette, Frigate, Destroyer; Landing craft tank, and Landing craft utility.

Design features and calculations with respect to hull, propulsion and auxiliary machinery of Submarines (Diesel-Electric, Air Independent Propulsion and Nuclear propulsion) taking surface, sub-surface and deep dive conditions.

Strategic role of air craft carrier; Design features and calculations with respect hull, propulsion and auxiliary machinery of air craft carrier.

Design strategy and procedures of High speed crafts and multi-hull vessels.

### 12.2.7 NAOE 4229: Port and Harbor Engineering

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to teach the students various aspect of planning, design and construction of marine terminals, port and harbors.

**Learning Outcomes:**

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

- explain the functions of ports and waterways in the total transport chain, and discuss port planning methodologies
- apply the knowledge of hydraulic interaction between ship and waterways and ship navigation to design approach channels and inland waterways
- develop port and terminal layout (quay length, number of cranes, apron area, storage yard)
- demonstrate an understanding of dredging and related environmental issues in ports and harbours

**Contents:**

Introduction to port and harbor structures; Harbor classifications; Port facilities - berthing and mooring structures and rendering system; Operational and environmental loads; Wave oscillations in harbor and its control; Maneuvering of ships within harbor; Cargo handling in ports; Offshore mooring - design of breakwaters, jetties, wharfs, quays, diaphragm walls, slipways and docks; Sediment transport and maintenance dredging in harbors. Control and marine pollution in ports.

### 12.2.8 NAOE 4231: Marine Pollution and Prevention

3.00 Credit, 3 hrs. /wk.

**Objectives:**

The objective of this course is to provide updated information and the knowledge of various aspects of marine pollution and the ways and methods of its prevention.

**Learning Outcomes:**

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

- identify the basic sources of marine pollution caused by human activities
- demonstrate fluency to read, analyse and synthesise marine pollution literature
- know the basic techniques and practices for the monitoring of pollution in the coastal marine environment
- apply methodologies and techniques to assess/evaluate marine and coastal pollution

**Contents:**

General concepts of marine pollution; Types of marine pollution - oil pollution, heavy metal pollution, synthetic organic chemical pollution and eutrophication; Biological consequences of marine pollutants – substances harmful to living organisms.

Sources of marine pollution - natural, transportation, accidents and routine discharge; Monitoring of pollution

and environmental impact assessment; Life cycle assessment of marine transport; Past, current and proposed approaches for the improvement of marine pollution problems related to marine transports.

Pollution Control - Oil; Air; Garbage; Sewage; Ballast water; Oily water separator; Sewage plant; Incinerator.

### 12.2.9 NAOE 4233: Control Engineering

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to introduce mechanical, hydraulic, pneumatic, thermal and electro-mechanical control systems and theories behind them.

**Learning Outcomes:**

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

- apply knowledge of mathematics, science and engineering
- use the analysis and design tools of control engineering

**Contents:**

Introduction to theory of control system, mechanical, hydraulic, pneumatic, thermal and electro-mechanical control systems. Representation of control systems- block diagrams. Study of frequency, step function and system responses. Transfer functions and characteristics functions. Routh's criterion for stability. System analysis – Nyquist and Bode diagrams. Root locus plots.

System compensation, analogues of control system, application of servomechanisms in marine – mechanical system, hydraulics, servo control, pneumatic and electro mechanical controls

### 12.2.10 NAOE 4235: Composite Materials

3.00 Credit. 3 hrs/wk.

**Objectives:**

This course introduces various types of composite materials and their characteristic features. Student will also learn the theoretical basis of the experimental techniques utilized for failure mode of composites.

**Learning Outcomes:**

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

- identify and explain the types of composite materials and their characteristic features
- describe current and emerging applications of composites in the maritime sectors and industries
- understand the strengthening mechanism of composite and its corresponding effect on performance and application
- calculate the elastic and strength properties of unidirectional laminates using micromechanics theory
- select the most appropriate manufacturing process for fabricating composite components
- demonstrate an understanding of fibres, resins and cores used in composites
- describe the fracture, fatigue and impact performance of composites
- describe the non-destructive inspection (NDE) and structural health monitoring of composites
- describe the durability performance of composites in the marine environment
- appreciate the theoretical basis of the experimental techniques utilized for failure mode of composites
- develop expertise on the applicable engineering design of composite

**Contents:**
Introduction to composites: Background, characteristics and uses; Micro-mechanics and macro-mechanics of composite materials; Fibrous composites; Reinforcement types; Ply stiffness; Ply strength; Layered laminate; Laminate stiffness; Laminate strength; Residual stress; Thin-walled composite sections; Inter-laminar stresses; Hole in laminates; Buckling of laminates; Stiffness of unidirectional composites. Transformation of stress and strain; Off-axis stiffness of unidirectional composites; In-plane stiffness of symmetric laminates; Flexural stiffness of symmetric sandwich laminates; Behaviour of general laminates; Strength of composite materials and their modes of failure; Failure criteria.

### 12.2.11 NAOE 4237: Machine Design

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to teach the students the fundamental principles of Machine Design. Students will also learn how to design an appropriate machine element using allowable load, required element life, manufacturing considerations.

**Learning Outcomes:**

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

- define failure and decide on appropriate failure model;
- design an appropriate machine element using allowable load, required element life, manufacturing considerations;
- apply theories of failure and material science in the design of machine elements and components;
- make proper assumptions, perform correct analysis while drawing upon various machine elements;
- demonstrate the abilities by performing correctly: the selection, design, analysis and sizing of shafts, springs, bearings, gear types and gear systems;
- use existing as well as develop new computer based techniques and algorithms for the analysis, selection, and synthesis of machine components and systems

**Contents:**
Fundamental Principles of Machine Design: Working Stresses and Failure Theories; Stresses in curved members; Deflection and stiffness considerations; Column design; Statistical considerations; Types of fits.
Design parameters: analysis with isotropic and anisotropic materials.

Design for static strength; Fracture mechanics in design; Design for fatigue strength.

Design of screws, fasteners and connections; Keys and couplings, welded and brazed joints; Shafts, keys and couplings, Power screws and bolted connections, Belt and chain drives, Brakes and clutches, Welded and Riveted Connections, rope, belt and chain drives.

Springs, Shock and vibration: Properties and design for damping and arresting of vibration.

Bearings: Design of Journal, Ball, Needle and Roller bearings. Gears and Gearing systems: spur, helical, worm and bevel gears. Lubrication of machine elements: Boundary, Hydrostatic and Hydrodynamic lubrication systems.

### 12.2.12 NAOE 4239: Optimization Methods in Ship Design

3.00 Credit. 3 hrs/wk.

**Objectives:**

The objective of this course is to familiarize the students with various optimization tools and their uses for solving ship design problems.

**Learning Outcomes:**

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

- demonstrate an understanding of various methods for optimization
- formulate and solve ship design problems using optimization methods

**Contents:**

Concept of optimization. Linear programming: simplex algorithm, dual simplex algorithm. Integer programming: Branch and Bound method, cutting plane method, force integerization. Powell's method. Constrained optimization: Lagrangean functions, penalty functions, sequential unconstrained minimization technique (SUMT). Optimality criteria method. Sequential linear programming (SLP). Introduction to genetic algorithm and neural network. Formulation and solution of ship design problems.

## 12.3 Allied Engineering Courses

### 12.3.1 EEE 1201: Electrical Engineering Principles

3.00 Credit, 3 hrs/wk.

**Objectives:**

This course emphasizes the understanding of the basic electrical circuit's laws and network theorems and their application to electrical network analysis. It will provide the foundation in electricity to prepare the students for subjects that are more specialized.

**Learning Outcomes:**

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

- understand how to solve DC and AC circuits with inductors and capacitors
- understand the basic principles and use of transformers, generators and motors
- analyze circuits containing loads in series and parallel and series-parallel combinations.
- distinguish between voltage, current, resistance, energy and power.

**Contents:**

Direct Current: Theorems of electric circuit, electrical network analysis, measuring instruments. Alternating current: AC quantities and waveforms, phasor algebra, AC circuit analysis, three phase circuits. Transformers: Single phase and three phase, auto transformer. Fundamentals of DC generators, DC motors: principle and operation, Switchgear & protection.

### 12.3.2 EEE 2101: Electrical and Electronic Technology for Marine Application

3.00 Credit, 3 hrs/wk.

**Objectives:**

This course will help the students to understand the basic principles and uses of electrical and electronic devices required for marine application. Ship born power distribution system will also be introduced here.

**Learning Outcomes:**

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

- understand the basic principles and uses of electrical and electronic devices required for marine application
- demonstrate an understanding of ship born power distribution system

**Contents:**

Three phase induction motors. AC generators, synchronous motor, speed control of three phase motors, Ship born power distribution system. Diodes, BJTs, diode and BJT circuits, MOSFET and SCR as power switching devices, controlled rectifiers and inverters. Radar and wireless equipment, electronic navigation aids, Concept of PLC.

### 12.3.3 EEE 2102: Electrical and Electronic Technology for Marine Application Lab

1.50 Credit, 3 hrs/wk.

**Objectives:**

Objective of this course is to familiarize the students with electrical and electronic equipment and tools related to marine applications and their uses.

**Learning Outcomes:**

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

- utilize testing devices for analysis of circuits
- use electrical and electronic equipment and tools to fabricate simple circuits, test and determine circuit parameters and gather and analyze data
- Recognize and practice safe methods of work

**Contents:**

EEE 2102 lab is based on EEE 1201 & EEE 2101 and may consists of the following experiments:

a) Study Of Diode Characteristics
b) Study Of Diode Rectifier Circuits
c) Study Of N-P-N Cb (Common Base) Transistor Characteristics
d) Study Of N-P-N Ce (Common Emitter) Transistor Characteristics
e) Study The Properties Of Dc Shunt Motor
f) Study The Properties Of Three-Phase Alternator In Various Loads
g) Regulation Of The Transformer In Various Loads
h) Familiarization With Radar (Radio Detection And Ranging) Module, Especially Microwave Component Of Radar And Analysis Of Radar Echo (Video) Output

### 12.3.4 ME 1100: Mechanical Drawing and CAD Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course introduces students to the use of technical drawing in an effective way for communicating and integrating with engineering concepts.

**Learning Outcomes:**

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

- use the computer and drafting board to produce complete drawing based on well-defined technical graphics standard
- apply basic geometric construction techniques to create engineering drawing using drawing instruments and CAD
- apply the standard and convention to create engineering drawing that can be read and accurately interpreted by the engineers
- produce engineering drawing efficiently and effectively.

**Contents:**

Introduction, Instruments and their uses, First and third angle projections, Orthographic drawings, Isometric views, Missing lines and views, Sectional views and conventional practices, Auxiliary views.

Introduction to CAD; Drawing unit and scale; 2-D drawing tools; Modification tools, layers, hatching and dimensioning; Drawing sheet layout and viewpoints.

### 12.3.5 ME 1201: Thermal Engineering

3.00 Credit, 3 hrs. /wk

**Objectives:**

These subjects will introduce students to the basic concepts and various cycles used in thermodynamic studies. It will enable the students to familiarize themselves with the components of marine diesel engines and boilers, and also power management and fuel system of engines.

**Learning outcomes:**

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

- understand the principal of thermodynamics
- demonstrate the various cycles of thermodynamics
- familiarize with the components of marine diesel engines and boilers

**Contents:**

Thermodynamics: The laws of thermodynamics; Definitions of basic parameters, properties, units, dimensions and energy groups; Thermodynamics systems and control volumes: closed and open systems; Working fluid: state, process and cycles, including equation of state and specific heat capacities for perfect gases; The heat engine cycles using a perfect gas: The Carnot cycle, the air standard cycles, thermodynamic cycle's calculations; Heat engine cycles using condensable fluids: charts and tables for condensable fluid state properties, steam cycles.

Marine diesel engines: Types of propulsion engines; Four stroke and two stroke cycles; Power measurement (indicated power, brake power, fuel power, efficiencies); Combustion equations; Stoichiometric air/fuel ratio calculation; Gas exchange process and pressure charging; Components of two and four stroke engines; Marine engine supporting systems: fuel system, lubricating oil system (including cylinder oil lubrication), cooling systems and air starting system.

Boilers - Steam requirements; Boilers types; Other boiler arrangements; Boiler mountings; Purity of boiler feed water; Boiler water treatment.

### 12.3.6 ME 1202: Thermal Engineering Lab

1.50 Credit, 3 hrs. /wk

**Objectives:**

The objective of the course is to familiarize the students with applications of thermodynamics and functions of various components of diesel engines and boilers.

**Learning outcomes:**

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

- apply the principal of thermodynamics
- demonstrate the various cycles of thermodynamics
- identify the components of marine diesel engines and boilers and understand their functions

**Contents:**

Thermal engineering lab is based on ME 1201 course. Minimum 7 (Seven) experiments must be carried out from the following lists.

a. Determination of flash point of liquid fuel.
b. Study of sling psychrometer.
c. Viscosity test of liquid substance.
d. Determination of carbon residue of a given fuel.
e. Proximate analysis of coal.
f. Study of different speed measuring devices.
g. Study of a refrigeration and air conditioning unit.
h. Study and calibration of pressure gauge by dead weight tester.
i. Determination of calorific value of gaseous fuel by gas calorimeter.
j. Determination of the calorific value of fuel.
k. Concept of pressure and pressure sensor behavior.
l. Dismantling and assembling of a diesel engine.
m. Study and performance test of a steam turbine.
n. Study of a boiler.

### 12.3.7 ME 2201: Heat Transfer

3.00 Credit, 3 hrs. /wk.

**Objectives:**

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:

- understand and describe the fundamental concepts of various heat transfer methods
- build the necessary theoretical background to understand the heat transfer cases in ship design

**Contents:**

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.

Convection: forced and natural, basic mechanism, methods of evaluation, non-dimensional parameters, empirical and semi-empirical methods.

Radiation: fundamental laws, black and gray bodies, form factors, evaluation of form factors.

Heat exchangers: parallel flow and counter flow. LMTD relationship; Heat transfer cases in ship design: insulation in bulkheads, refrigerated spaces, fish holds in trawlers.

## 12.4 Basic Science

### 12.4.1 CHEM 1101: Chemistry

3.00 Credit, 3 hrs. /wk.

**Objectives:**

The objective of the course is to help students to understand the need of Chemistry in daily life and to solve analytical problems with a molecular perspective. Students will also learn fundamentals about the structure and properties of materials that will help them in carrying out their future research in different fields.

**Learning Outcomes:**

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

- identify, explain, and apply established scientific theories and principles of chemistry
- explain the structure and understand the properties of matter
- explain the bonding within atoms of a molecule and understand stoichiometry of reactions
- develop idea about spontaneity, rate and mechanism of reactions

**Contents:**

**Structure of Atom:** Atomic theory of Matter, Classical concept of Atom models, Nuclear Structure, Properties of Wave, Electromagnetic Radiation, Quantum Effects and Photons, Atomic Spectra, Bohr theory of Hydrogen atom, Quantum Mechanics, Quantum numbers, Atomic orbitals and their energies, Electronic Structure of Atoms.

**Periodic Table:** History of Periodic Table, Development of Periodic Table, Periodic law, Some Periodic Properties, Periodicity in the Main Group Elements.

**Structure and Bonding:** An overview of Chemical Bonding, Ionic and Covalent bonds, Properties of Ionic and Covalent Compounds, Lewis Structure and Shapes of molecules, Hybridizations, Bond length and bond order, Molecular geometry and directional bonding, Molecular Orbital Theory, Molecular orbital diagrams of homonuclear and hetronuclear diatomic molecules.

**Chemical reactions:** Classification of chemical reactions, Precipitation reactions, Acid-base reactions, Redox reactions, Balancing simple redox reactions, Addition, Substitution and Elimination reactions.

**Gas:** States of matter, Equation of state, Kinetic Molecular Theory, Molecular velocities, Distribution of velocities, Behaviour of Real Gases: Amagat's Curves, Van der Waals' Equation and critical phenomena.

**Phase Equilibria:** Phase, Components and Degrees of Freedom, Deduction of Phase rule, Phase Diagram of water and sulphur system, Solid-liquid equilibria, Eutectic point.

**Acids and Bases:** Acid-base concepts, Relative Strengths of acids and bases, Molecular structure and strengths, Autoionisation of water, Solutions of strong acids and bases, pH of solutions, Acid-Base equilibria.

**Thermodynamics:** First law of Thermodynamics, Work and Heat, Heat of reactions, Entropy and Second law of Thermodynamics, Free energy and spontaneity, Interpretation of free energy, Free energy and equilibrium constant.

**Chemical Kinetics:** Rate law, Determination of rate law, Molecularity and order of reactions, Factors affecting rate of reaction, Temperature dependence of reaction rates, Collision and Transition state theory, Some chain reactions and their mechanism.

**Organic Chemistry:** Nomenclature, Synthesis and properties of alkanes, Cycloalkanes, Alkenes, Alkynes and aromatic hydrocarbon, Derivatives of hydrocarbons, Polymer materials.

**Nuclear Chemistry:** Radioactivity, Nuclear bombardment reactions, Radiation and matter, Rate of radioactive decay, Energy of nuclear reactions, Application of radioactive isotopes.

**Electrochemistry:** Voltaic Cells-its construction and notation, Cell Potential, Standard cell potential and standard electrode potential, Some Commercial Voltaic cell, Electrolysis of molten salts, Aqueous electrolysis, Stoichiometry of electrolysis.

### 12.4.2 CHEM 1102: Chemistry Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

The objective of the course is to introduce students with contemporary instrumentation used in analytical chemistry. It will also develop confidence of the students to perform qualitative and quantitative analysis with an understanding of principles and proper interpretation of experimental results.

**Learning Outcomes:**

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

- develop idea about the qualitative and quantitative analysis of substances
- use different experimental methods and instrumentation
- enhance knowledge on data interpretation and analysis

**Contents:**

Chemistry lab is based on Chem 1101 course. Minimum 7 (Seven) experiments must be carried out from the following lists:

a. Purification of commercial sodium chloride, NaCl, by re-crystallization and salting out process.
b. Preparation of Ferrous Ammonium Sulphate (Mohr's salt), $FeSO_4.(NH_4)_2SO_4.6H_2O$.
c. Qualitative analysis of few selected cations and anions from mixture of salts/from supplied solutions.
d. Preparation of a primary standard solution of oxalic acid and standardization of a supplied NaOH solution.
e. Preparation of a primary standard solution of $Na_2CO_3$ and standardization of a supplied HCl solution.
f. Determination of the amount of Fe(II) and Fe(III) in a given sample using a standard dichromate solution.
g. Standardization of a sodium thiosulphate solution using a standard dichromate solution and hence determination of the amount of copper (II) in a supplied solution with the standard thiosulphate solution.
h. Determination of hardness of the supplied water sample by Complexometric Method.
i. Elemental (Nitrogen, Sulphur and Halogen) analysis and melting point determination of some selected organic compounds.
j. Identification of few functional groups of some selected organic compounds.
k. Determination of the pH-neutralization curve of a strong acid by a strong base.
l. Determination of the dissociation constant of ethanoic acid by investigating its conductance behavior

at different concentrations.

m. Determination of the enthalpy change for the thermal decomposition of $NaHCO_3$ into $Na_2CO_3$.

### 12.4.3 MATH 1101: Differential and Integral Calculus

3.00 Credit, 3 hrs/wk.

**Objectives:**

The objective of the course is to teach the students differential and integral calculus, and co-ordinate geometry 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.

**Learning Outcomes:**

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

- calculate limits, infinite limits and limit at infinity using appropriate techniques including L' Hospital Rule.
- compute derivatives of various types of functions.
- expand functions using Taylor's theorem and Maclaurin's theorem.
- evaluate maximum and minimum value of functions of single and double variables.
- calculate indefinite and definite integrals by basic integration formulas.
- solve applied problems using the concept of Geometry.

**Contents:**

Differential Calculus: Functions; Limit; Continuity and Differentiability; Differentiation of explicit and implicit functions and parametric equations; Differentials. Successive differentiation of various types of functions; Leibnitz's theorem; Related rates; Rolle's theorem; Mean Value theorems; Taylor's theorem; Maclaurin's theorem; Lagrange's form of remainders; Cauchy's form of remainder. Evaluation of indeterminate forms by L'Hospitals rule; Equation of tangent and normal; Partial differentiation; Euler's theorem; Maxima and Minima of functions of single and double variable; Curvature and circle of curvature; Asymptotes.

Integral Calculus: Integration by parts; Standard integrals; Integration by the method of successive reduction; Definite integral with properties; Improper integral; Beta function and Gamma Function; Area; Arc lengths of curves in Cartesian and polar co-ordinates; Volumes of solid of revolution; Area of surface of revolution.

Co-Ordinate Geometry: Change of axes; Transformation of co-ordinates; Pair of straight lines; General equations of $2^{nd}$ degree; System of circles; Co-axial system of circles and limiting points.

### 12.4.4 MATH 1203: Ordinary and Partial Differential Equation

3.00 Credit, 3 hrs/wk

**Objectives:**

The objective of the course is to teach the students ordinary and partial differential equations, and complex variables 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.

**Learning Outcomes:**

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

- explain the fundamental concept of differential equations and partial differential equations.
- distinguish between linear, nonlinear, partial and ordinary differential equations.

- solve 2nd and higher order differential equations using different methods.
- use line and contour integral to evaluate integral.
- appriciate how mathematics is used in design. e.g conformal mapping.

**Contents:**

Ordinary Differential Equation: Degree and order of ordinary differential equation; Formation of differential equations; Solutions of first order differential equations by various methods; Solution of general linear equations of 2nd and higher orders with constant coefficient. Solutions of homogeneous linear equations of higher order when the dependent and independent variables are absent; Solution of Euler's linear homogeneous equation; Solution of differential equation by the methods based on factorization of the operator; Solution of differential equations in series by the method of Frobenius.

Partial Differential Equation: Introduction, Equations of the linear and non-linear first order, Standard forms, Linear equations of higher order, Equations of the second order with variable coefficient.

### 12.4.5 MATH 2101: Linear Algebra, Statistics and Probability

3.00 Credit, 3 hrs/wk

**Objectives:**

The objective of the course is to teach the students matrices, vector analysis and probability 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.

**Learning Outcomes:**

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

- understand fundamental concept of matrix and matrix algebra including inverse matrix, canonical form and rank of a matrix.
- compute eigen values and eigen vectors using characteristic polynomial.
- solve system of linear equations.
- explain the concept of differentiation and integration of vector valued function.
- provide a physical interpretation of the gradient, divergence and curl.
- understand the basic of statistical methods in the context of marine technology.
- understand the basic of statistical methods in the context of marine technology

**Contents:**

Matrices: Definition of matrix; Different types of matrices; Algebra of matrices; Adjoint and inverse of a matrix; Rank and elementary transformations of matrices; Normal and canonical forms; Solution of linear equations; Quadratic forms; Matrix polynomials; Caley-Hamilton theorem; Eigenvalues and eigenvectors.

Vector Analysis: Position vector of a point; Resolution of vectors; Scalar and vector product of two vectors and their geometrical interpretation; Triple products and multiple products; Application to geometry and mechanics. Linear combinations; Linear dependence and independence of vectors; Differentiation and integration of vectors together with elementary applications; Definition of line; surface and volume integrals; Gradient; Divergence and Curl of point functions; various formulae; Divergence/Gauss's theorem; Stoke's theorem.

Probability; Sampling; Descriptive statistics; Discrete distributions (binomial, Poisson); Continuous distributions (uniform, normal, exponential, extreme value, Rayleigh); Random number generation; Linear combinations of variables; Central limit theorem; Confidence intervals for means; Variances and proportions and for comparisons of these between samples; Regression.

### 12.4.6 MATH 2203: Fourier Analysis, Laplace Transformation and Complex Variable

3.00 Credit, 3 hrs/wk

**Objectives:**

The objective of the course is to teach the students fourier analysis, harmonic function and Laplace transformation that is most widely used in the engineering core subjects. It will provide the foundation in mathematics to prepare the students for engineering subjects.

**Learning Outcomes:**

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

- understand the basic properties of Fourier transform and its role in engineering.
- understand how the wave and diffusion partial differential equations can be used to model certain systems
- find Laplace transformation and inverse Laplace transformation of functions.
- solve differential equations using Laplace transformation.
- use harmonic function theory in the solution of problems in fluid flow.
- apply the concept of Cauchy's integral theorem and residue theorem to evaluate integral

**Contents:**

Fourier analysis: Real and complex form; Finite transform; Fourier integral; Fourier transforms and their uses in solving boundary value problems.

Harmonic Function: Definition of harmonics; Laplace equation in Cartesian; polar; cylindrical and spherical co-ordinates; Solutions of these equations together with applications;

Laplace Transforms: Definition of Laplace transforms; Elementary transformation and properties; Convolution; Solution of differential equation by Laplace transforms; Evaluation of integrals by Laplace's transforms.

Complex Variable: Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Complex differentiation and the Cauchy-Riemann equations, Mapping by elementary functions. Line integral of a complex function, Cauchy's integral theorem, Cauchy's integral formula, Liouville's theorem, Taylor's and Laurent's theorem, Singular points, Residue, Cauchy's residue theorem, Evaluation of residues, Contour integration, Conformal mapping.

### 12.4.7 PHY 1201: Physics

3.00 Credit, 3 hrs. /wk.

**Objectives:**

Objective of this course is to develop student's concept of everyday occurring phenomena's and build confidence in their analytical and critical thinking skills.

**Learning Outcomes:**

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

- identify, explain, and apply established scientific theories and principles in areas of structure and physics of material, classical waves, special and general relativity, and modern physics.

- develop critical thinking and problem solving skills by applying prescribed methods for solving problems

**Contents:**

**Structure of Matter:** Crystalline and non-crystalline solids, Single crystal and polycrystal solids, Unit cell, Crystal systems, Co-ordinations number, Crystal planes and directions, NaCl and CsCl structure, Packing factor, Miller indices, Relation between interplaner spacing and Miller indices, Bragg's Law, Methods of determination of interplaner spacing from diffraction patterns. Defects in solids: Point defects, Line defects, Bonds in solids, Interatomic distances, Calculation of cohesive and bonding energy, Introduction to bond theory, Distinction between metal, Semiconductor and insulator.

**Oscillations:** Simple Harmonic Motion (SHM). Mass-Spring system, Energy conservation in mass energy system. Damped SHM-Under-damped, over-damped motion, Critical damping, Forced Oscillations, Resonance, Superposition of Periodic Motion: Beats, Lissajous Figures

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

**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.

**Rudiments of Fluid Dynamics:** Streamline and Turbulent Flow; Equation of Continuity; Bernoulli's Equations and its Applications; Poiseuille's Equation for Fluid Flow.

**Wave Optics:** Light as electromagnetic wave; interference of light; Michelson interferometer; Newton's ring; Fresnel and Fraunhofer diffractions; diffraction by single and double slits; Diffraction gratings and its resolving power; Polarization of light; Different types of polarization.

### 12.4.8 PHY 1202: Physics Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

Objective of this course is to teach the students how to conduct experiment using the protocols and methods offered as in the discipline and interpret the results of experiments.

**Learning Outcomes:**

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

- demonstrate that they can conduct an experiment using the protocols and methods offered as in the discipline.
- interpret the results of experiments, observations, understand and explain the random or systematic error associated with their experiment and make appropriate conclusion.

**Contents:**

Physics lab is based on PHY 1201 course. Minimum 7 (Seven) experiments must be carried out from the following lists.

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

b. Determination of high resistance by the method of deflection.
c. Determination of the specific heat of a liquid by the method of cooling.
d. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
e. Determination of frequency of a tuning fork by using Melde's Apparatus.
f. Determination of the value of g, acceleration due to gravity by means of a compound pendulum.
g. Determination of spring constant and effective mass of a given spring and hence to calculate the rigidity modulus of the material of the spring.
h. Determination of buoyant up draught as a function of immersion depth (Archimedes principle).
i. Determination of the surface tension of water by the method of capillary rise.
j. Determination of the surface tension of mercury and the angle of contact by Quinckes' method.
k. Determination of the wavelength of various spectral lines by a spectrometer using a plane diffraction grating.
l. Determination of radius of curvature of a Plano convex lens by Newton's ring method.
m. Determination of focal length and the power of a convex lens by displacement method with the help of an optical bench.

## 12.5 Humanities/Social Science

### 12.5.1 HUM 1101: English

3.00 Credit, 3 hrs. /wk.

**Objectives:**

The course will develop students' writing skills necessary for their academic and professional success. It will also help the students to learn and follow the conventions of standard written English in sentence structure, punctuation, grammar usage and spelling.

**Learning Outcomes:**

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

- improve academic writing in English
- enhance students' reading skills and understanding of short passages
- enrich students' vocabulary
- develop grammatical accuracy
- write coherent, well-organized and argumentative essays
- learn the phases of writing: draft, revision, final copy

**Contents:**

Reading: Reading and thinking critically; Reading Comprehension and answering questions; Reading short stories and poems; Learning different reading strategies (skimming, scanning, predicting, guessing etc); Active reading (highlighting, getting information from texts quickly, following main arguments, interacting with the text and summarizing); Reading to improve linguistic skills and expand vocabulary.

Writing: Paragraph Writing; Organizing a paragraph: topic sentence, detailed sentences, logical orders and conclusions; Writing different types of essays: narrative/descriptive, argumentative, cause effect; Paraphrase and summary writing; Writing strategies: free-writing, brainstorming, mind mapping/clustering, narrowing the focus etc.; Reading to write: reading critical essays, obtaining information and note taking; Mechanics of writing: grammar, punctuation and spelling.

Advanced Grammar: Common mistakes in English; Use of tenses; Problem Verbs; Appropriate preposition;

Subject verb agreement; Error corrections; Affirmative and Negative Agreement; Conditional Sentences; Comparisons of Adjectives; Right forms of verbs; Causative Verbs; Subjunctive; Redundancy; Parallel Structure; Learning when to use passive voice; Commonly Misused Words; Confusingly Related Words; Use of Prepositions; Use of Linkers.

### 12.5.2 HUM 1102: English Lab

1.50 Credit, 3 hrs. /wk.

**Objectives:**

This course will help students enhance their communication skills through interactive participation in the class. It will also enable them to speak fluently for academic as well as professional purposes.

**Learning Outcomes:**

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

- engage in pre-writing activities, including narrowing a topic, generating ideas, determining the audience and the relationship between audience and content and setting an appropriate tone
- demonstrate the phases of writing: draft, revision, final copy
- demonstrate ability to write in various modes: personal narrative, expository, analytical, descriptive, argument
- improve critical thinking skills, especially those of analysis and argument
- develop fluency in delivering speech
- speak more accurately and confidently
- develop listening skills

**Contents:**

Speaking: Guided conversations (greetings, requesting, apologizing)**;** Two- minute impromptu talks; Role-plays and simulations**;** Preparing and presenting talks on a given theme**;** Informal debates and group discussion**;** Public Speaking**;** Oral presentation**;** Responding to audio/video clips.

Listening: Listening for main ideas/key information; Listening for specific details; Listening and responding to texts (i.e. following instructions, answering questions, reacting to texts, etc.); Listening and note-taking; Listening to news, broadcasts and songs; Listening and watching short video clips.

Writing: Generating ideas, drafting, revising, and editing; Gathering, evaluating, documenting and using sources; Writing and organizing different types of essay; Writing different types of essays: narrative/descriptive, argumentative, cause effect; Developing a thesis statement; Paraphrasing, summarizing, and quoting; Using rhetorical modes including exposition; Writing formal and informal letters; Writing business letters; Resume and Job application letter writing; Report Writing; Amplification writing; MLA and APA Citation Style Guide; Avoiding plagiarism.

### 12.5.3 HUM 1103: Bangladesh Studies

2.0 Credit, 2 hrs. /wk.

**Objectives:**

The objectives of this course is to introduce the students with the key concepts like socio-economic, geo-political, institutional, social organizational, context of origin and development of Bangladesh and the importance of Bay of Bengal.

**Learning outcomes:**

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

- address different contemporary issues of modernization in context of Bangladesh ;
- demonstrate an understanding of the key concepts like socio-economic, geo-political, institutional, social organizational, context of origin and development of Bangladesh
- identify the role of foreign investors and development partners in private sector development
- demonstrate an understanding of the importance of Bay of Bengal

**Contents:**

The major Socio-Economic and Cultural Features of Bangladesh

Agricultural Development and the contribution of agricultural sector to the national economy and society of Bangladesh; An overview of agricultural policies of Bangladesh

The Process of Industrialization in Bangladesh: The evolution of industrial growth in Bangladesh; sector wise development of industries; the role of private and public sectors in industrial development; An overview of industrial policies of Bangladesh

Private Sector Development in Bangladesh: The contribution of Private Sector in the economy of Bangladesh; An overview of private sector development policy in Bangladesh; The opportunities and Challenges of private sector development; The role of Foreign Investors and Development Partners in Private Sector Development

The Health and Demographic Features of Bangladesh: An overview of Fertility, Mortality, Marriage, Migration, Primary Health Care Services, Family Planning, Reproductive Health, Youth and Development etc.

Culture, Tradition and Heritage of Bangladesh: An overview of the development of Art, Literature, Folk Culture, Music, Traditional Food Habit, Dresses, Architecture, Monument, Objects of Civilization, Song, Paintings, Classic, Traditional and Modern Songs and integration of Western Culture

Rural Development: The notion and evolution of Rural development; BARD as a Model of Rural Development; Challenges and Constraints of Rural Development; The Role of NGOs, Go and Development Partners in Rural Development

The Political and Governmental system in Bangladesh: The forms of Government; Bureaucracy as a system of Administration; The role of Political parties in sustaining modern democracy

Bay of Bengal: Introduction to Bay of Bengal; Geostrategic and economic importance of Bay of Bengal.

### 12.5.4 HUM 1105: □□□□□□□□□□ □□□□□□□□□ □□□□□□

1.0 Credit, 1 hr. /wk.

**Objectives:**

To introduce the students with social, political and economic context of liberation war of Bangladesh**.**

**Learning Outcomes:**

On successful completion of this course the students shall be able to demonstrate an understanding of the emergence of Bangladesh.

**Contents:**

১. দেশ ও জনগোষ্ঠীর পরিচয়।
২. সাম্প্রদায়িক রাজনীতি ও দ্বিজাতিতত্ত্ব উদ্ভব ও বিকাশ।
৩. পাকিস্তান রাষ্ট্রীয় কাঠামো ও বৈষম্য।
৪. গণতান্ত্রিক রাজনীতির প্রয়াস ও ভাষা আন্দোলন।
৫. গণতান্ত্রিক সরকার প্রতিষ্ঠার প্রচেষ্টা।

৬. সামরিক শাসন: আইয়ুব খানের শাসনামল।
৭. জাতীয়তাবাদের বিকাশ ও স্বাধিকার আন্দোলন।
৮. ১৯৬৯-এর গণঅভ্যুত্থান ও ১১ দফা আন্দোলন।
৯. ১৯৭০-এর নির্বাচন ও বঙ্গবন্ধুর স্বাধীনতা ঘোষণা।
১০. মুক্তিযুদ্ধ ১৯৭১।

**Recommended Text(s):**

১. স্বাধীন বাংলাদেশের অভ্যুদয়ের ইতিহাস - মুনতাসীর মামুন, ড.মো. মাহবুবুর রহমান

**12.5.5 HUM 1207:** □□□□□ □□□□ □ □□□□□□□
3.00 Credit, 3 hrs. /wk.

**Objectives:**

- বাংলা ভাষা শেখার ও বাংলা সাহিত্যকে জানার ইতিবাচক মনোভাব তৈরি।
- বাংলাদেশ এবং বাঙালির ইতিহাস ও সংস্কৃতি সম্পর্কে সম্যক ধারণা প্রদান।
- বাংলা ব্যাকরণ ও নির্মিতি সম্পর্কে সামগ্রিক ধারণা প্রদান।
- দৈনন্দিন জীবনে শুদ্ধরূপে বাংলা ভাষার প্রয়োগ।

**Learning Outcomes:**
কোর্সটি সফলভাবে সম্পন্ন করার মাধ্যমে শিক্ষার্থীরা যা শিখতে পারবে:

- বাংলাদেশের সামাজিক, ঐতিহাসিক ও সাংস্কৃতিক অনুষঙ্গের সঙ্গে বাংলা সাহিত্যের সংযোগ স্থাপন করতে পারবে।
- বাংলাদেশ এবং বাঙালির ইতিহাস ও সংস্কৃতি সম্পর্কে সামগ্রিক ধারণা তৈরি হবে।
- দৈনন্দিন জীবনে শুদ্ধরূপে বাংলা প্রয়োগ করতে সক্ষম হবে।
- প্রমিত বাংলা উচ্চারণে কথা বলার দক্ষতা বৃদ্ধি পাবে।
- বাংলা ব্যাকরণ ও নির্মিতি সম্পর্কে সামগ্রিক ধারণা তৈরি হবে।
- উপস্থিত বক্তব্য এবং যেকোনো বিষয়ে যৌক্তিক বিশ্লেষণধর্মী লেখা লিখতে সক্ষম হবে।

**Contents:**
**প্রথম খণ্ড**

- **ভাষা ও নির্মিতি**

-বাংলা উচ্চারণ
-সাধু ও চলিত (প্রমিত) ভাষা
-বাংলা বানানের নিয়ম

**নির্মিতি**

-বক্তব্য লেখন
-প্রতিবেদন বা রিপোর্ট
-পত্রাদি লেখন
-ক্ষুদেগল্প লেখা
-ব্যবহারিক বাংলা: সংক্ষিপ্ত আলোচনা
ক. একুশে ফেব্রুয়ারি; খ. মুক্তিযুদ্ধ; গ. বাংলা নববর্ষ; ঘ. বাংলা উৎসব; ঙ. ষড়ঋতু; চ. বাংলা ভাষা;
ছ. বাংলার লোকসংস্কৃতি; জ. মানবতা ও নৈতিকতা; ঝ. বিশ্বায়ন; ঞ. আধুনিক তথ্যপ্রযুক্তি।

**দ্বিতীয় খণ্ড**

- **সাহিত্য**

**কবিতা [নির্বাচিত ০৫ টি]**

-আবদুল হাকিম ♦ বঙ্গাবাণী
-মাইকেল মধুসূদন দত্ত ♦ বঙ্গভাষা
-লালন সাঁই ♦ খাঁচার ভিতর অচিন পাখি
-রবীন্দ্রনাথ ঠাকুর ♦ নির্ঝরের স্বপ্নভঙ্গ
-কাজী নজরুল ইসলাম ♦ আজ সৃষ্টি সুখের উল্লাসে
-জীবনানন্দ দাশ ♦ বাংলার মুখ আমি
-হাসান হাফিজুর রহমান ♦ অমর একুশে
-আলাউদ্দিন আল আজাদ ♦ স্মৃতিস্তম্ভ
-শামসুর রাহমান ♦ তোমাকে পাওয়ার জন্যে হে স্বাধীনতা
-সৈয়দ শামসুল হক ♦ আমার পরিচয়

**ছোটগল্প ও অন্যান্য রচনা [নির্বাচিত ০৪ টি]**

-রবীন্দ্রনাথ ঠাকুর ♦ পোস্টমাস্টার
-রোকেয়া সাখাওয়াত হোসেন ♦ বায়ুযানে পঞ্চাশ মাইল
-বিভূতিভূষণ বন্দ্যোপাধ্যায় ♦ পুঁইমাচা
-শওকত ওসমান ♦ মৌন নয়
-সৈয়দ ওয়ালীউল্লাহ্ ♦ নয়নচারা
-জাহানারা ইমাম ♦ একাত্তরের দিনগুলি
-হাসান আজিজুল হক ♦ খাঁচা
-আখতারুজ্জামান ইলিয়াস ♦ অপঘাত

**প্রবন্ধ [নির্বাচিত ০৪টি]**

-বঙ্কিম চট্টোপাধ্যায় ♦ বাঙ্গালা ভাষা
-রবীন্দ্রনাথ ঠাকুর ♦ সভ্যতার সংকট
-হরপ্রসাদ শাস্ত্রী ♦ তৈল
-প্রমথ চৌধুরী ♦ যৌবনে দাও রাজটিকা
-কাজী নজরুল ইসলাম ♦ বর্তমান বিশ্বসাহিত্য
-মুহম্মদ আবদুল হাই ♦ আমাদের বাংলা উচ্চারণ
-কবীর চৌধুরী ♦ আমাদের আত্মপরিচয়

**নাটক**

-মুনীর চৌধুরী ♦ কবর

**Recommended Text(s):**

| | |
|---|---|
| ১. বাংলা ভাষা ও সাহিত্য | -রফিকুল ইসলাম, সৌমিত্র শেখর |
| ২. নীহাররঞ্জন রায় | -রবীন্দ্র সহিত্যের ভূমিকা |
| ৩. জীনাত ইমতিয়াজ আলী | -ধ্বনিবিজ্ঞানের ভূমিকা |
| ৪. মোহাম্মদ মনিরূজামান | -নজরুল সমীক্ষণ |
| ৫. আবদুল মান্নান সৈয়দ | -শুদ্ধতম কবি |
| ৬. মোহাম্মদ জয়নুদ্দীন | -মুনীর চৌধুরীর সাহিত্যকর্ম |
| ৭. হুমায়ুন আজাদ | -শামসুর রাহমান/নিঃসঙ্গ শেরপা |
| ৮. অধীর দে | -আধুনিক বাংলা প্রবন্ধ সাহিত্যের ধারা |
| ৯. অরবিন্দ পোদ্দার | -বঙ্কিম-মানস |

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| ১০. রফিকউল্লাহ খান | -বাংলাদেশের কবিতাঃ সমবায়ী স্বতন্ত্রস্বর |
| ১১. সাঈদ-উর রহমান | -পূর্ব বাংলার রাজনীতি-সংস্কৃতি ও কবিতা |
| ১২. সুভাষ ভট্টাচার্য | -আধুনিক বাংলা প্রয়োগ অভিধান |
| ১৩. আহমদ শরীফ, আনিসুজ্জামান ও অন্যান্য | -বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ |
| ১৪. বাংলা একাডেমি | -প্রমিত বাংলা বানানের নিয়ম |
| ১৫. মাহবুবুল হক | -বাংলা বানানের নিয়ম |
| ১৬. আনন্দ পাবলিশার্স | -তিষ্ঠ ক্ষণকাল |
| ১৭. যতীন সরকার | -গল্পে গল্পে ব্যাকরণ |
| ১৮. সুবল দাস বণিক | -ছড়ায় ছড়ায় শব্দ বানান |
| ১৯. বাংলা একাডেমি | -ব্যবহারিক বাংলা অভিধান |
| ২০. যতীন সরকার | -ভাষাজ্যোতি |

### 12.5.6 HUM 3201: Economics and Accounting

3.00 Credit, 3 hrs. /wk.

**Objectives:**

Objective of this course is to familiarize the students with basic economic principles of as applied to business organizations and engineering firms, and basic accounting techniques and instruments.

**Learning outcomes:**

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

- identify and use economics terminologies in oral and written communications;
- explain the basic economic principles of as applied to business organizations and engineering firms;
- demonstrate their knowledge of the fundamental and technical concepts of economics;
- take the lead in creating change as the economics environment changes;
- understand and apply basic accounting techniques and instruments;
- estimate costing for production

**Contents:**

The Fundamentals of Economics: Utility, Wealth, Production; Theory of Demand (meaning, determinants of demand, law of demand, elasticity of demand price, income and cross elasticity) and Supply (meaning, determinants, law of supply and elasticity of supply). Equilibrium; Theory of Production (meaning , factors, laws of production- law of variable proportion, laws of returns to scale); Cost of Production (concept of costs, short-run and long-run costs, average and marginal costs, total, fixed and variable costs). Pricing strategies in various forms of markets. Money and Banking: Definition of Money, Types, Features and Functions; Definition, functions, utility, principles of Banking; Commercial Banks, Central Bank; Measures of credit control and Money Market. Determining Consumption, Investment, Employment and Unemployment, Productivity, Economic Growth and Determining Factors; Economic policies: Fiscal Policy and Monetary Policy; benefits and costs of a global economy.

Concept and classification of accounting; Users of accounting information; Requirements of accounting. Preparing financial statements in accordance with Generally Accepted Accounting Principles. Definition and components of Balance Sheet; assets, liabilities and equity. Accounting Instruments: Business transactions, Companies´ wealth, Accounting tools, accounting books, annual accounts. Concept of earnings; fund flows and cash flows; Revenues, expenses, gains and losses; Components of the Income Statement; Phases in the accounting cycle. Costing: methods of costing; standard costing and marginal costing; budgets and budgetary controls.

## 12.6 Project

### 12.6.1 NAOE 3000: Project

3.00 Credit

**Objectives:**

This course intends to involve the students in carrying out design project that replicate closely to the actual design task starting from conceptual design based on owners requirements and then followed by the development of hull forms and hydrostatics calculation. Apart from providing the fundamental technical knowledge on design, this course will also give emphasis on the development of students' generics skill such as problem solving skills, team working, communication skills, project planning and report writing.

**Learning outcomes:**

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

- formulate, undertake and report on a substantial design or research project
- carryout and understand the complete design process of a particular ship

**Contents:**

Design of a particular ship or offshore structures - principal particulars, lines plan, displacement, general arrangement (GA), freeboard, volume, scantling, power, machinery, endurance, outfit, approximate trim and stability, light weight and deadweight.

Design update and final design with lines, GA, midship, profile, deck and bottom construction based on Rule Book, shell expansion, hydrostatic curves, trim and cross curves of stability, power, engine selection and propeller design.

## 12.7 Thesis

### 12.7.1 NAOE 4000: Thesis

6.00 Credit

**Objectives:**

This course intends to involve the students in carrying out specific related to naval architecture and offshore engineering discipline. It will help them to learn how to carry out engineering research work, present and defend the research work, and write a thesis paper.

**Learning outcomes:**

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

- understand the nature and basic requirements of research work
- carry out literature search, then write literature review, research proposal and project plan
- write the final report in the form of a thesis paper
- defend research work

**Contents:**

Major Fields of thesis are as follows:
(a) Ship design (b) Ship construction (c) Strength of ship (d) Material testing and fracture problems (e) Ship motion (f) Resistance and propulsion of ships (g) Marine engines and ship vibration (h) Marine transportation system (i) Marine engineering (j) Dynamics of ship/floating bodies/structures (k) Environmental impact assessment (l) Life cycle assessment (LCA). (m) Offshore structure design (n) Subsea pipeline (o) Mooring and Riser design (p) Drilling system etc.

## 12.8 Industrial Attachment

### 12.8.1 NAOE 3200: Industrial Attachment

1.50 Credit, consolidated 3 weeks

**Objectives:**

This course will help the students relate theoretical knowledge in practical fields and understand the marine design and construction process.

**Learning outcomes:**

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

- relate theoretical knowledge in practical fields related to Naval Architecture and Offshore Engineering
- understand and describe total marine design and construction process

**Contents:**

Marine design - Basic design; Estimation; Hull design; Piping and equipment design; Shell expansion; Detailed construction drawings.

Marine construction - Mould loft; Gas cutting; CNC cutting; Welding; Fabrication; Sub-assembly; Assembly; Field assembly; Erection; Launching; Outfitting; Delivery trial; Workshop practices.

## 12.9 Co-curricular

### 12.9.1 COCR 2202: Co-curricular

0.00 Credit

**Objectives:**

This course will help students on developing their confidence as a participant in various co-curricular activities. It will also enhance their personal position independently or within the organization and understand the right behavior during public and private interactions.

**Learning outcomes:**

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

- Successfully confront personal and professional challenges
- Engage in appropriate business/social conduct
- Determine what constitutes right behavior in a given situation
- Enhance your personal position independently or within the organization
- Set realistic goals to help you reach your full potential in life

**Contents:**

Student have to be member of the least two registered club of BSMRMU and actively take part in the club activities.

## 12.10 Industrial Study Tour (IST)

**Objectives:**

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 and offshore industries of Bangladesh;
- describe the importance of development of the shipbuilding and offshore sectors of Bangladesh

**Contents:**

Study tour to various maritime and offshore industries for example marine design firms, shipyards, dry-docks, ports, oil and gas companies, etc.

### 12.11 Degree ++

The department/faculty shall offer Certificate Courses in the relevant field. Each student shall have to complete minimum 3 (Three) courses from the approved list in section 11 as a part of requirement of the degree. These courses will be conducted according to the regulations for conducting short (certificate) course of BSMRMU. Registration fees will be applicable for these certificate courses.