

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**REGULATIONS - 2017**  
**B.E. MARINE ENGINEERING**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAMME EDUCATIONAL OBJECTIVES:**

1. Graduates will have the knowledge for the application of scientific principles, Mathematical methods, technical and Innovative skills to perform analysis, application engineering, and system or process development in Marine Industry
2. Graduates will have the knowledge by engaging in continuous education and will have the ability to function effectively as leaders on professional teams with ability to communicate effectively using speaking, writing and presentation skills.
3. Graduates of the program are to have demonstrated the competent to carry out the Engineering watch at sea and to maintain systems or processes and to direct, supervise, and make important decisions regarding the design and engineering of problems based on engineering fundamentals and modern technological tools.
4. Graduates will demonstrate a respect for professional, ethical and social and environmental issues as well as a commitment to safety, quality and productivity.

**PROGRAMME SPECIFIC OBJECTIVE**

1. The ability to have thorough knowledge of maritime industry in accordance with the STCW-conventions amended time-to-time,
2. Possess an overall and conscious understanding about marine engineering at the operational and management level
3. Posses knowledge of national and international rules and regulations concerning marine engineering
4. Posses the Necessary skill for the technical operation of ships in both off-shore and on-shore.

**2. PROGRAMME OUTCOMES**

- a. Ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology to problems associated with marine equipment, systems, and vehicles.
- b. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- c. Ability to conduct, use proper laboratory practices, use instrumentation for measuring physical phenomena, analyze and interpret experiments and apply experimental results to improve processes and design.
- d. Ability to apply creativity in the design of systems, components, or processes in the marine environment.
- e. Ability to apply the principles of fluid mechanics, hydrostatic stability, solid mechanics, materials, dynamics, and energy systems to technical problems related to marine equipment, systems, and vehicles. (including selecting appropriate materials and methods for manufacturing of machine parts).
- f. Graduates should be able to operate maintain and repair main, auxiliary machinery and associated control System and automation. Graduate should be capable of using appropriate hand tools, machine tools and measuring instruments.

- g. Graduates should be capable of preventing, controlling, and fighting fire on board and be aware of proper use of Fire Fighting Appliances & Life Saving Appliances and have the knowledge of Ship safety and First aid.
- h. Ability to understand and apply professional, ethical and social responsibilities and global issues
- i. An ability to communicate effectively and apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature including technical report.
- j. Commitment to quality, timeliness and continuous improvement with lifelong learning
- k. Ability to engage in the operation, maintenance, analysis and management of modern marine power plants and associated equipment and systems and competent to undertake independent watch-keeping at Engine room.
- l. Competency of the knowledge, techniques, skills and to use design manuals, equipment specifications, and industry regulations, modern tools of marine engineering technology as specified in Table III/I as per 2010 STCW Convention.

### 3. PEO/ PO Mapping

PEO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	√		√						√			
2		√	√					√	√			
3		√		√	√	√					√	√
4				√			√	√		√		

#### 4. Semester Course wise PEO mapping

		Course Title	a	b	c	d	e	f	g	h	i	j	k	l
YEAR I	SEMESTER I	Technical English – I									√			
		Mathematics for Marine Engineering – I	√											
		Engineering Physics	√											
		Chemistry for Marine Engineering	√											
		Problem solving and Python Programming		√										
		Engineering Graphics				√								
		<b>Practical</b>												
		Problem solving and Python Programming Laboratory			√									
		Physics and Chemistry Laboratory			√									
	SEMESTER II	Technical English for Marine Engineering – II	√											
		Mathematics for Marine Engineering – II	√											
		Materials Science					√							
		Basics of Electrical and Electronics Engineering											√	
		Environmental Science and Engineering								√				
		Engineering Mechanics	√			√								
		<b>Practical</b>												
		Engineering Practices Laboratory			√									
		Basic Electrical and Electronics Engineering Laboratory			√									

YEAR II	SEMESTER III	Transforms and Partial Differential Equations	√											
		Marine Hydraulics and Fluid Machinery					√							
		Basics of Marine Engineering						√						
		Marine Manufacturing Technology					√							
		Marine Electrical Machines – I	√			√								
		Strength of Materials for Mechanical Engineers					√							
		Marine Machinery Drawing		√										
		<b>Practical</b>												
		Marine Hydraulics and Fluid Machinery Laboratory			√									
		Strength of Materials and Applied Mechanics Laboratory			√									
	SEMESTER IV	Marine Engineering Thermodynamics										√		
		Marine Diesel Engines – I						√						
		Marine Boilers and Steam Engineering										√		
		Marine Electrical Machines – II	√			√								
		Marine Engineering Materials					√							
		Marine Electronics					√							
		Marine Refrigeration and Air Conditioning						√						
		<b>Practical</b>												

		Welding Techniques, Lathe and Special Machine Shop			√								√
		Heat Engines, Boiler Chemistry and Refrigeration Laboratory			√								√
YEAR III	SEMESTER V	Marine Auxiliary Machinery I										√	
		Marine Diesel Engines II										√	
		Stability of Ships					√					√	
		Ship Construction					√						
		Mechanics of Marine Machines					√						
		Seamanship, Elementary Navigation and Survival At Sea						√				√	√
		Open Elective -I											
		<b>Practical</b>											
		Electrical Engg., Electronics and Microprocessor Laboratory			√								
		Professional Communication			√								
	SEMESTER VI	Marine Workshop Practical and Afloat Training			√		√		√		√	√	√

YEAR IV	SEMESTER VII	Marine Machinery and Systems Design		√			√							
		Marine Electrical Technology										√	√	
		Marine Control Engineering and Automation					√						√	
		Marine Auxiliary Machinery – II					√							
		Ship's Fire Prevention and Control						√					√	
		Open Elective- II												
		Professional Elective – I												
		<b>Practical</b>												
		Fire Fighting, Controls and Simulator Laboratory			√			√					√	
		Marine Propulsion and Auxiliary Machinery Overhauling Laboratory			√							√	√	
		Measurement and Instrumentation Laboratory			√									
	SEMESTER VIII	Marine Vehicles Performance										√		
		Ship Operational Management and IMO Requirements							√		√		√	
		Safety Precautions and Watch Keeping						√				√	√	
		Offshore Technology										√		
		Professional Elective II										√	√	
		<b>Practical</b>												
		Project Work			√					√	√			

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**CHOICE BASED CREDIT SYSTEM**  
**I TO VIII SEMESTERS CURRICULA AND SYLLABI**

**SEMESTER I**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	HS8101	Technical English – I	HS	4	4	0	0	4
2.	MA8101	Mathematics for Marine Engineering – I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8101	Chemistry for Marine Engineering	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
<b>PRACTICALS</b>								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
<b>TOTAL</b>				<b>31</b>	<b>19</b>	<b>0</b>	<b>12</b>	<b>25</b>

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	HS8201	Technical English for Marine Engineering – II	HS	4	4	0	0	4
2.	MA8201	Mathematics for Marine Engineering – II	BS	4	4	0	0	4
3.	PH8251	Materials Science	BS	3	3	0	0	3
4.	BE8253	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
5.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
6.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
<b>PRACTICALS</b>								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	BE8261	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>30</b>	<b>20</b>	<b>2</b>	<b>8</b>	<b>25</b>

### SEMESTER – III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2.	MV8301	Marine Hydraulics and Fluid Machinery	PC	3	3	0	0	3
3.	MV8302	Basics of Marine Engineering	PC	3	3	0	0	3
4.	MV8303	Marine Manufacturing Technology	PC	3	3	0	0	3
5.	MV8304	Marine Electrical Machines – I	PC	5	3	2	0	4
6.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
7.	MV8305	Marine Machinery Drawing	PC	5	1	0	4	3
<b>PRACTICAL</b>								
8.	MV8311	Marine Hydraulics and Fluid Machinery Laboratory	PC	4	0	0	4	2
9.	MV8312	Strength of Materials and Applied Mechanics Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>34</b>	<b>20</b>	<b>2</b>	<b>12</b>	<b>27</b>

### SEMESTER – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MV8401	Marine Engineering Thermodynamics	PC	3	3	0	0	3
2.	MV8402	Marine Diesel Engines – I	PC	3	3	0	0	3
3.	MV8403	Marine Boilers and Steam Engineering	PC	3	3	0	0	3
4.	MV8404	Marine Electrical Machines – II	PC	3	3	0	0	3
5.	MV8405	Marine Engineering Materials	PC	3	3	0	0	3
6.	MV8406	Marine Electronics	PC	3	3	0	0	3
7.	MV8407	Marine Refrigeration and Air Conditioning	PC	5	3	2	0	4
<b>PRACTICAL</b>								
8.	MV8411	Welding Techniques, Lathe and Special Machine Shop	PC	4	0	0	4	2
9.	MV8412	Heat Engines, Boiler Chemistry and Refrigeration Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>31</b>	<b>21</b>	<b>2</b>	<b>8</b>	<b>26</b>



### SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEROY</b>								
1.	MV8501	Marine Auxiliary Machinery I	PC	3	3	0	0	3
2.	MV8502	Marine Diesel Engines II	PC	3	3	0	0	3
3.	MV8503	Stability of Ships	PC	4	4	0	0	4
4.	MV8504	Ship Construction	PC	3	3	0	0	3
5.	MV8505	Mechanics of Marine Machines	PC	5	3	2	0	4
6.	MV8506	Seamanship, Elementary Navigation and Survival At Sea	PC	3	3	0	0	3
7.		Open Elective -I	OE	3	3	0	0	3
<b>PRACTICAL</b>								
8.	MV8511	Electrical Engineering, Electronics and Microprocessor Laboratory	PC	4	0	0	4	2
9.	HS8581	Professional Communication	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>30</b>	<b>22</b>	<b>2</b>	<b>6</b>	<b>26</b>

**Note:-** \* This course and syllabi are prescribed as per directions of the Director General of Shipping, Government of India.

### SEMESTER –VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MV8611	Marine Workshop Practical and Afloat Training	EEC		8hrs per day – 6 days a week, 26 weeks, 500 Marks. Sessional Marks 200 Report + Viva 300			<b>12</b>

### SEMESTER –VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MV8701	Marine Machinery and Systems Design	PC	3	3	0	0	3
2.	MV8702	Marine Electrical Technology	PC	4	4	0	0	4
3.	MV8703	Marine Control Engineering and Automation	PC	3	3	0	0	3
4.	MV8704	Marine Auxiliary Machinery – II	PC	3	3	0	0	3
5.	MV8705	Ship's Fire Prevention and Control	PC	3	3	0	0	3
6.		Open Elective- II	OE	3	3	0	0	3
7.		Professional Elective – I	PE	3	3	0	0	3
<b>PRACTICAL</b>								
8.	MV8711	Fire Fighting, Controls and Simulator Laboratory	PC	4	0	0	4	2
9.	MV8712	Marine Propulsion and Auxiliary Machinery Overhauling Laboratory	PC	2	0	0	2	1
10.	MV8713	Measurement and Instrumentation Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>32</b>	<b>22</b>	<b>0</b>	<b>10</b>	<b>27</b>

### SEMESTER –VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MV8801	Marine Vehicles Performance	PC	3	3	0	0	3
2.	MV8802	Ship Operational Management and IMO Requirements	PC	3	3	0	0	3
3.	MV8803	Safety Precautions and Watch Keeping	PC	3	3	0	0	3
4.	MV8804	Offshore Technology	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
<b>PRACTICAL</b>								
6.	MV8811	Project Work	EEC	20	0	0	20	10
<b>TOTAL</b>				<b>35</b>	<b>15</b>	<b>0</b>	<b>20</b>	<b>25</b>

**TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 193**

### HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8101	Technical English – I	HS	4	4	0	0	4
2.	HS8201	Technical English for Marine Engineering – II	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3

### BASIC SCIENCE (BS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8101	Mathematics for Marine Engineering – I	BS	5	3	2	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8101	Chemistry for Marine Engineering	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	MA8201	Mathematics for Marine Engineering – II	BS	4	4	0	0	4
6.	PH8251	Materials Science	BS	3	3	0	0	3
7.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4

### ENGINEERING SCIENCES (ES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8253	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
5.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
6.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	BE8261	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
8.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3

**PROFESSIONAL CORE (PC)**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MV8301	Marine Hydraulics and Fluid Machinery	PC	3	3	0	0	3
2.	MV8302	Basics of Marine Engineering	PC	3	3	0	0	3
3.	MV8303	Marine Manufacturing Technology	PC	3	3	0	0	3
4.	MV8304	Marine Electrical Machines – I	PC	5	3	2	0	4
5.	MV8305	Marine Machinery Drawing	PC	5	1	0	4	3
6.	MV8311	Marine Hydraulics and Fluid Machinery Laboratory	PC	4	0	0	4	2
7.	MV8312	Strength of Materials and Applied Mechanics Laboratory	PC	4	0	0	4	2
8.	MV8401	Marine Engineering Thermodynamics	PC	3	3	0	0	3
9.	MV8402	Marine Diesel Engines – I	PC	3	3	0	0	3
10.	MV8403	Marine Boilers and Steam Engineering	PC	3	3	0	0	3
11.	MV8404	Marine Electrical Machines – II	PC	3	3	0	0	3
12.	MV8405	Marine Engineering Materials	PC	3	3	0	0	3
13.	MV8406	Marine Electronics	PC	3	3	0	0	3
14.	MV8407	Marine Refrigeration and Air Conditioning	PC	5	3	2	0	4
15.	MV8411	Welding Techniques, Lathe and Special Machine Shop	PC	4	0	0	4	2
16.	MV8412	Heat Engines, Boiler Chemistry and Refrigeration Laboratory	PC	4	0	0	4	2
17.	MV8501	Marine Auxiliary Machinery I	PC	3	3	0	0	3
18.	MV8502	Marine Diesel Engines II	PC	3	3	0	0	3
19.	MV8503	Stability of Ships	PC	4	4	0	0	4
20.	MV8504	Ship Construction	PC	3	3	0	0	3
21.	MV8505	Mechanics of Marine Machines	PC	4	4	0	0	4
22.	MV8506	Seamanship, Elementary Navigation and Survival At Sea	PC	3	3	0	0	3
23.	MV8511	Electrical Engineering, Electronics and Microprocessor Laboratory	PC	4	0	0	4	2
24.	MV8701	Marine Machinery and Systems Design	PC	3	3	0	0	3
25.	MV8702	Marine Electrical Technology	PC	4	4	0	0	4
26.	MV8703	Marine Control Engineering and Automation	PC	3	3	0	0	3
27.	MV8704	Marine Auxiliary Machinery – II	PC	3	3	0	0	3
28.	MV8705	Ship's Fire Prevention and Control	PC	3	3	0	0	3
29.	MV8711	Fire Fighting, Controls and	PC	4	0	0	4	2

		Simulator Laboratory						
30.	MV8712	Marine Propulsion and Auxiliary Machinery Overhauling Laboratory	PC	2	0	0	2	1
31.	MV8713	Measurement and Instrumentation Laboratory	PC	4	0	0	4	2
32.	MV8801	Marine Vehicles Performance	PC	3	3	0	0	3
33.	MV8802	Ship Operational Management and IMO Requirements	PC	3	3	0	0	3
34.	MV8803	Safety Precautions and Watch Keeping	PC	3	3	0	0	3
35.	MV8804	Offshore Technology	PC	3	3	0	0	3

**ELECTIVES FOR B. E. MARINE ENGINEERING****SEMESTER VII, ELECTIVE I**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MV8001	Advanced Marine Heat Engines	PE	3	3	0	0	3
2.	MV8002	Ship Safety and Environmental Protection	PE	3	3	0	0	3
3.	MV8003	Pressure Vessels and Piping	PE	3	3	0	0	3
4.	GE8074	Human Rights	PE	3	3	0	0	3
5.	GE8077	Total Quality Management	PE	3	3	0	0	3
6.	GE8071	Disaster Management	PE	3	3	0	0	3

**SEMESTER VIII, ELECTIVE II**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MV8004	Special Duty Vessels and Type of Operation	PE	3	3	0	0	3
2.	MV8005	Marine Robotics	PE	3	3	0	0	3
3.	MV8006	Marine Corrosion and Prevention	PE	3	3	0	0	3
4.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3
6	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	HS8581	Professional Communication	EEC	2	0	0	2	1
2	MV8611	Marine Workshop Practical and Afloat Training	EEC		8hrs per day – 6 days a week, 26 weeks, 500 Marks. Sessional Marks 200 Report + Viva 300			12
3	MV8811	Project Work	EEC	20	0	0	20	10

### Summary

MARINE ENGINEERING											
S. No.	Subject Area	Credits Per Semester								Credit Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	4	7							11	7.77
2	BS	12	7	4						23	9.84
3	ES	9	11	3						23	10.36
4	PC			20	26	22		21	12	101	53.89
5	PE							3	3	6	3.11
6	OE					3		3		6	3.11
7	EEC					1	12		10	23	11.92
	TOTAL	25	25	27	26	26	12	27	25	193	
8	Non-Credit/(Mandatory)										

**OBJECTIVES:**

- To enable learners of Engineering and Technology develop their basic communications skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

**UNIT I****12**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking- Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials – Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

**UNIT II****12**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions -Writing - Process descriptions (general/specific) – Definitions Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials -Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations.

**UNIT III****12**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing – Writing-Channel conversion (flowchart into process) - Types of paragraph (cause and effect /compare and contrast / narrative / analytical) - Informal writing - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

**UNIT IV****12**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - writing.

**UNIT V****12**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Sending their responses through email; Writing - Creative



writing, Grammar- Direct and indirect speech; Vocabulary - Lexical items (fixed / semifixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary – Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

**TOTAL : 60 PERIODS**

### **OUTCOMES:**

**Learners should be able to**

- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/view and comprehend different spoken discourses/excerpts in different accents

### **TEXTBOOKS:**

1. NP. Sudharshana , C. Savitha ENGLISH FOR TECHNICAL COMMUNICATION. Cambridge University Press: 2016.

### **REFERENCES:**

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011.
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006.
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001.

### **TEACHING METHODS:**

- Lectures
- Activities conducted individually, in pairs and in groups like self-introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

### **EVALUATION PATTERN:**

**Internal assessment: 20%**

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews
- Creative writing

**OBJECTIVES :**

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus and three-dimensional analytical geometry. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of Marine Engineering students to model the engineering problems mathematically and provide solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and three-dimensional analytic geometry and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

**UNIT I THREE DIMENSIONAL ANALYTICAL GEOMETRY****12**

Equation of a sphere – Plane section of a sphere – Tangent plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

**UNIT II DIFFERENTIAL CALCULUS****12**

Differentiation of algebraic, circular, exponential and logarithmic functions, products, quotient functions of a function and simple implicit functions - Successive differentiation : Introduction and notation -  $n^{\text{th}}$  order derivatives of standard functions -  $n^{\text{th}}$  order derivatives using (a) Trigonometric identities and standard functions (b) Partial fractions - Leibnitz's theorem - Maclaurin's theorem - Taylor's theorem - Indeterminate forms and L'Hospital's rule - Curve tracing of cartesian and polar curves.

**UNIT III FUNCTIONS OF SEVERAL VARIABLES****12**

Limits and continuity - Partial derivatives – Definition - Geometrical interpretation and rules of partial differentiation - Higher order partial derivatives - Homogeneous functions - Euler's theorem for homogenous functions – Total derivatives and chain rules - Differentiation of implicit functions and composite functions - Errors and approximations - Maxima and Minima - Method of Lagrangian multipliers.

**UNIT IV INTEGRAL CALCULUS****12**

Integration of standard forms by substitution and by parts - Definite integral as the limit of a sum - Application of integration to area under curve - Volume of revolution - First moment of area and the position of a centroid of an area - Work done by variable forces - Mean values, Root mean square values of  $\sin nx$  and  $\cos nx$ . Rules of Guldinus - Theorems of parallel and perpendicular axes - Second moments of area and moments of inertia of a rectangular and circular laminas

**UNIT V MULTIPLE INTEGRALS****12**

Double and triple integrals – Cartesian coordinates - Region of integration and change of order of integration - Spherical polar and cylindrical coordinates - Theorems of parallel and perpendicular axes - Second moments of area and moments of inertia of a rectangular and circular laminas - Applications - Area, Volume, Mass of wire, Lamina and solid - Centre of Gravity of wire, lamina and solid - Moment of inertia using multiple integrals.

**TOTAL : 60 PERIODS****OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Use rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals using the Fundamental Theorem of Calculus.
- Apply integration to compute arc lengths, volumes of revolution and surface areas of revolution.
- Apply integration to compute multiple integrals, area, moment of inertia, integrals in polar coordinates, in addition to change of order.

- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Apply the concepts of three-dimensional geometry to model engineering problems.

#### TEXT BOOKS :

1. Bali N. P and Manish Goyal, "A Text Book of Engineering Mathematics", 9<sup>th</sup> Edition, Laxmi Publications Ltd., 2014.
2. Grewal B.S, "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publications, Delhi, 2014.

#### REFERENCES :

1. Embleton, W. and Jackson, L., "Mathematics for Engineers", Vol - I, 7th Edition, Reed's Marine Engineering Series, Thomas Reed Publications, 1997.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Narosa Publishing House Pvt. Ltd., 2007.
3. James, G., "Advanced Engineering Mathematics", 7<sup>th</sup> Edition, Pearson Education, 2007.
4. Ramana, B.V, "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

<b>PH8151</b>	<b>ENGINEERING PHYSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

#### OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

#### UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

#### UNIT II WAVES AND FIBER OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

#### UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conduction in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV                      QUANTUM PHYSICS****9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

**UNIT V                      CRYSTAL PHYSICS****9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL :      45              PERIODS****OUTCOMES:**

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

**TEXT BOOKS:**

1.      Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2.      Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3.      Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

**REFERENCES:**

1.      Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2.      Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3.      Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, 2007.

**OBJECTIVES:**

On Completion of the course the Students are expected to

- Have a thorough knowledge of Boiler Chemistry and Feed Water Treatment methods.
- Have a knowledge of various Water Hardness analysis procedures
- Have a basic concept on Nanochemistry.

**UNIT I WATER TECHNOLOGY****9**

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

**UNIT II WATER TREATMENT PROCESSES****9**

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

**UNIT III BOILER CHEMISTRY****9**

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

**UNIT IV WATER HARDNESS ANALYSIS****9**

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

**UNIT V ENERGY SOURCES AND NANOCHEMISTRY****9**

Introduction - Properties (Electrical, Mechanical and vibration) – carbon nano tubes -Applications in fuel cells, catalysis and use of gold nanoparticles - batteries –secondary batteries - alkaline batteries – lead acid, Ni – Cd and Li batteries, principles and applications of solar cells, fuel cells – Hydrogen and methanol.

**TOTAL: 45 PERIODS****OUTCOME:**

The knowledge gained on various aspects of water chemistry, energy sources and nanochemistry will provide a strong platform to understand concepts on these subjects for further learning.

**TEXT BOOKS:**

1. Jain. P.C. and Monika Jain, "Engineering Chemistry", 4<sup>th</sup> Edition, Dhanpat Rai & Sons, New Delhi, 2002.
2. Milton and Leech, "Marine Boilers", Butter Worth Publishers, UK.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

**REFERENCES:**

1. L. Jackson and T.D. Morton, "Reed's General Engineering Knowledge for Marine Engineers", Vol. 8, 2013.
2. Vairam S., Murugavel S.C. and Chelladurai C, "Engineering Chemistry-I & II", Gems Publishers, 2016.

**OBJECTIVES:**

To know the basics of algorithmic problem solving

- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I ALGORITHMIC PROBLEM SOLVING****9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II DATA, EXPRESSIONS, STATEMENTS****9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III CONTROL FLOW, FUNCTIONS****9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV LISTS, TUPLES, DICTIONARIES****9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

**UNIT V FILES, MODULES, PACKAGES****9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

**OUTCOMES:**

**Upon completion of the course, students will be able to**

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

**REFERENCES:**

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

**GE8152****ENGINEERING GRAPHICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>4</b>	<b>4</b>

**OBJECTIVES:**

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

**CONCEPTS AND CONVENTIONS (Not for Examination)****1**

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

**UNIT I PLANE CURVES AND FREEHAND SKETCHING****7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE****6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS****5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

#### **UNIT IV            PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**

**5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

#### **UNIT V            ISOMETRIC AND PERSPECTIVE PROJECTIONS**

**6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS**

#### **OUTCOMES:**

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

#### **TEXT BOOK:**

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

#### **REFERENCES:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2<sup>nd</sup> Edition, 2009.

#### **Publication of Bureau of Indian Standards:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

#### **Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day



**OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

**LIST OF PROGRAMS**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**

Python 3 interpreter for Windows/Linux

**OUTCOMES:**

**Upon completion of the course, students will be able to**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**TOTAL :60 PERIODS**

**BS8161**

**PHYSICS AND CHEMISTRY LABORATORY**  
**(Common to all branches of B.E. / B.Tech Programmes)**

L	T	P	C
0	0	4	2

**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

- Determination of rigidity modulus – Torsion pendulum
- Determination of Young's modulus by non-uniform bending method
- (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
- Determination of thermal conductivity of a bad conductor – Lee's Disc method.
- Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
- Determination of wavelength of mercury spectrum – spectrometer grating
- Determination of band gap of a semiconductor
- Determination of thickness of a thin wire – Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

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

- apply principles of elasticity, optics and thermal properties for engineering applications.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
  - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
- Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
  - Determination of total, temporary & permanent hardness of water by EDTA method.
  - Determination of DO content of water sample by Winkler's method.
  - Determination of chloride content of water sample by argentometric method.
  - Estimation of copper content of the given solution by Iodometry.
  - Determination of strength of given hydrochloric acid using pH meter.
  - Determination of strength of acids in a mixture of acids using conductivity meter.
  - Estimation of iron content of the given solution using potentiometer.
  - Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
  - Estimation of sodium and potassium present in water using flame photometer.
  - Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
  - Pseudo first order kinetics-ester hydrolysis.
  - Corrosion experiment-weight loss method.
  - Determination of CMC.
  - Phase change in a solid.
  - Conductometric titration of strong acid vs strong base.

**OUTCOMES:**

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

**TOTAL: 30 PERIODS****TEXTBOOKS:**

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)

**HS8201****TECHNICAL ENGLISH FOR MARINE ENGINEERING - II****L T P C**  
**4 0 0 4****OBJECTIVES:**

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

**UNIT I****12**

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary - Listening to different types of conversation and answering questions.

**UNIT II****12**

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

**UNIT III****12**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information - expressing feelings (affection, anger, regret, etc.); Reading - Speed reading - reading passages with time limit - Skimming; Writing -Writing strategies- essay writing; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary

#### **UNIT IV**

**12**

Listening - Listening to a telephone conversation, Speaking- Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

#### **UNIT V**

**12**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

**TOTAL : 60 PERIODS**

#### **OUTCOMES:**

Learners should be able to

- Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- Write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- Listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

#### **TEXT BOOKS:**

1. NP. Sudharshana, C. Savitha. **ENGLISH FOR TECHNICAL COMMUNICATION** Cambridge University Press, 2016.

#### **REFERENCES:**

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007
6. EXTENSIVE Reading (Not for Examination) <http://owl.english.purdue.edu>

**TEACHING METHODS:**

- Lectures and activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc.
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc

**MA8201****MATHEMATICS FOR MARINE ENGINEERING – II**

L	T	P	C
4	0	0	4

**OBJECTIVES :**

This course is designed to cover topics such as Ordinary Differential Equations, Vector Calculus, Complex Analysis and Laplace Transform. Ordinary Differential Equations is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modeling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

**UNIT I                      ORDINARY DIFFERENTIAL EQUATIONS – FIRST ORDER  
AND APPLICATIONS**
**12**

Definition - Order and degree - Formation of differential equation - Solution of first order, first degree equations in variable separable form, homogeneous equations, other substitutions - Equations reducible to homogeneous and exact differential equations - Equations reducible to exact Integration - Factor - Linear differential equation of first order first degree, reducible to linear - Applications to electrical circuits and orthogonal trajectories

**UNIT II                      ORDINARY DIFFERENTIAL EQUATIONS – HIGHER ORDER  
AND APPLICATIONS**
**12**

Higher ( $n^{\text{th}}$ ) order linear differential equations - Definition and complementary solution - Methods of obtaining particular integral - Method of variation of parameters - Method of undetermined coefficients - Cauchy's homogeneous linear differential equations and Legendre's equations - System of ordinary differential equations - Simultaneous equations in symmetrical form - Applications to deflection of beams, struts and columns - Applications to electrical circuits and coupled circuits

**UNIT III                      VECTOR CALCULUS**
**12**

Gradient - Divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

**UNIT IV                      ANALYTIC FUNCTIONS**
**12**

Functions of a complex variable – Analytic functions – Necessary conditions - Cauchy – Riemann equation and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping

:  $w = z + c$ ,  $c\bar{z}$ ,  $\frac{1}{z}$ , and bilinear transformation.

**UNIT V LAPLACE TRANSFORM****12**

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions - Definition of inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**TOTAL : 60 PERIODS****OUTCOMES :**

After successfully completing the course, the student will have a good understanding of the following topics:

- Apply various techniques in solving differential equations.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

**TEXT BOOKS :**

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", 9<sup>th</sup> Edition, Laxmi Publications (p) Ltd., 2014.
2. Grewal. B.S, "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publications, Delhi, 2014.

**REFERENCES :**

1. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Narosa Publishing House Pvt. Ltd., 2007.
2. James, G., "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2007.
3. Kreyszig Erwin, "Advanced Engineering Mathematics", 10<sup>th</sup> Edition, John Wiley, India, 2016.
4. Ramana B.V, "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd., New Delhi, 2016.

**MATERIALS SCIENCE**

PH8251	(Common to courses offered in Faculty of Mechanical Engineering Except B.E. Materials Science and Engineering )	L	T	P	C
		3	0	0	3

**OBJECTIVES:**

- To introduce the essential principles of materials science for mechanical and related engineering applications.

**UNIT I PHASE DIAGRAMS****9**

Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

## 9

## 9

## 9

## 9

**TOTAL: 45 PERIODS**

**OBJECTIVES:**

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Working principle of Various electronic devices and measuring instruments

**UNIT I      ELECTRICAL CIRCUITS**

**9**

Basic circuit components – Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevenin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

**UNIT II      AC CIRCUITS**

**9**

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits – Three phase loads - housing wiring, industrial wiring, materials of wiring

**UNIT III      ELECTRICAL MACHINES**

**9**

Principles of operation and characteristics of ; DC machines, Transformers (single and three phase), Synchronous machines , three phase and single phase induction motors.

**UNIT IV      ELECTRONIC DEVICES & CIRCUITS**

**9**

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics —Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

**UNIT V      MEASUREMENTS & INSTRUMENTATION**

**9**

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - ,Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes- – three-phase power measurements– instrument transformers (CT and PT )

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Ability to

- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

**TEXT BOOKS**

1. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

**REFERENCES**

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006



3. Allan S Moris, "Measurement and Instrumentation Principles", Elsevier, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016

**GE8291**

**ENVIRONMENTAL SCIENCE AND ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

**14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION**

**8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES**

**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources,

use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

#### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

#### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

#### **TEXT BOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

#### **REFERENCES :**

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

**OBJECTIVES:**

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

**UNIT I          STATICS OF PARTICLES****9+6**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

**UNIT II          EQUILIBRIUM OF RIGID BODIES****9+6**

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

**UNIT III          PROPERTIES OF SURFACES AND SOLIDS****9+6**

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

**UNIT IV          DYNAMICS OF PARTICLES****9+6**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

**UNIT V          FRICTION AND RIGID BODY DYNAMICS****9+6**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

**TOTAL : 45+30=75 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

**TEXT BOOKS:**

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8<sup>th</sup> Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**REFERENCES:**

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11<sup>th</sup> Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4<sup>th</sup> Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3<sup>rd</sup> Edition, Vikas Publishing House Pvt. Ltd., 2005.

**GE8261****ENGINEERING PRACTICES LABORATORY****L T P C  
0 0 4 2****OBJECTIVES:**

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)****I CIVIL ENGINEERING PRACTICE****13****Buildings:**

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**Plumbing Works:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

- (e) Demonstration of plumbing requirements of high-rise buildings.

**Carpentry using Power Tools only:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

**II MECHANICAL ENGINEERING PRACTICE****18****Welding:**

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making – Trays and funnels.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)****III ELECTRICAL ENGINEERING PRACTICE****13**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**IV ELECTRONICS ENGINEERING PRACTICE****16**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:****CIVIL**

- |   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |

3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

### **MECHANICAL**

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

### **ELECTRICAL**

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

### **ELECTRONICS**

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

**OBJECTIVE:**

- To train the students in performing various tests on electrical drives, sensors and circuits.

**LIST OF EXPERIMENTS:**

1. Load test on separately excited DC generator
2. Load test on Single phase Transformer
3. Load test on Induction motor
4. Verification of Circuit Laws
5. Verification of Circuit Theorems
6. Measurement of three phase power
7. Load test on DC shunt motor.
8. Diode based application circuits
9. Transistor based application circuits
10. Study of CRO and measurement of AC signals
11. Characteristics of LVDT
12. Calibration of Rotometer
13. RTD and Thermistor

**Minimum of 10 Experiments to be carried out :-**

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to determine the speed characteristic of different electrical machines
- Ability to design simple circuits involving diodes and transistors
- Ability to use operational amplifiers

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	D. C. Motor Generator Set	2
2	D.C. Shunt Motor	2
3	Single Phase Transformer	2
4	Single Phase Induction Motor	2
5	Ammeter A.C and D.C	20
6	Voltmeters A.C and D.C	20
7.	Watt meters LPF and UPF	4
8.	Resistors & Breadboards	-
9.	Cathode Ray Oscilloscopes	4
10.	Dual Regulated power supplies	6
11.	A.C. Signal Generators	4
12.	Transistors (BJT, JFET)	-

**OBJECTIVES:**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS****12**

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

**UNIT II FOURIER SERIES****12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS****12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

**UNIT IV FOURIER TRANSFORMS****12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS****12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

**TOTAL : 60 PERIODS****OUTCOMES :**

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.



**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

**REFERENCES :**

1. B.V Ramana.., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10<sup>th</sup> Edition, John Wiley, India, 2016.
3. G. James, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2007.
4. L.C Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
5. N.P. Bali. and Manish Goyal, "A Textbook of Engineering Mathematics", 9<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd, 2014.
6. R.C. Wylie, and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**MV 8301****MARINE HYDRAULICS AND FLUID MACHINERY**

L	T	P	C
3	0	0	3

**OBJECTIVE:**

- To develop the theoretical and application skills of students in Marine Hydraulics and Fluid Machinery.

**UNIT I****FLUID STATICS****9**

Properties of fluid – pressure head – Pascal’s law – absolute and gauge pressures – measurement of pressure – manometers (single, U-tube, differential), Mechanical gauges – Hydrostatic forces on a submerged plane and curved surfaces – centre of pressure – Buoyancy and Floatation – Metacentric height – stability of floating and submerged bodies.

**UNIT II****FLUID KINEMATICS AND DYNAMICS****9**

Kinematics: Types of fluid flow – Types of flow lines – rate of flow – continuity equation – circulation and vorticity – stream function, velocity potential – equipotential line – Cauchy Riemann equations – flow nets.

Dynamics: Euler’s Equation of motion – Bernoulli’s equation – applications – venturimeter, orifice meter, pilot tube – free liquid jet – impulse momentum equation – Coriolis coefficients – flow through an orifice – Torricelli’s theorem – hydraulic coefficients.

**UNIT III****LAMINAR AND TURBULENT FLOWS****9**

Reynold’s experiment – critical Reynolds number – Rotating Viscometer – Navier – Stokes equations of motion – relation between shear stress and pressure gradient – flow of viscous fluid in circular pipes – turbulent flow – major and minor energy losses – pipes in series and parallel – power transmission through pipes – boundary layer – characteristics – thickness – total drag due to laminar and turbulent layer – boundary layer separation and its control.

**UNIT IV****PUMPS****9**

Rotodynamic pumps – principles of dimensional analysis – Buckingham’s theorem – important dimensionless numbers applicable to fluid mechanics – impact of jets – force exerted by a jet on flat, curved plates and pipe bends. surge pressure and control – centrifugal pumps – some definitions – pump output and efficiencies – effect of vane angle – cavitation – constructional

details, pump characteristics, multistage pumps. Axial flow pumps – characteristics – constructional details, non-dimensional parameters – efficiencies. Vibration & noise in hydraulic pumps.

## **UNIT V                      HYDRAULIC TURBINES**

**9**

Classification of hydraulic turbines – pelton turbines, velocity triangle – efficiencies – non dimensional numbers, working principle of the pelton wheel. francis and kaplan turbines – velocity triangles, - efficiencies of the draft tubes, hydraulic turbine characteristics.

**TOTAL : 45              PERIODS**

### **OUTCOMES:**

- The Fluid properties and effect of various forces acting on different planes ,surfaces and Pipes.
- The In-viscid flow and Real Viscous flow and their characteristics.
- The principles of theoretical aspect of pumps and hydraulic turbines fitted on board ships.

### **TEXT BOOKS:**

1. Joy, “Hydraulic Power Transmission In Marine Machinery”, Marine Engineering Practice Vol-1, Part-07 , IMarEST, London,2002
2. Gupta, S.C.,” Fluid Mechanics and Hydraulic Machines” 1<sup>st</sup> Ed. Pearson, 2011.
3. John F.Douglas, Janusz M. Gasiorek, John A. Swaffield and Lynne B. Jack, “ Fluid Mechanics”, 1<sup>st</sup> Ed. Pearson, Sixth Impression, 2011

### **REFERENCES**

1. Roberson, J.A. and Crowe C.T., “Engineering Fluid Mechanics”, 6th Edition, John wiley, 1999.
2. Narayana Pillai,N,”Principles of Fluid Mechanics and Fluid Machines”,3<sup>rd</sup> Edition, University Press, 2013
3. James A. Fay, “Introduction to Fluid Mechanics”, PHI Learning Pvt. Ltd.,1994
4. Anthony Esposito, “ Fluid Power with Applications”,6<sup>th</sup> Ed. Pearson, 2003
5. R K Rajput, “Fluid Mechanics and Hydraulic Machines” 2<sup>nd</sup> revised Edition, S.Chand & Company Ltd., New Delhi, 2002
6. Bruce,R.M., Donald, F.Y., Theodore, H.O., “Fundamentals Of Fluid Mechanics” 5th Edition, John Wiley & Sons (Asia) Pvt. Ltd. India,2002

**MV8302**

**BASICS OF MARINE ENGINEERING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **OBJECTIVES:**

- Have studied the renewable and Non-Renewable Energy Sources
- Have a good knowledge of working principle of 2 Stroke and 4 Stroke Marine IC Engines
- Have sound knowledge of Marine Refrigeration and Air- Conditioning Plant
- Have a Knowledge of Metal Forming and Joining Processes and various Power Transmission methods

## **UNIT I                      ENERGY RESOURCES AND POWER GENERATION**

**9**

Renewable and Non-renewable resources – thermal, hydel, solar, wind, tidal, geothermal and nuclear – Indian energy scenario.

Power Plants - Steam, gas turbine, diesel, nuclear and hydel power plants – Layout, major components and working, Choice of the type of plant, Combined cycles, cogeneration, Importance of Energy storage, Environmental constraints of power generation using fossil fuels and nuclear energy.

Steam generators - Classification, working or Cochran, Babcock Wilcox, Lamont and Benson boilers, Principles and features of modern high pressure boiler – tower type boilers. (A separate study of boiler mountings and accessories are beyond the scope of this course).



**OBJECTIVE:**

- To develop theoretical Knowledge of students on the process of manufacture of Marine Components.

**UNIT I METAL JOINING PROCESSES 9**

Metal joining processes – flexible and permanent, Principles of welding – Fundamentals of arc welding, gas welding, gas cutting and Under water welding, Brazing and Soldering. Classification plastic welding, fusion welding, solid phase welding and sub classification. Study of power sources, electrodes, processes and applications: SMAW, SAWM, GTAW, GMAW, PAW, electro gas welding and Electro Slag, resistance welding. Defects and Inspection of welded joints.

**UNIT II CASTING PROCESSES 9**

Sand casting, pattern and core making, moulding process - sand properties, melting furnaces – pit furnace and electric furnaces. Special casting processes – shell, investment, die casting – pressure and gravity types – squeeze casting - defects in casting - Plastic moulding – injection and blow moulding, and moulding – testing and inspection., Defects in shafting

**UNIT III FINISHING PROCESSES 9**

Surface finishing processes: grinding processes, various types of grinders, work holding devices, grinding wheels and specification, selection of grinding wheels for specific applications – selection of cutting speed and work speed. Fine Finishing Process: Lapping, honing, and super finishing process , ship hull finishing.

**UNIT IV METAL FORMING PROCESSES 9**

Hot and cold working processes – rolling, forging, drawing and extrusion processes, bending, hot spinning, shearing, tube and wire drawing, cold forming, shot peening. Sheet metal working – blanking, piercing, punching, trimming, Bending – types of dies – progressive, compound and combination dies. High-energy rate forming processes.

**UNIT V MACHINING PROCESSES 9**

Lathe: working principle, classification, specification accessories, lathe and tool holders, different operations on a lathe, methods of taper turning machining time and power required for cutting, Drilling and boring - classification, specification, cutters speed feed, machining time parts and description of parts parts-boring machines- jig borer –description, types and hole location procedures – milling - classification, principle, parts- specification milling cutters indexing, selection of milling m/c fundamentals of inches processes, milling processes and operations – CNC machines.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Metal joining processes
- Casting processes.
- Metal forming, Machining and finishing processes.

**TEXT BOOKS:**

- Jeffus, Welding and Metal fabrication”,1<sup>st</sup> Ed. Cengage, Indian reprint-Yesdee Publishings Pvt. Ltd. 2012
- Rao.P.N., “Manufacturing Technology, Metal Cutting and Machine Tools”, Tata McGraw-Hill, 2000.
- Shan, H.S., “ Manufacturing processes”, Vol I, 1<sup>st</sup> Ed. Pearson, 2013

## REFERENCES

1. Jain K.C. Agarwal, L.N. "Metal Cutting Science and Production Technology", 1<sup>st</sup> edition, Khanna Publishers, 1986.
2. Chapman W.A.J., "Workshop Technology", Vol. II, Arnold Publishers, 1972
3. H.M.T., "Production Technology", Tata McGraw-Hill, New Delhi, 2000.
4. Serope Kalpakjian, Steven, R. Schmid, "Manufacturing Engineering and Technology," 4<sup>th</sup> Ed. Pearson, 2011
5. Timings, "Fabrication and Welding Engineering", Elsevier, Indian Reprint -Yesdee Publishings Pvt. Ltd. 2011
6. Kemp & Young, "Ship construction : Sketches and Notes", 1<sup>st</sup> Ed. Standfor Maritime Limited, 1982

**MV 8304**

**MARINE ELECTRICAL MACHINES – I**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>2</b>	<b>0</b>	<b>4</b>

### OBJECTIVE:

- To expose the students to the Electrical equipments fitted on boards ships, the concepts of electrical measurements and electrical distribution systems.

### **UNIT I                      PRINCIPLES OF D.C. MACHINES AND GENERATORS                      9+6**

Principles of DC machines – construction – winding and e.m.f equations – armature reaction – commutation – brush shift – compensating winding – D.C. generator – their characteristics- methods of excitation – parallel operation – performance equations.

### **UNIT II                      D.C. MOTORS                      9+6**

D.C. Motor –their characteristics – starting and reversing – speed – torque equations – starters– speed control including electronic method of control – testing of D.C. machines for finding out the losses and efficiency – braking of D.C. motor, Ward-Leonard control.

### **UNIT III                      TRANSFORMERS                      9+6**

Transformers – types and applications – operating principle – e.m.f. Equations – phase diagrams under no load and load conditions – leakage resistance – equivalent circuits –voltage regulation – losses and efficiency – open circuit and short circuit tests – parallel operation – three phase transformers – core and shell type – current and potential transformers – auto-transformers (single phase and three phase) - specification of coolants

### **UNIT IV                      INSTRUMENTS AND TESTING                      9+6**

Basic requirements of measuring instrument-static and dynamic characteristics of measuring instruments – principles of indicating instruments – control and damping devices – moving coil and moving iron instruments and their use as voltmeters and ammeters – dynamometer type wattmeter – thermocouple type ammeter, voltmeters and wattmeter. extension of instrument range.

### **UNIT V                      DISTRIBUTION AND TRANSMISSION SYSTEMS                      9+6**

Two wire and three wire D.C. distribution – A.C. Transmission – single and three phase – comparison of D.C. and A.C. transmission – use of balancer – 2-wire, 3-wire and 4- wire A.C. distribution – copper efficiency under different modes of distribution – one end fed and ring main distributor – fuses and its materials – D.C. air circuit breaker – A.C. air circuit breakers. Introduction to high voltage installations.

**TOTAL :75 PERIODS**

**OUTCOMES:**

- The knowledge about construction and operation of D.C. Machines in general and generators in particular
- To introduce the concepts about measurement practices and measuring instruments.
- To familiarize the students with the operation and control of D.C. motors.
- To study the construction and operation of transformer.
- To study the structure and functioning of transmission and distribution.

**TEXT BOOKS:**

1. Edmund GR Kraal, Stanley Buyers, Christopher Lavers, "Basic electro-technology for marine engineers", 4<sup>th</sup> Ed. Reeds Vol 06, 2013
2. Hughes Edward, "Electrical technology", 2nd edition, "ELBS with DP Publications", USA, 1996.
3. I.J Nagrath and D.P Kothari, "Basic Electrical Engineering", 2nd Edition, McGraw Hill Publishing Co., Ltd., New Delhi, 2002.

**REFERENCES**

1. Uppal S.L., "Electrical Power", 13th Edition, Khanna publishers, Mumbai, 2002.
2. Berde M.S., "Electric Motor Drives", 1st Edition, Khanna Publishers, Mumbai, 1995.
3. W. Laws, "Electricity Applied To Marine Engineering", 4th edition, The Institute Of Marine Engineers, London, 1998.
4. Gorti Ramamurthi, " Handbook of Electrical Power Distribution", 2<sup>nd</sup> Ed. Universities Press, 2009
5. Bhag, S. Guru, Huseyin, R. Hizioglu, "Electric Machinery and Transformers", 3<sup>rd</sup> Ed. Oxford University Press, 2013

**CE8395****STRENGTH OF MATERIALS FOR  
MECHANICAL ENGINEERS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

**UNIT I                      STRESS, STRAIN AND DEFORMATION OF SOLIDS                      9**

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

**UNIT II                      TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM                      9**

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

**UNIT III TORSION****9**

Torsion formulation stresses and deformation in circular and hollow shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

**UNIT IV DEFLECTION OF BEAMS****9**

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS****9**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theorem.

**TOTAL: 45 PERIODS****OUTCOMES:**

Students will be able to

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures.

**TEXT BOOKS:**

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

**REFERENCES:**

1. Egor. P. Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

**MV 8305****MARINE MACHINERY DRAWING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>1</b>	<b>0</b>	<b>4</b>	<b>3</b>

**OBJECTIVE:**

- To make the students understand and practice Machine Drawing.

**UNIT I EXPLANATION AND SKETCHING****3+12**

Dimensioning conventions of shafts, arcs, angles, holes, tapers, welded joints, threads and pipes conventional representation of metals and materials. sectioning conventions, removed sections and revolved sections, parts not usually sectioned, conventions of gears

**UNIT II LIMITS, FITS AND TOLERANCES 3+12**

Limits and tolerances, Surface Finish, Type of fits – description, hole basis system and shaft basis system, calculations involving minimum and maximum clearances for given combination of tolerance grades- simple problems, geometric tolerances

**UNIT III RIVETS AND JOINTS 3+12**

Sketching screw-threads, screwed fastenings, rivets and riveted joints keep. cotter joints & pin joints.

**UNIT IV MARINE MACHINERY PARTS 3+12**

Drawing of machine components in assembly - details like couplings, glands, non-return valves, cocks & plugs, cylinder, connecting rod & bearings. boiler mountings – full bore safety valve, gauge glass, main stop valve.

**UNIT V MARINE COMPONENT 3+12**

Assembly drawings of simple marine components - bilge strainer boxes, control valves, cylinder relief valves, boiler blow down cock.

**TOTAL : 75 PERIODS**

**OUTCOMES:**

- The Method of sketching to Explain the Limits, Fits and Tolerances arcs etc., with respect to the Marine Machinery.
- To Sketch Valves, Cocks and Plugs .
- To draw Various parts of Marine Machinery and the general Marine components

**TEXT BOOKS:**

1. MacGibbon's "Pictorial Drawing Book for Marine Engineers-James", 8th Edition, G.Holburn & John J. Seaton, James Munro & Company Limited, Engineering and Nautical Publishers, Mumbai, 1978.
2. Beck, H.G., "Engineering Drawings for Marine Engineers", 2<sup>nd</sup> Ed., Reeds Vol 11, Adlard Coles Nautical, London, 2012
3. N.D.Bhatt, "Machine Drawing", 18th Edition, Charotar Publication, Mumbai, 2001.

**REFERENCES**

1. Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore, 2003.
2. Gill P.S., "A text book on Machine Drawing", S.K. Kataria & sons, Mumbai, 2000.
3. Junnarkar, N.D., "Machine Drawing", 1<sup>st</sup> Ed. Pearson, 2004
4. Jindal, U.C., "Machine Drawing", 1<sup>st</sup> Ed. Pearson, 2010

<b>MV 8311</b>	<b>MARINE HYDRAULICS AND FLUID MACHINERY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVE:**

- To impart skill and knowledge on Fluid Mechanics and Fluid Machinery operation

**LIST OF EXPERIMENTS****(A) FLUID MECHANICS LAB****20**

Buoyancy Experiment – Metacentric Height for Cargo and War ship models. Fluid flow measurement using Pitot tube, Flow nozzle, Rotameter, Notches etc. Cd of Venturimeter and orifice-meter. Determination of frictional losses in pipes.



**(B) FLUID MACHINERY LAB****25**

Centrifugal pumps- Performance characteristics of a constant speed pump, specific speed. Performance characteristics of multistage pump. Characteristics of Impulse and Reaction Turbine Specific speed and unit quantities. Positive displacement pumps. Performance characteristics of a deep well pump, Jet pump

**TOTAL: 60 PERIODS****OUTCOMES:****Upon Completion of the course, the students will be able to:**

- Understand the flow behavior of fluids
- Calculate the frictional losses and  $C_d$  of fluids when it passes through various obstructions
- Calculate the performance characteristics of hydraulic pumps and turbines.

**REFERENCES**

1. Laboratory Manuals
2. Anthony Esposito, "Fluid Power with Applications", 6<sup>th</sup> Ed. Pearson, 2003
3. Schober, "Fluid Mechanics for Engineers", 1<sup>st</sup> Ed. Springer, Indian Reprint 2013( Yesdee Publishings Pvt. Ltd.)
4. Shesha Prakash, "Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures", 1<sup>st</sup> Ed. PHI Learnings Pvt. Ltd., 2011

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS  
FLUID MECHANICS LABORATORY**

Sl.No.	Name of the Equipment	Qty.
01	<b>Buoyancy Experiment</b>	
	Cargo Ship Model	01
	War Ship Model	01
02	Pitot tube	01
	Flow nozzle	01
	Rotameter	02
	Notches	02
03	Venturimeter	02
04	Orifice meter	01
05	Frictional Losses in pipes	01

**FLUID MACHINERY LABORATORY**

Sl.No.	Name of the Equipment	Qty.
01	Centrifugal pump	01
02	Multistage Centrifugal Pump	01
03	Impulse Turbine (Pelton)	01
04	Reaction Turbine (Francis)	01
05	Reciprocating pump	01
06	Submersible pump	01
07	Jet pump	01

**OBJECTIVE:**

- To impart skill to the students to understand and conduct the experiments to test materials in the Strength of materials and applied mechanics Laboratory

**STRENGTH OF MATERIALS LAB**

**LIST OF EXPERIMENTS**

1. Tension Test on M.S. Rod.
2. Compression test – Bricks, concrete cubes.
3. Deflection Test - Bench type verification of Maxwell theorem.
4. Tension test on thin wire.
5. Hardness test on various machines.
6. Tests on wood - Tension, compression, bending, impact in work testing machine.
7. Tests on springs - Tension, compression.

**APPLIED MECHANICS LAB**

8. Impact test.
9. Double shear Test in U.T.M.
10. Load measurement using load indicator, load coils.
11. Fatigue test.
12. Strain measurement using Rosette strain gauge.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- To operate the various testing machines.
- To carry out various tests on materials
- To choose the best materials for a particular use , based on the test results

**REFERENCES**

1. Laboratory Manuals
2. Jindal, U.C., “ Strength of Materials’, 1<sup>st</sup> Ed., Pearson, 2011

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

SL.NO	NAME OF THE EQUIPMENT	QTY.
1.	UTM (Universal Testing Machine)	01
2.	Compression Testing Machine	01
3.	Deflection Testing Rig	01
4.	Hardness – Vickers, Brinell, Rockwell, Testing Machines	01
5.	Spring Testing Machines – Tension, Compression	01
6.	Impact Testing Machines – (Izod, Charpy)	01
7.	Load Cells	01
8.	Fatigue Testing Machine	01
SL.NO	NAME OF THE EQUIPMENT	QTY.
1.	Crucible furnace	01
2.	Sand Strength Testing Machine	01
3.	Permeability	01
4.	Shear Strength Testing Machine	01
5.	Compression Strength Testing Machine	01
6.	Transfer Strength Testing Machine	01

**OBJECTIVE:**

- At the end of the study of this topic the students should have the knowledge on basic Thermodynamics and solve the problems on First and Second Law of Thermodynamics and Gas power cycles. Also should have the knowledge on fuel used in IC Engines and Combustion of Fuels.

**UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9**

Thermodynamic systems, concepts of continuum, thermodynamic properties, equilibrium, processes, cycle, work, heat, temperature, Zeroth law of thermodynamics. First law of thermodynamics – applications to closed and open systems, internal energy, specific heats, enthalpy, – applications to steady and unsteady flow conditions.

**UNIT II BASIC CONCEPTS OF SECOND LAW OF THERMODYNAMICS 9**

Thermodynamic systems, Second law of thermodynamics Statements, Reversibility, causes of irreversibility, Carnot cycle, reversed Carnot cycle, heat engines, refrigerators, and heat pumps. Clausius inequality, entropy, principles of increase in entropy, Carnot theorem, available energy, availability.

**UNIT III FLUID CYCLES 9**

Thermo dynamic properties of pure substances, property diagram, PVT surface of water and other substances, calculation of properties, first law and second law analysis using tables and charts,

**UNIT IV GAS POWER CYCLES 9**

Properties of ideal and real gases, equation of state, gas laws. Gas power cycles – Carnot, Otto, Diesel, Dual, Brayton, Ericsson, Sterling, Lenoir, Atkinson Cycles.

**UNIT V THERMODYNAMIC RELATIONS AND COMBUSTION OF FUEL 9**

Exact differentials, T-D diagrams, Maxwell relations, Clasius Claperon Equations, Joule-Thomson coefficients. Heat value of fuels, Combustion equations, Theoretical and excess air, Air fuel ratio and Exhaust gas analysis

**TOTAL : 45 PERIODS****OUTCOMES:**

- Upon completion of this course, the students can able to apply the Thermodynamic Principles to Mechanical Engineering Application.
- Apply mathematical fundamentals to study the properties of steam, gas and gas mixtures

**TEXT BOOKS:**

- Nag, P.K., "Engineering Thermodynamics", 1<sup>st</sup> Edition, Tata McGraw-Hill Publishing Company Limited New Delhi, 1993.
- Russel, "Engineering Thermodynamics", 1<sup>st</sup> Edition, Oxford University Press, 2007.

**REFERENCES:**

- Holmann, "Thermodynamics", 4<sup>th</sup> Edition, McGraw-Hill Book Company, New York, 1888.
- Rao, Y.V.C., "Thermodynamics", 4<sup>th</sup> Edition, Wiley Eastern Ltd., New Delhi, 1993.
- William Embleton obe., "Applied Heat for Engineers", Reed's Marine Engineering Series, Vol.3, Thomas Reed Publication, Reprint 1999.

**OBJECTIVE:**

- To Teach students so as to have the basic knowledge in Marine Diesel Engines

**UNIT I PERFORMANCE CHARACTERISTICS OF I.C. ENGINE 9**

4-Stroke and 2-Stroke cycles; Deviation from ideal condition in actual engines; Limitation in parameters, Timing Diagrams of 2-Stroke and 4-Stroke engines. Comparative study of slow speed, medium speed and high-speed diesel engines – suitability and requirements for various purposes. Mean Piston speed, M.C.R. & C.S.R. ratings. Practical heat balance diagrams and thermal efficiency.

**UNIT II GENERAL DESCRIPTION OF MARINE DIESEL ENGINE 9**

Constructional Details of I.C. engines and marine diesel engines: components: jackets and liners, cylinder heads and fittings, pistons, cross heads, connecting rods, crank shaft, bearings, bed plates, A-frames, welded construction for bedplates & frames and tie rods etc.

**UNIT III SCAVENGING SYSTEM 9**

Scavenging arrangements in 2-stroke engines; air charging and exhausting in 4-stroke engines; various types of scavenging in 2-stroke engines; uniflow, loop and cross flow scavenging, their merits and demerits, scavenge pumps for normally aspirated engines, under piston scavenging, scavenge manifolds.

**SUPERCHARGING ARRANGEMENTS**

Pulse and constant pressure type; merits and demerits in highly rated marine propulsion engines. air movements inside the cylinders. turbocharger and its details.

**UNIT IV FUEL TECHNOLOGY 9**

Liquid fuels – petroleum – distillation process – effects of modern refining on residual fuel properties – fuel oil for marine diesel engines – testing and properties of fuel oils – shore side and shipboard sampling and testing. Treatment of fuel for contaminants including microbiological infection. Combustion of fuel-air for combustion – combustion of hydrocarbons (theoretical treatment). Compression pressure ratio and its effect on engines. Reasons for variation in compression pressure and peak pressure. Design aspects of combustion chamber. Control of NOX, SOX in Exhaust emission.

**UNIT V MARINE LUBRICATING OIL 9**

Introduction – hydrocarbon classification refining of crude petroleum and lubricating oils properties and testing of lubricating oils and additives – greases. lubrication principles: introduction – friction – functions of lubricants – basic requirements – machine components – surface finish – types of lubricants – hydrodynamic or full fluid film lubrication – lubrication of slider bearings – hydrostatic lubrication – boundary lubrication – elastohydrodynamic lubrication.

**SELECTION OF LUBRICANTS**

Introduction – field of application – cylinder lubrication for large two stroke engines – crank case oil for large two stroke engines – lubricants for medium speed trunk piston engines medium / high and high – speed engines – air compressor cylinder oil – all purpose oil – refrigeration compressor crank case oil. Lubricating systems for various engines – monitoring engines through lubricating oil analysis reports. Treatment of Luboil for contaminants including microbiological degradation.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- On Various types of Marine Diesel Engines.
- Of Various systems used in Marine Diesel Engine plants.
- On the theoretical aspect of Scavenging and super charging system.
- Of qualities and behavior of various types of fuel Oil and Lubricating Oil used in Marine Diesel Engines.

**TEXT BOOKS:**

1. D.A. Taylor, "Introduction to Marine Engineering", 2nd Edition, Butter worth – Heinemann, London, 1999
2. Wood yard, Doug, "Pounder's Marine Diesel Engines", 7th Edition, Butter Worth Heinemann Publishing, London, 2001.
3. Leslie Jackson, Thomos D Morton, Paul A Russell, "Motor Engineering Knowledge For Marine Engineers", 3<sup>rd</sup> Ed. Reeds Vol 12, Adlard Coles Nautical, London, 1994

**REFERENCES**

1. M.E.P., "Low Speed Diesel Engines New", Marine Engineering Practice, Vol-2 Part-17,, IMarEST, London, 2004
2. S. H. Henshall, "Medium and High Speed Diesel Engines for Marine Use", 1<sup>st</sup> Edition, Institute of Marine Engineers, Mumbai, 1996.
3. D.K. Sanyal, "Principle & Practice of Marine Diesel Engines", 2nd Edition, Bhandarkar Publication, Mumbai, 1998.
4. Mathur, M.L., Sharma, R.P., " Internal Combustion Engines", 7<sup>th</sup> Ed. Dhanpat rai Publications, REPRINT 2002

**MV 8403****MARINE BOILERS AND STEAM ENGINEEERING**

L	T	P	C
3	0	0	3

**OBJECTIVE:**

- To provide knowledge to the students about Marine Boilers and Steam Engines.

**UNIT I MARINE BOILERS & BOILER MOUNTINGS 9**

Scotch Boiler, Cochran, Spanner, Clarkson thimble tube, Waste heat recovery calculation, Lamont exhaust gas boiler, Composite boilers, Water tube boilers – Babcock Wilcox, Foster Wheeler – D-type, Double evaporation boilers.

Safety Valves – Improved High Lift, Full lift and full Bore type:

Gauge glass – Ordinary plate type and remote Indicator; Automatic feed regulator, three element High & Low water level alarms, Main Steam stop valve, Retractable type Soot blower etc.

**UNIT II OPERATION & MAINTENANCE OF BOILERS 9**

Pre-commissioning procedures, Hydraulic tests, steam raising and Operating procedures, Action in the event of shortage of water. Regular boiler water tests on board. Blowing down of boiler, Laying up a boiler; general maintenance, External and internal tube cleaning. Tube renewals, etc., maintenance, inspection and survey of boilers. Refractory: Purposes of refractory, types of refractory and reasons for failure. Oil burning: Procedure of Liquid fuel burning in open furnace, Various types of atomizer, Furnace arrangement for oil burning, Boiler Control System i.e. master control, fuel control, air control and viscosity control, Introduction to Automation.

### **UNIT III        MARINE STEAM PLANTS**

**9**

Steam engines - History of multiple expansion marine reciprocating engines & steam turbines. Description of different types of steam turbines. Layout of plant - General layout of plant & description of a modern geared steam turbine installation including auxiliaries in modern use, open and closed feed system.

Condensers - Types of condensers, constructional details, location & working principles, contraction and expansion allowances, leak test. Effect of change of temperature, circulating water quantity, change of main engine power, condenser surface.

### **UNIT IV        LUBRICATION FOR STEAM ENGINES AND TURBINES**

**9**

Suitable oils and their properties, lubrication of main bearings, thrust bearings and gears. Gravity and pressure lubrication-oil system and emergency lubrication arrangement.

### **UNIT V        OPERATION AND MAINTENANCE OF TURBINES**

**9**

Turbine drain system, turbine gland system, warming through a turbine plant, control of speed and power of propulsion, throttle valve control and nozzle control, emergency controls, emergency operation of turbines, vibration in marine steam turbine, steam turbine losses. Breakdown and faultfinding. Selection of materials: Materials used in various components like blades, rotors, casings, sealing glands, gears etc & their justification.

**TOTAL : 45 PERIODS**

#### **OUTCOMES:**

- Waste heat boilers and boiler mountings.
- Operation and Maintenance of boilers.
- Construction of steam turbines and steam engines.
- The various Method of Lubrication of turbines
- The operation and maintenance of steam turbines.

#### **TEXT BOOKS:**

1. J.H. Milton & R.M. Leach, "Marine Steam Boilers", 4th Edition, Butter worth, London, 1980
2. C. McBirnie, "Marine Steam Engines and Turbines", 4th Edition, Butter worth, London 1980.
3. Thomas D. Morton, "Steam Engineering Knowledge for Marine Engineers", 3<sup>rd</sup> Edition, Thomas Reed Publications, London 1979.

#### **REFERENCES**

1. GTH. Flanagan, "Marine Boilers" 3rd Edition, Butter worth, London, 2001.
2. K.M.B. Donald, "Marine Steam Turbines", 1st Edition, Institute of Marine Engineers, London, 1977.
3. Leslie Jackson and Thomas D. Morton, "General Engineering Knowledge for Marine Engineers, Reed's Vol.8, Thomas Reeds Publication, United Kingdom, 2003
4. Norros.A, "Operation Of Machinery In Ships Steam Turbines, Boilers", Marine Engineering Practice, Vol 2, Part 15, IMarEST, London, 2000

**OBJECTIVE:**

- To expose the students to the concepts about Electricity production, measurements, cable faults and AC Machines used in Marine engineering.

**UNIT I ELECTRICAL MEASUREMENTS AND CONTROL SYSTEM 8**

Induction type energy meters-megger (Basic construction & principles of operation only).– Single phase and three phase wattmeter for power measurement – Measurement of energy, speed, frequency and phase devices– Measurement of resistance, inductance and capacitance by Bridge method – Magnetic measurement. Location of cable faults – transducers and its application in the measurement of pressure, flow, temperature, Torque, Humidity, Water content etc – simple electronic measuring devices – CRO, IC tester, Signal generator, Timers, Multi Tester, Clamp meter-Principle of operation and Application of Automatic control system-PID controller.

**UNIT II ALTERNATORS 11**

Alternators – general arrangement – construction of salient pole and cylindrical rotor types – types of stator windings – e.m.f equation – distribution and pitch factor – waveform of e.m.f. generated – rotating magnetic field – armature reaction – voltage regulation – load characteristics – open circuit and short circuit tests – e.m.f and m.m.f. methods – parallel operation of alternators – KW and KVA sharing – Brushless alternator – static excitation system.

**UNIT III SYNCHRONOUS MOTORS 5**

Principle of operation of 3-phase synchronous motor. – operation of infinite bus bars torque/angle characteristics – hunting – methods of starting – merits and limits of synchronous motor over others.

**UNIT IV INDUCTION MACHINES 12**

Three phase induction motor –Principle of operation and theory of action – slip speed–rotor to stator relationship – rotor frequency – rotor e.m.f. and current – equivalent circuit relationship between rotor IR loss and rotor slip – torque/Slip characteristics – starting torque and maximum running torque-Effect of change in supply voltage on Torque-Induction generator.

**UNIT V CONTROL OF INDUCTION MACHINES 9**

Reversing – speed control of induction motor-Electronic methods of speed control of Induction Motor(IGBT,Thyristor) – starting of induction motor – method of starting – Direct on-line starters – Star – delta starter – auto-transformer starter – starting of special high torque induction motors – single phase induction motor – principle and operational characteristics – starting control – constructional details – Failure and repairs of electrical machines.

**TOTAL : 45 PERIODS****OUTCOMES:**

- The procedure for producing electricity on board ships through alternators and associated controls
- To measure the power method of finding cable faults.
- Design features of Alternators – their construction and operation.
- Principles of operation and construction details of synchronous motors, induction machines
- Speed control and trouble shooting in induction machines.

**TEXT BOOKS:**

1. Edmund G R, Kraallavers, "Advanced Electro-technology For Marine Engineers", 2<sup>nd</sup> Ed. Reeds Vol 07, Adlard Coles Nautical, London, 2010
2. W. Laws, "Electricity Applied To Marine Engineering", 4th edition, The Institute Of Marine Engineers, London, 1998.
3. IHerman, "Electrical Transformers and Rotating Machines", 3<sup>rd</sup> Ed. Cengage, First Indian Reprint 2012 ( Yesdee Publishings Pvt. Ltd.),

**REFERENCES**

1. Uppal S.L., "Electrical Power", 13th Edition, Khanna publishers, Mumbai, 2002.
2. Berde, M.S., "Electric Motor Drives", 1st Edition, Khanna Publishers, Mumbai, 1995.
3. J. Nagrath and D.P. Kothari, "Basic Electrical Engineering", 2nd Edition, McGraw Hill Publishing Co., Ltd., New Delhi, 2002.
4. Charles, I. Hubert, "Electric Machines", 2<sup>nd</sup> Ed., Pearson, 2002
5. Ghosh, S., "Electrical Machines", 2<sup>nd</sup> Ed., Pearson, 2012

**MV 8405****MARINE ENGINEERING MATERIALS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To impart knowledge on the properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various Marine Engineering applications.

**UNIT I FUNDAMENTALS OF METALLURGY****9**

Basic metallurgy, metals and processes, properties of materials and uses - Metallurgy of steel and cast iron - iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure - Aluminium, copper and its alloys - Non-metallic materials – polymers properties - applications of marine materials.

**UNIT II HEAT TREATMENT****9**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram - Hardenability, Jominy end quench test –Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding, flame and induction hardening – precipitation hardening.

**UNIT III MECHANICAL PROPERTIES AND TESTING****9**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Failure modes - Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

**UNIT IV MATERIAL PROCESSING****9**

Properties and applications of materials used in machinery on board ships. Engineering processes used in construction and repair. Design characteristics and selection of materials in construction of equipment – Welding ,Gas cutting methods.



**UNIT V TESTING OF JOINTS****9**

Materials under load, self-secured joints, permanent joints, bonding plastics, adhesives and bonding. Vibration tests. Destructive and non-destructive testing of materials – different methods

**TOTAL : 45 PERIODS****OUTCOMES:**

- Properties of metals and non metals and uses
- Various heat treatment processes
- Metal Processing methods
- Testing of joints using destructive and non destructive methods

**TEXT BOOKS:**

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
2. Frederick, S.H. Capper,H. ,”Materials for Marine Machinery” Marine Media Management, 1<sup>st</sup> Edition, 1976
3. Jindal,U.C., Atish Mozumder, “Material Science and Metallurgy”, 1<sup>st</sup> Ed. Pearson, Third Impression 2013.

**REFERENCES**

1. Eyres, D.J. “Ship Construction” 5Edition,2001 ( Elsevier India Private limited , Reprint 2005)
2. William D Callister “Material Science and Engineering”, John Wiley and Sons 2007.
3. Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 2007.
4. Parasihivamurthy, K.I., “Material Science and Metallurgy”, 1<sup>st</sup> Ed. Pearson, 2012.
5. Higgins, “Materials for Engineers and Technicians”4<sup>th</sup> Ed. Elsevier, Reprint 2009 (Yesdee Publishings Pvt. Ltd.)
6. Sir Alan Cottrell, “ An Introduction to Metallurgy”, 2<sup>nd</sup> Ed. Universities Press, Indian Reprint 2013
7. Todd. B , “Selecting Material For Sea Water Systems”, Marine Engineering Practice ,Vol-1, Part-10, IMarEST, London, Reprint 1996

**MARINE ELECTRONICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**MV 8406****OBJECTIVE:**

- To make the students understand the Marine Electronics and its applications.

**UNIT I OPERATION AMPLIFIER THEORY****9**

Concept of Differential Amplifiers – its use in DP AMPS, Linear OP amp circuits.

**UNIT II DIGITAL CIRCUITS****11**

Logic Systems and Gates – Binary and BCD codes – Boolean algebra – Simplifications – Flip – flops – Counters – Registers and multiplexers.

**ITL & CMOS GATES:**

Digital integrated circuits – Semi conductor memories – ROM – RAM and PROM.

**UNIT III CONVERTERS; (A-D AND D- A): 10**

Analog to Digital and Digital to Analog Converters and their use in Data – Loggers.

**ELECTRONIC INSTRUMENTS**

Cathode Ray Oscilloscope – digital voltmeters and frequency meters – Multimeters – Vacuum Tube voltmeter and signal Generators – Q- Meters., Transducers for vibration, pressure, volume, velocity measurement-V-I,I-V,P-I,I-P Converters.

**UNIT IV INDUSTRIAL ELECTRONICS 8**

Power rectification – silicon control rectifier power control-Filters ,RPS –Photoelectric devices – invertors. Satellite communication as applicable to GMDSS,GPS, Inmarsat. Introduction to ECDIS

**UNIT V MICROPROCESSORS 7**

8085 Architecture – Programming – interfacing and Control of motors – Temperature/Speed control –Basics and Control mechanism of PLC.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Amplifier Theory, Digital Circuits, Logic systems and Gates.
- Analog and Digital Converters and their applications
- Electronic Instruments and Micro Processors.

**TEXT BOOKS:**

1. Ramakant.A. Geakwad, “Linear integrated circuits”, 3rd edition, Prentice – Hall of India, New Delhi, 2001
2. Malvino Leach, “Digital principles and applications”, 5th edition, Tata McGraw-Hill, Publishing co., New Delhi, 1995.
3. Hofmann, “Global Positioning System”, 5<sup>th</sup> Ed.,Springer, Indian reprint 2007 (Yesdee Publishings Pvt. Ltd.)

**REFERENCES**

1. P.S.Bimbhra, “Power Electronics”, 3rd edition, Khanna Publisher, New Delhi, 2001.
2. Ramesh Gaonkar, “Microprocessors and Microcomputers”, 4th edition, Ulhasthatak, India, 1999.
3. Ray choudhary & Shail B Jain, “Linear Integrated Circuits”, New Age International publisher, 2015
4. Rashid, “ Power Electronics Handbook”,3<sup>rd</sup> Ed. Elsevier, Indian Reprint 2013( Yesdee Publishings Pvt. Ltd.)

<b>MV 8407</b>	<b>MARINE REFRIGERATION AND AIR CONDITIONING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>2</b>	<b>0</b>	<b>4</b>

**OBJECTIVE:**

- To develop the knowledge of students in Marine Refrigeration and Air conditioning.

**UNIT I RECIPROCATING COMPRESSORS 9+6**

Ideal cycle for compressors work transfer in a single stage compressors – mass flow – volume flow – free air delivery – effect of clearance and volumetric efficiency in single stage compressors. Multi stage compression neglecting clearance volume. Condition for minimum work input and perfect inter cooling. Tandem in line arrangements in compressors. air motors.

**UNIT II            BASIC REFRIGERATION AND AIR CONDITIONING            9+6**

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

**UNIT III            MARINE REFRIGERATING PLANTS            9+6**

Typical marine refrigerating plants with multiple compression and evaporator system – heat pump cycles – refrigeration in liquefied gas carriers – applied problems.

**UNIT IV            MARINE AIR CONDITIONING            9+6**

Principles of air conditioning – Psychrometric properties of air – comfort conditions – control of humidity – airflow and air conditioning capacity – calculation for ships plants.

**UNIT V            BASIC DESIGN OF HEAT EXCHANGERS            9+6**

Introduction - types - LMTD and NTU method - double-pipe, shell and tube type, condenser and evaporator – problems

**TOTAL :    75       PERIODS**

**OUTCOMES:**

- The performance of Reciprocating Compressors,
- The theoretical aspects of Marine refrigeration and air-conditioning
- The method of economical and efficient design of Heat Exchangers for Air conditioning and refrigeration plants.

**TEXT BOOKS:**

1. Arora C.P., "Refrigeration & Air Conditioning", 1st Edition, Sri Eswar Enterprises, Chennai, 1993.
2. Stoecker, Wilbert .F Jones, Jerold. W., "Refrigeration and Air Conditioning", 2<sup>nd</sup> Edition, Tata McGraw-Hill, Delhi, 1985.
3. Stott. J.R, "Refrigeration Machinery And Air Conditioning Plant", Marine Engineering Practice, Vol-1 P Part-05, IMarEST, London, 1998

**REFERENCES**

1. D.A. Taylor, "Introduction to Marine Engineering", 2nd Edition, Butter Worth, London,1993.
2. J.R. Stott, "Refrigerating Machinery and Air Conditioning Plant", 1st Edition, The Institute of Marine Engineers, London, 1974, Reprint 1998.
3. Ghoshdastidar, P.S., " Heat transfer", 2<sup>nd</sup> Edition, Oxford University Press, 2012
4. Sukhatme, S.P., " Heat Transfer", 4<sup>th</sup> Ed. Universities Press, 2011
5. Roy, J. Dossat, "Principles Of Refrigeration", 1<sup>st</sup> Ed., Pearson, 2006
6. Kuppan Thulukkanam, "Heat Exchanger Design Handbook", 1<sup>st</sup> Ed., CRC Press, 2000

<b>MV 8411</b>	<b>WELDING TECHNIQUES, LATHE AND SPECIAL MACHINE SHOP</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVE:**

- To develop skill of the students in welding and machining techniques

**WELDING TECHNIQUES**

**LIST OF EXPERIMENTS**

- WELDING - Exercises in Electric Arc welding and Gas welding Advanced Techniques.
- HAND TOOLS - Hand tools, sharpening, Powered hand tools, Measurements etc. Exercise involving above.
- SHEET METAL WORKING - Simple Exercise.
- PIPE WORK - Experiments involving thin pipes, Joining, bending, welding and inspection.

**LATHE & SPECIAL M/C SHOP**

- Lathe – Straight turning, Step turning, under cut, taper turning, knurling and thread cutting exercises. Shaping Machine – Making square from round rod and grooving exercises. Exercises on milling machine. Grinding: Exercises to the required accuracy on universal cylindrical grinder and surface grinder. Slotting Machine: Slotting and Key-way cutting.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- To carry out repair of Ship machinery and components by welding
- To do any kind of sheet metal works
- To make machine components using Lathes and Special machines such as milling, grinding and slotting machine.

**REFERENCES:**

- Youssef, “ Machining Technology”, 1<sup>st</sup> Vol.,Taylor & Francis, Indian Reprint 2012( Yesdee Publishings Pvt. Ltd.)
- Kuppuswamy, G., “Principles of Metal Cutting”, 1<sup>st</sup> Ed. Universities Press, Reprint 2013
- Mukherjee,S., “Metal Fabrication Technology”,1<sup>st</sup> Ed., PHI Learning Pvt. Ltd., 2010
- Larry Jeffus, “ Welding and Metal Fabrication”, 1<sup>st</sup>. Ed. Cengage Learning, Indian Print,2012 (Yesdee Publishings Pvt. Ltd.)

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

**WELDING TECHNIQUES, LATHE AND SPECIAL MACHINE SHOP:**

<b>Sl. No.</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
1.	Light duty Lathe	01
2.	Medium duty Lathe	03
3.	Heavy duty Lathe	04
4.	Shaper	01
5.	Slotter	01
6.	Planner	01
7.	Radial drilling m/c	01
8.	Surface grinder	01
9.	Pedestal grinder	01
10.	Vertical milling m/c	01
11.	Universal milling m/c	03
12.	Tool & cutter grinder	01



12. Testing of lubricants- Viscosity index, corrosion stability, carbon residue.
13. Testing of lubricants - Mechanical stability, ash content.
14. Wind Tunnel - Drag and lift measurements.
15. Performance test on IC Engine as per BIS specifications.

#### **BOILER CHEMISTRY LAB**

16. To determine hardness content of the sample of boiler water in P.P.M. in terms of  $\text{CaCO}_3$ .
17. To determine Chloride Content of the sample of water in P.P.M. in terms of  $\text{CaCO}_3$ .
18. To determine Alkalinity due to Phenolphthaleine, total Alk. and Caustic Alk. Of the sample of water (in P.P.M).
19. To determine Phosphate Content of the sample of water.
20. To determine dissolved Oxygen content of the sample of water.
21. To determine sulphate content of given sample of water.
22. To determine Ph-value of the given sample of water.
23. Boiler trial.
24. Water Testing - Dissolved oxygen, total-dissolved solids, turbidity.
25. Water Analysis (Fresh and sea water)- Chloride, sulphate, hardness.
26. Sludges and scale deposit - Silica, volatile and non-volatile suspended matter.

#### **REFRIGERATION LABORATORY**

27. Watch keeping: Parameters to be monitored during running of refrigeration unit.
28. Various cut-outs, viz, pressure, temperature
29. Determination of actual COP, theoretical COP and Carnot COP.

**TOTAL: 60 PERIODS**

#### **OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- To perform various tests on the heat engines
- To Analyse the results to understand the performance characteristics of engines
- To Perform Boiler water tests , Sea water and fresh water tests
- To Choose the best water ,oils, fuels and lubricants based on the test results.

#### **REFERENCES:**

1. Laboratory Manuals
2. Skelly.J.D, "Water Treatment", Marine Engineering Practice , Vol-2 Part-14, IMarEST, London, 2004
3. Mathur, M.L., Sharma, R.P., "Internal Combustion Engines", 7<sup>th</sup> Ed. Dhanpat rai Publications, REPRINT 2002
4. Willard W. Pulkrabek, " Engineering Fundamentals of the Internal Combustion Engines", 1<sup>st</sup> Ed. , PHI Learnings Pvt. Ltd., 2011
5. Flanagan,G.T.H, 'Marine Boilers", 1<sup>st</sup> Ed. ,Elsevier, 1990

#### **LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

##### **HEAT ENGINES LAB**

Sl.No	Name of the Equipment	Qty.
1.	Orsat Apparatus	02 nos
2.	Steam Turbine	01
3.	Steam Calorimeter	01
4.	Air Blower	01
5.	Air Compressor	02 nos
6.	Vapour Compression Refrigeration test rig	01
7.	Vapour compression Air Conditioning test rig	01
8.	Bomb calorimeter and Junker's calorimeter	01

9.	Crucible Metener Burner, Electric Benser Hot air oven	01
10.	Flash & Fire point – closed cup apparatus	01
	Redwood's Viscometer	01
	Say bolt's Viscometer	01
11.	Carbon residue apparatus.	
12.	Wind Tunnel	01

#### **FUELS AND LUBRICATION OIL TESTING EQUIPMENTS**

<b>Sl.No</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
1.	Redwood Viscometer	01
2.	Saybolt's Viscometer	01
3.	Abel's flash point and fire point apparatus	01
4.	Closed cup apparatus (Pensky)	01
5.	Bomb Calorimeter with Beckman (Digital)	01
6.	Junker's Gas Calorimeter	01

#### **BOILER CHEMISTRY LAB**

<b>Sl.No</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
1.	Burette, Pipette, Beaker, Conical Flask, Bunsen Burner	01 each
2.	Burette, Pipette, Conical Flask, STD Flask 100ml	01 each
3.	Burette, Pipette, Conical Flask, STD Flask	01 each
4.	Burette, Pipette, Conical Flask.	01 each
5.	Do Bottle, Burette, Pipette, Conical Flask.	01 each
6.	Wephlo turbidity meter, STD Flask Pipette.	01 each
7.	PH meter, Buffer tablets, beaker.	01 each
8.	Petridish, Hot air Oven, Weighing Balance	01 each
9.	Water Analysis kit.	01 nos
10.	Burner, Silica, Crucible, Electric Bunsen, Petridish Hot air Oven	01 each
11.	Burette, Pipette, Conical Flask, turbidity meter, Bunsen Burner, Beaker, STD Flask	01 each

#### **.THERMAL ENGINEERING**

<b>Sl.No</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
1.	Internal Combustion Engines Section	01
2.	Fuel and Lubrication Oil Testing Equipments	01
3.	Heat Transfer Equipments	01
4.	Steam Lab. Equipments	01
5.	Refrigeration and Air Conditioning Equipments	01 set
6.	Automobile Components	01
7.	Engine Research Centre	01
8.	Computers with UPS	01
9.	Miscellaneous Equipments	01

#### **INTERNAL COMBUSTION ENGINES SECTION**

<b>Sl.No</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
1.	Multi Cylinder Petrol Engine	01
2.	Twin Cylinder Diesel Engine	01
3.	Kirloskar Diesel Engine	01
4.	Greaves Cotton diesel engine	01
5.	Two Stroke Petrol Engine	03 nos
6.	Two Stroke Diesel Engine Model	01
7.	Four Stroke Petrol Engine	01
8.	Four Stroke Diesel Engine Model	01

9.	Two Stroke Petrol Engine Model	01
10.	Multi Cylinder Petrol Engine	01
11.	Four Stroke Single Cylinder Diesel Engine (Anil)	01
12.	MK-12 Petrol Start Kerosene run Engine	01
13.	Battery charger	01

#### **MARINE AC & REFRIGERATION LABORATORY**

<b>Sl.No</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
01	Marine Refrigeration Plant (10 ton capacity)	<b>01</b>
02	Marine Air Conditioning Plant (10 ton capacity)	<b>01</b>
03	Vapour compression and Vapour Absorption refrigeration test RIG	<b>01 each</b>

**MV 8501**

**MARINE AUXILIARY MACHINERY – I**

**L T P C**  
**3 0 0 3**

#### **OBJECTIVE:**

- To impart Knowledge on Ship's Auxiliary Machines

#### **UNIT I ENGINE ROOM LAYOUT , PIPING SYSTEMS AND FITTINGS 9**

Layout of main and auxiliary machinery in Engine Rooms in different ships. Steam and condensate system, water hammering in pipes, Expansion joints in pipelines, Bilge – ballast, fuel oil bunkering and transfer system, bunkering procedure, precautions taken, fuel oil service system to main and auxiliary engines, lubricating oil and Engine cooling system to main and auxiliary engines, central cooling and central priming systems, control and service air system, domestic fresh water and sea water (Hydrophore) service system, drinking water system, fire main system.

#### **UNIT II VALVES, COCKS , PACKING, JOINTS, FILTERS AND STAINERS 9**

Straight way cocks, right angled cock, 'T' cock, spherical cock, Boiler gauge glass cock (cylindrical cock). Globe valves, SDNR valve, swing check valve (storm valve), gate valves, butterfly valves, relief valves, quick closing valves, pressure reducing valves, control valves, change over valve chests, fuel oil transfer chest, valve actuators, steam traps.

Packings, Insulation of materials, Types,- Various applications. Seals – purpose of bearing seal, description and application of non rubbing seals and rubbing seals, simple felt seal, seals suitable for various peripheral speeds, V-ring seals, Lip seals.

Filtration, filter elements basket strainers, duplex strainers, edge type strainers, auto-kleen strainers, back flushing strainers, magnetic filter, rotary filters, fine filters.

#### **UNIT III PUMPS 9**

Types of pumps for various requirements – their characteristics, performance and application in ships – centrifugal pumps – gear pumps – screw pumps and reciprocating pumps – care and maintenance of pumps, operation of all pumping systems on board such as bilge, ballast and cargo pumping operations.



#### **UNIT IV                      HEAT EXCHANGERS, EVAPORATORS AND DISTILLERS                      9**

Principle of surface heat transfer – description, contact heat transfer, construction of shell and tube type – flat plate type, single and double pass – lubricating oil coolers, fuel oil heaters, fresh water coolers, compressed air coolers, Main Engine charge air cooler, Fresh water heaters, steam condensers, evaporators and condensers in refrigeration system – materials used in all the above heat exchangers, expansion allowance – temperature controls effect of air in the system – maintenance.

Distillation of water, distilling equipment, problem of scale formation and method of controlling, methods of distillation, single effect and double effect shell type evaporator, low pressure vacuum type evaporator, flash evaporators, multiple effect evaporators-construction and operation salt water leaks and detection, reverse osmosis desalination plant, membranes, drinking water and treatment.

#### **UNIT V                      STEERING SYSTEM                      9**

Hydraulic Telemotor system (Transmitter and receiver), Bypass valve – charging system, – hydraulic power unit – hunting gear heleshaw pump principle, construction and operation – pawl and ratchet mechanism, 2-ram and 4-ram steering gear – All electric steering gear, principle and operation – Hunting gear and emergency steering gear. Electro-hydraulic steering gear, Rapson and slide Actuators, Rotary vane steering gear – principle – construction – operation – safety features, relief, isolating and bypass valves, steering system regulations and testing – trouble shooting – rectification maintenance. Navigational safety of a ship – case history, cause and /or errors – how to avoid rudder restraining, general requirements – requirements for large tankers and gas carrier, additional requirements (electrical) definitions – controls – automatic system, general arrangement – rudder and pintle, rudder wear down – rudder carrier.

**TOTAL :    45    PERIODS**

#### **OUTCOMES:**

- Ship's Engine Room Layout, Piping systems and fittings.
- Various types of Pumps and its applications.
- Construction details of Heat exchangers, Evaporators
- Fresh water Generators
- Ship's steering systems.

#### **TEXT BOOKS:**

1. D.W. Smith, "Marine Auxillary Machinery", 6th Edition, Butter worths, London, 1987.
2. H.D. McGeorge, "Marine Auxillary Machinery", 7th Edition, Butter worth, London, 2001.

#### **REFERENCE:**

1. H.D. McGeorge, "General Engineering Knowledge", 3rd edition, Butter worth – Heineman, London, 1991.

**OBJECTIVE:**

- To make the students learn the concept and working of Marine Diesel Engines.

**UNIT I FUEL PUMPS AND METERING DEVICES 9**

Jerk and common rail systems, fuel injection systems helical groove and spill valve type fuel pumps, system for burning heavy oil in slow and medium speed Marine engines, V.I.T. Super VIT & Electronic injection systems. Effects of viscosity on liquid fuel combustion. Measuring equipment and its working principle. Necessity of variable fuel injection system. Procedure of application on modern slow speed long stroke engine. Necessity for adoption of fuel quality setting system.

Incorporation of FQSL along with the V.I.T. system on the engine., Governors

**UNIT II MANOUVERING SYSTEMS, INDICATOR DIAGRAMS AND POWER CALCULATIONS 9**

Starting and reversing systems of different Marine diesel engines with safety provisions Including Main Engine auto slowdown and shutdown. Restoration of operations.

Constructional details of indicator instrument, significance of diagram, theoretical knowledge of power calculations, fault detection, simple draw cards and out of phase diagrams, power balancing, performance characteristic curves, test bed and sea trials of diesel engines.

**UNIT III MEDIUM SPEED ENGINES 9**

Different types of medium speed marine diesel engines, couplings and reduction gear used in conjunction with medium speed engine, development in exhaust valve design, V type engine details, crankcase inspection., Depth gauge and crankshaft deflection.

**UNIT IV FORCES AND STRESSES 9**

Balancing, overloading, different types of vibration & its effects, forces and stresses acting on various components of I.C. Engine parts.

**UNIT V TYPE OF ENGINES 9**

Construction and Operation of Sulzer, B&W, MAN, Piel-stick, Main Propulsion diesel engines - Latest development in marine diesel engines – camless concept, improvement in design for increased TBO U.M.S. Operation of ships.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Marine fuel injection pumps and its applications.
- Manouvering systems of various marine diesel engines.
- Forces and stresses in slow speed and medium speed engines.
- Construction and operation of various Marine slow speed engines.

**TEXT BOOKS:**

- C.C Pounder, "Marine Diesel Engines", 6th Edition, Butter worth – Heinemann, Scotland, 1995.
- D.A. Taylor, "Introduction to Marine Engineering", 2nd Edition, Butter worth – Heinemann, London, 1996.
- John Lamb, "Marine Diesel Engines", 8th Edition, Butter worth – Heinemann, London, 1990.

## REFERENCES

1. S. H. Henshall, "Medium and High Speed Diesel Engines for Marine Use", 1st Edition, Institute of Marine Engineers, Mumbai, 1996.
2. A.B. Kane, "Marine Internal Combustion Engines", 1st Edition, Shroff Publishers & Distributors, Mumbai, 1984.
3. D.K. Sanyal, Principle & Practice of Marine Diesel Engines", 2nd Edition, Bhandarkar Publication, Mumbai, 1998.
4. VL Maleev, "Internal Combustion Engines", 2nd edition, McGraw-Hill book co., Singapore, 1987.
5. Wood yard, Doug, "Pounder's Marine Diesel Engines", 7th Edition, Butter Worth Heinemann Publishing, London, 2001.
6. Christen Knak, "Diesel Motor Ships Engines and Machinery", 1st Edition, Marine Management Ltd., London, 1990.

**MV 8503**

**STABILITY OF SHIPS**

L	T	P	C
4	0	0	4

### OBJECTIVE:

To impart the Knowledge on the Basic Hydrostatics and Stability Calculations of Ship.

#### **UNIT I                      HYDROSTATICS                      12**

Density, relative density, pressure exerted by a liquid on an immersed plane, centre of pressure, load on immersed plane, load diagram, shearing forces on bulk head stiffeners – problems.

#### **UNIT II                      GEOMETRY AND SHIP FORM CALCULATION                      12**

Archimedes principle, Laws of floatation, displacement, tonne per cm immersion. Coefficients of form, wetted surface area, similar figures, shearing force and bending moment – problems.

#### **UNIT III                      CALCULATION OF AREA, VOLUME, FIRST AND SECOND MOMENTS                      12**

Simpsons first rule and second rule, application to area and volume, use of intermediate ordinate rule, trapezoidal rule, mean and mid – ordinate rule, application of 5,8, – 1 Rule for area, application of simpson rule to first and second moments of area – Centre of gravity, effect of addition of mass, effect of movement of mass, effect of suspended mass – problems.

#### **UNIT IV                      TRANSVERSE STABILITY AND HEEL                      12**

Static stability at small angles of heel, calculation of BM and meta centric height, meta centric diagram, inclining experiment, free surface effect, stability at large angles of heel, curves of static stability, dynamic stability, angle of loll, stability of a wall sided ship –inclining experiment , problems. IMO recommendations concerning ship stability.

#### **UNIT V                      LONGITUDINAL STABILITY                      12**

Longitudinal BM – MCT1 cm – Change of trim, change of LCB with change of trim, alteration of trim by adding or removing weights, mean draft, change in mean and end draft due to density and bilging – flooding calculation – floodable length – factor of sub division – loss of stability due to grounding – problems- Knowledge of Trim and stress tables and equipments.

**TOTAL : 60 PERIODS**

## OUTCOMES:

- Basic hydrostatics , Geometry of Ships
- Calculations of Ship Forms and various coefficients,
- Calculating the Area of wetted Surface , Volume etc., and Usage of Simpson rule
- Transverse and Longitudinal Stability and Heel etc.,

## TEXT BOOKS:

1. Stokoe, E.A., "Reeds Naval Architecture for Marine Engineers", 2nd Edition, Thomas Reed Publications, London, 1982.
2. K.J. Rawson and E.C Tupper "Basic ship theory" volume – I & II – 5th edition Butterworth and Heine Mann, London , 2001.
3. John Letcher Edited by J. Randolph Paulling, "Principles of Naval Architecture Series: The Geometry of Ships", 1<sup>st</sup> Ed. SNAME, 2009

## REFERENCES

1. Rawson, K.J.Tupper E.C, "Basic Ship theory", 5th Edition, Butter worth – Heinemann, London, 2001.
2. G.N.Hatch, "Creative Naval Architecture", 1st Edition, Thomas Reed Publications, London, 1971.
3. Kemp & Young Series, "Ship Stability Notes and Examples",1<sup>st</sup> Ed. , Stanford Maritime Limited, 1998

**MV 8504**

**SHIP CONSTRUCTION**

L	T	P	C
3	0	0	3

## OBJECTIVE:

- To impart knowledge to the students on Construction of ships.

### UNIT I SHIP TERMS

**9**

Various terms used in ship construction with reference to ship's parameter e.g. L.B.P.- Moulded Depth - Moulded draught etc. - General classification of ships.

Stresses in Ship's structure: Hogging – Sagging – Racking – Pounding – Panting etc., and Strength members to counteract the same.

Sections And Materials Use: Type of sections like angles – Bulb plates flanged beams used in ship construction – Process of welding. Riveting & Welding testing of welds – Fabricated components.

### UNIT II BOTTOM & SIDE FRAMING

**9**

Double bottoms, watertight floors solid and bracket floors – Longitudinal framing keels – side framing like tank side brackets – Beam knee – Web frame etc.,

Shell & Decks: Plating systems for shells – Deck plating & Deck Girders –discontinuities like hatches and other openings – supporting & closing arrangements –mid-ship section of ships.

Bulk Heads & Deep Tanks: water tight bulkheads – Arrangement of plating and stiffeners – water tight sliding doors – Water tight openings through bulkheads for electric cables pipes and shafting – Deep tank for oil fuel or oil cargo corrugated bulk heads.

<b>UNIT III</b>	<b>FORE &amp; AFT END ARRANGEMENTS</b>	<b>9</b>
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Fore end arrangement, arrangements to resist pounding bulbous bow – Types of sterns stern frame and rudder – Types of rudder – Supporting of rudder – Locking pintle – Bearing pintle – Pallister, bearing shaft tunnel – Tunnel bearings.

## UNIT IV      FREE BOARD AND TONNAGE      9

Significance and details of markings various international Regulations. Plimsol Line Shipyard Practice - layout of a shipyard – Mould loft –Optical marking – Automatic plate cutting, Fabrication and assembly etc., Ship Types - Tankers, Ventilation arrangements for pump rooms, holds and oil fuel tanks.– Bulk Carriers, Arrangement for the carriage of dangerous goods in bulk– Container ships – L.N.G., L.P.G., and Chemical carriers – Lash ships – Passenger ships – Dredgers – Tugs etc., - Constructional details and requirements.

## UNIT V OFFSHORE TECHNOLOGY 9

Drilling ships and Platforms – Supply vessels – fire fighting arrangement – Pipe laying ships – special auxiliary service ships.

Ship Surveys : Survey rules – Functions of ship classification – Societies – Surveys during construction – Periodical surveys for retention of class.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ships terms and stresses in ships.
- Primary and Secondary girders used in ships.
- Fore-end and After-end arrangements.
- Free board and Tonnage of ships
- Off shore Technology

**TEXT BOOKS:**

1. D.J. Eyres, "Ship Construction", 4th Edition, Butter worth – Heinemann, Oxford, 1994.
2. Stokoe,E.A., "Reed's Ship Construction for Marine Engineers", 1st Edition, Thomas Reed Publication, London, 2000.
3. Thomas Lamb, " Ship Design and Construction", 1<sup>st</sup> Ed., SNAME, 2003

## REFERENCES

1. A.J. Young, "Ship Construction Sketch & Notes", 1st Edition, Butter worth – Heinemann, London,1980.
2. H.J. Pursey, "Merchant Ship Construction", 7th Edition, Brown Son & Ferguson Ltd. GlasGow Great Britain, 1994.
3. Larrie D. Ferreiro, " Ships and Science", 1<sup>st</sup> Ed. SNAME, 2006
4. Richard Lee Storch, Colin P. Hammon, Howard McRaven Bunch, and Richard C. Moore. "Ship Production, 1<sup>st</sup> Ed., SNAME,1995

**OBJECTIVE:**

- To impart theoretical knowledge about mechanism of machinery, balancing and Vibration of machines and associated system components and equipment,

**UNIT I MECHANISMS****9+6**

Introduction – science of mechanisms – terms and definitions kinematic inversion – slider crank chain inversions – four bar chain inversions – Grashoff's law–Determination of velocities and acceleration in mechanisms – relative motion method (graphical) for mechanisms having turning, sliding and rolling pair – Coriolis acceleration

Force Analysis Of Mechanisms : Static, Inertia and combined force analysis – graphical and analytical method – slider crank mechanism and four bar mechanism, turning moment diagram and flywheel – applications in engine, punching presses.

**UNIT II THEORY OF GEARING****9+6**

Classification of gears, law of gearing, nomenclature – involutes as a gear tooth profile –lay out of an involute gear, producing gear tooth – interference and undercutting – minimum number of teeth to avoid interference, contact ratio, internal gears – cycloid tooth profiles – comparison of involutes and cycloidal tooth forms, Backlash of Marine Gearing. Self Shift Synchronous Gears

**UNIT III CONTROL MECHANISMS****9+6**

Governors – gravity controlled and spring controlled – governor characteristics – governor effort and power - Gyroscopes – gyroscopic forces and couple – forces on bearing due to gyroscopic action – gyroscopic effects on the movement of air planes and ships, stability of two wheel drive and four wheel drive

**UNIT IV BALANCING****9+6**

Static and dynamic balancing – balancing of rotating masses – balancing of several masses in different planes – balancing of rotors, balancing machine, unbalance due to reciprocating parts – Balancing of inline engines – firing order – balancing of V and W engines – balancing of radial engines – Lanchester technique of engine balancing.

**UNIT V VIBRATION****9+6**

Periodic motion – non harmonic periodic motion – undamped free vibration – linear and torsion solution – natural frequency of single degree freedom system — Free vibrations with viscous damping of single degree freedom system and solution – logarithmic decrement.

Forced vibration of single degree freedom system with damping – reciprocating and rotating unbalance – vibration isolation and transmissibility

System with two degrees of freedom – shaft with two rotors, system with many degrees of freedom –three rotor system – geared system- torsional vibration of major components in Ships - problems.

**TOTAL : 75 PERIODS****OUTCOMES:**

- Velocity and acceleration of various kinematic linkages
- Four bar and slider crank mechanisms using analytical and graphical methods.
- Force analysis of Mechanisms and turning moment diagrams and flywheel.
- Various parameters of gears and gear trains.
- Governors and gyroscopes.
- Concept of balancing.
- Free and Forced Vibration of Single degree of freedom systems. Two and Multi Degree Freedom Systems.

**TEXT BOOKS:**

1. Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
2. Rao, J.S., and Dukkippatti, R.V., "Mechanism and machinery theory", 2<sup>nd</sup> Edition, New age international, Mumbai, 1992.
3. Srikant Bhawe, "Mechanical Vibrations", 1<sup>st</sup> Ed. Pearson, 2010

**REFERENCES**

1. Shingley, J.E. & John Joseph Uivker, Jr., "Theory of Machines and Mechanisms", 2<sup>nd</sup> Ed., McGraw – Hill International Editions, London, 1981.
2. Ghosh A. and Malik, A.M. "Theory of Mechanisms and machines", 2<sup>nd</sup> Ed., Affiliated East – West Press Pvt. Ltd., New Delhi, 1988.
3. Francis. TSE. Ivan E-Morse Rolland T. Hinkle, "Mechanical Vibrations", 2<sup>nd</sup> Ed., CBS Publishers and Distributed, India, 1983.
4. Thomson, W.T. and Dahleh, M.D., "Theory Of Vibration with Applications" 5<sup>th</sup> Ed., Pearson, 2005
5. Grover. G.K., "Mechanical vibrations", 7th Edition, Nem Chand & Bros, Roorkee, India, 2001.
6. Thomas Bevan, "Theory of Machines", 1<sup>st</sup> Ed. Pearson, 2011
7. Gordon John Roy, "Steam Turbines and Gearing Marine Engineering Series", 1<sup>st</sup> Ed., Stanford Maritime limited, 1984
8. Sandhu Singh, " Theory of Machines", 3<sup>rd</sup> Ed., Pearson, 2012

**MV 8506****SEAMANSHIP, ELEMENTARY NAVIGATION AND  
SURVIVAL AT SEA**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To develop skill and knowledge about Navigation and Operation of ship.
- To develop self confidence and skillness for survival at sea.

**UNIT I SEAMAN & THEIR DUTIES****9**

Ship's Department, General ship knowledge and nautical terms like poop-deck, forecastle, bridge etc. deck equipment: winches, windlass, derricks, cranes, gypsy, capstan, hatches and function. navigation lights and signals: port and starboard, forward and aft mast lights, colors and location. look out, precautions and bad weather, flags used on ships, flag etiquette, sound signals.

**UNIT II ROPE KNOTS AND MOORINGS****9**

Types of knots. practice of knot formation, materials of ropes, strength, care and maintenance, use of mooring line, heaving line, rat guards, canvas and its use. anchors: their use, drooping and weighing anchor, cable stopper.

**UNIT III NAVIGATION****9**

General knowledge of principal stars. Sextant, Navigation compasses, echo sounder, Gps, Glonass, log and uses, barometer and weather classification, G.M.T and Zonal time, wireless Navigational Instruments, radar satellite navigation etc.

**UNIT IV LIFE BOATS & LIFE RAFTS****9**

Life buoy, EPRIB, SART, TPA, Construction, equipment carried, carrying capacity. Davits and their operation, Launching of life rafts (Inflatable type) Embarkation into lifeboat and life raft. Survival pack, Stowage and securing arrangement, Abandon ship: Manning of lifeboat and life raft. Muster list. Radio an alarm signals, Distress signals (S.O.S) Distress Calls time and Radio frequency. Pyro – techniques.

**UNIT V SURVIVAL AT SEA****9**

Survival difficulties and factors, equipment available, duties of crew members, Initial action on boarding, Maintaining the craft, Practical: Knots, bends and hitches, Ropes splice, donning of life jackets, life boat drills. Lowering & hoisting of life boats (model).

**TOTAL : 45 PERIODS****OUTCOMES:**

- Have learnt operation of various deck machinery and Navigation equipment
- Have sound knowledge of Navigation.
- Have learnt survival techniques at sea.
- Have learnt operation of life boats and life rafts.

**TEXT BOOKS:**

1. Graham Danton, "The theory and practice of seamanship", 11<sup>th</sup> Edition, Routledge, New york, USA and Canada, 1996.
2. Capt. J. Dinger, "Seamanship Primer", 7<sup>th</sup> Edition, Bhandarkar Publications, Mumbai 1998.
3. Kemp & Young, "Seamanship Notes", Stanford Maritime limited, 1997

**REFERENCES**

1. A.N. Cockcroft, "Seamanship and Nautical knowledge", 27<sup>th</sup> Edition, Brown son & Ferguson Ltd., Glasgow 1997.
2. Richards, " Principles of Modern Radar ", Yesdee Publishings Pvt. Ltd., Indian Reprint 2012
3. Capt.P.M.Sarma , "Theory of Marine Gyro Compass"1<sup>st</sup> Ed. , Bhandarkar Publications, 2002

<b>MV 8511</b>	<b>ELECTRICAL ENGINEERING, ELECTRONICS AND MICRO</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>PROCESSOR LABORATORY</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVE:**

- To impart Practical knowledge in operation and maintenance of Electrical Machines and electronic equipments

**ELECTRICAL ENGG. LABORATORY****LIST OF EXPERIMENTS**

1. Load Test on D.C. Shunt Motor
2. Load Test on D.C.Series Motor
3. O.C.C. & load characteristic of self/separately excited D.C. Generator.
4. Parallel operation of D.C.Shunt Generator
5. Speed control of D.C.Shunt Motor.
6. Load O.C. & S.C. test on single-phase transformer.
7. Parallel operation of single-phase transformers.
8. To connect similar single-phase transformers in the following ways.
9. Y-Y, A-A, A-Y and Y-A.



10. Load Test on Squirrel cage induction motor
11. Load Test on Slip ring induction motor
12. Pole changing motor for various speeds.
13. Synchronization of 3-phase alternator.
14. Trouble shooting in Electric Motors and Transformers.
15. Exercises in Power Wiring and earthing.

### **ELECTRONICS / MICROPROCESSOR LABORATORY**

1. To study the volt-ampere characteristics of a high current semi conductor diode.
2. To study the volt-ampere characteristics of a diode and Zener diode.
3. To study the half wave and full wave rectification circuit without and with filter circuit.
4. To study the volt-ampere characteristics of a Transistor.
5. To study the volt-ampere characteristics of Field Effect Transistor.
6. To study the characteristics of Silicon Control Rectifier.
7. To study the Transistor Feed Back Amplifier.
8. To study the Integrated Circuit operational amplifier.
9. To study the logic training board.
10. To study the speed control of D.C. motor using Thyristor.
11. Arithmetic operations using 8085
12. Logical operations using 8085
13. Array operations using 8085
14. Speed & Direction Control of Stepper motor using 8085.

**TOTAL: 60 PERIODS**

### **OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Conducting all types of tests on the Shunt and Series Motors,
- Load tests on the Transformers , parallel operation of single phase Transformers
- Synchronizing three phase Alternators
- understanding the volt-ampere characteristics of Semiconductors, Diodes, Transistors, Field Effect transistor
- Operation of Operational Amplifier, Thyristor
- Using the 8085 Micro processor

### **LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

#### **ELECTRICAL ENGINEERING LAB**

<b>Sl.No</b>	<b>Name of the Equipment</b>	<b>Qty.</b>
01	D. C. Motor Generator Set	02
02	D.C. Compound Motor	04
03	Single Phase Transformer	04
04	Three Phase Squirrel cage and Slip ring Induction Motor	02
05	Single Phase Induction Motor	02
06	Three Phase Alternator Set	02
07	Ammeter A.C and D.C	20
08	Voltmeters A.C and D.C	20
09	Watt meters LPF and UPF	12
10	Resistors & Breadboards	1 set

## ELECTRONICS AND MICROPROCESSOR LAB

Sl.No	Name of the Equipment	Qty.
01	Cathode Ray Oscilloscopes	04
02	Dual Regulated power supplies	06
03	A.C. Signal Generators	04
04	8085 Microprocessor Trainer kits	10
05	Voltmeters D.C	10
06	Ammeters D.C.	10
07	Resistors, Capacitors, Diodes	1 Set
08	Transistors (BJT, JFET), SCR, Logic Gates	1 Set
09	Stepper Motor, Interface Card and Power Supply	01
10	Breadboards, Probes	1 Set

**HS8581**

**PROFESSIONAL COMMUNICATION**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### **OBJECTIVES:**

#### **The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

### **UNIT I**

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

### **UNIT II**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

### **UNIT III**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -- questioning and clarifying –GD strategies- activities to improve GD skills

### **UNIT IV**

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview & panel interview – FAQs related to job interviews

## UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

**TOTAL : 30 PERIODS**

**OUTCOMES: At the end of the course Learners will be able to:**

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

### Recommended Software

1. **Globearena**
2. **Win English**

### REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. OrientBlackSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

## **MV 8611 MARINE WORKSHOP PRACTICAL AND AFLOAT TRAINING**

**L T P C**  
**0 0 48 12**

### OBJECTIVE:

To impart knowledge, skill and to train the students to be able to perform as Engineer officer on board ships

The students are required to undergo Marine Workshop Training in DG Shipping approved Marine Engineering Workshop for a duration of 6 months. The training should be as per the Merchant Shipping (Standard of Training Certification and Watch keeping for Seafarers) Rule 1998.

Competency on - use of hand tools used for marine equipments for dismantling, maintenance, repair and reassembly of shipboard equipments. **100 hrs.**

Competency on - use of hand tools used for electrical and electronic equipments, measuring and test equipment's for locating and repairing faults and malfunctions. **100 hrs.**

Competency on - Operation of Main and Auxillary machinery and associated control systems. **30 hrs.**

Competency on - Operating pumping systems & associated control systems. **90 hrs.**

Competency on - Operating alternators , generators & control systems. **100 hrs.**

Competency on -	Maintaining alternators, generators and Control systems.	<b>20 hrs.</b>
Competency on -	Maintaining Marine Engineering system including control systems (overhauling and maintenance of Marine Diesel Engines, air compressors, heat exchangers, oil separators etc.,)	<b>700 hrs.</b>
Competency on -	Controlling and fighting fire onboard.	<b>6 hrs.</b>
Competency on -	Operation of life saving appliances.	<b>6 hrs.</b>

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**Total hrs. of Training: 1152 hrs.**  
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The competency of the students are evaluated by the Marine Engineering Workshop and a report is sent to the college. During the training the students have to maintain a work diary. After completion of this training the students will be examined as follows:

a)Assessment on work diary (Internal)	200 Marks.
b)*(i) Written test for 1 hour. 10 questions	10 X 10 = 100 Marks
(ii) Viva voce	200 Marks

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**Total 500 Marks**  
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\* Valuation by both Internal and External Examiners.

## OUTCOMES:

On completion of the work shop training the students are expected to have acquired the sufficient knowledge

- In operation, maintenance, repair and refit of Marine machines viz. main engine, auxiliary engines,
- In operation, maintenance , repair and refit of Auxiliaries such as Compressors, Pumps, Steering gear, distillation plant, incinerator, sewage treatment plant etc.,
- In using hand tools, electrical and electronic equipments,
- In using Measuring and Testing Equipments for locating faults , malfunctions
- In repairing faults and malfunctions
- In operation, maintenance, repair and refit of Marine Electrical machines such as Alternators, Generators , Motors, Stabilizers
- Overhauling and maintenance of heat exchangers, oil separators, filters etc
- Of Fire fighting and Life saving Methods
- On maintenance of systems and controls

## REFERENCES:

1. Original Equipment Manufacturers Manuals For On Board Equipments
2. Benedict, " Nontraditional Manufacturing Processes", 1<sup>st</sup> Ed. taylor & Francis, Indian reprint 2011 (Yesdee Publishings Pvt. Ltd.)
3. Bloch, "Machinery Component Maintenance and Repair",3<sup>rd</sup> Ed. Elsevier, Indian Reprint 2010, (Yesdee Publishings Pvt. Ltd.)
4. Youssef, " Machining Technology", 1<sup>st</sup> Vol., Taylor & Francis, Indian Reprint 2012 (Yesdee Publishings Pvt. Ltd.)
5. Paulin.D.S, Fowler.D.J., "Steering Gear" Marine Engineering Practice, Vol 1, Part 09, IMarEST, London, Reprint 1997

6. Wright.A.A, " Exhaust Emission From Combustion Machinery", Marine Engineering Practice, Vol 3, Part 20, IMarEST, London, 2000
7. Leigh Jones, Chris., "A Practical Guide To Marine Fuel Oil Handling," Marine Engineering Practice, Vol 3, Part 19, IMarEST, London, 2008
8. Henshall. S.H, "Marine Medium Speed Diesel Engines," Marine Engineering Practice, Vol 1, Part 03, IMarEST, London, Reprint 1998
9. Norris.A, "Prime Movers For Generation Of Electricity(A) Steam Turbines", Marine Engineering Practice, Vol 1,Part 02, IMarEST, London, Reprint 1998
10. Sterling.L, "Selection Installation & Maintenance Of Marine Compressors", Marine Engineering Practice, Vol 1,Part 01, IMarEST, London, Reprint 1996
11. Gopalakrishnan & Banerji, "Maintenance and Spare Parts Management", PHI Learning Pvt. Ltd., 2010
12. Mishra and Pathak, " Maintenance Engineering and Management," 2<sup>nd</sup> Ed. , PHI Learning Pvt. Ltd., 2012
13. Venkataraman, "Maintenance Engineering and Management," 1<sup>st</sup> Ed., PHI Learning Pvt. Ltd., 2010
14. Alan Rowen, Raymond Gardner, Jose Femenia, David Chapman, and Edwin Wiggins, "Introduction to Practical Marine Engineering", 1<sup>st</sup> Ed., SNAME, 2005
15. Roy L. Harrington, "Marine Engineering", 1<sup>st</sup>. Ed., SNAME, 1992
16. GTH. Flanagan, "Marine Boilers" 3rd Edition, Butter worth, London, 2001.
17. K.M.B. Donald, "Marine Steam Turbines", 1st Edition, Institute of Marine Engineers, London, 1977.
18. L.Jackson & T.D. Morton, "General Engineering Knowledge for Marine Engineers", 4th Edition, Thomas Reeds Publication, United Kingdom, 1986.
19. Norris.A, "Operation Of Machinery In Ships Steam Turbines, Boilers", Marine Engineering Practice, Vol 2, Part 15, IMarEST, London, Reprint 2000
20. Edmund G.R, Kraallavers , "Advanced Electro-technology For Marine Engineers", 2<sup>nd</sup> Ed. Reeds Vol 07, Adlard Coles Nautical, London, 1999
21. W.Laws, "Electricity Applied To Marine Engineering", 4th edition, The Institute Of Marine Engineers, London, 1998.

**MV 8701**

**MARINE MACHINERY AND SYSTEMS DESIGN**

L	T	P	C
3	0	0	3

**OBJECTIVE:**

- To impart training and knowledge to the students about Marine Machinery system and Design.

**UNIT I SLIDING AND ROLLING CONTACT BEARINGS 9**

Journal bearings, thrust bearings, friction in journal bearings, bearing loads, bearing design using various equations. Thermal Equilibrium.

Rolling bearing -Load ratings, types of radial ball bearings, selection of bearings, lubrication of ball and roller bearings, methods of failure.

**UNIT II SPUR , HELICAL BEVEL AND WORM GEARS 9**

Basic design principles of spur gears, helical gears, dynamic tooth loads, design for strength and wear. Lewis and Buckingham equations.

Basic design principles of bevel gears and worm gears, Lewis formula, thermal rating of worm gears.

**UNIT III IC ENGINE PARTS 9**

Piston, connecting rod with bearings, crankshaft, flywheel and rocker arms

#### **UNIT IV VALVES & LIFTING DEVICES 9**

Valves, safety valves and reducing valves - crane hooks, lifting chains, chain blocks, E.O.T. Crane.

#### **UNIT V DESIGN CRITERIA FOR MARINE SYSTEMS 9**

Water cooling systems for diesel engines and steam plants. Lubricating oil systems for propulsion and auxiliary engines. Electro hydraulic steering gear system including rudder, rudderstock, tiller, rams. Marine Diesel Engine air starting system including air receiver, compressors and air starting valves. Marine Diesel Engine Scavenge and Exhaust systems. Marine diesel Engine fuel injection system including fuel pumps and fuel injectors. Power transmission system including thrust blocks, intermediate shaft and tail end shaft. Steam turbine plants. Gas turbine plants.

**TOTAL : 45 PERIODS**

#### **OUTCOMES:**

- Using Different types of Bearings.
- Design of IC Engine parts and gears.
- Design of Marine Machinery systems.

#### **TEXT BOOKS:**

1. Jindal, U.C., "Machine Design", 1<sup>st</sup>.Ed. , Pearson, 2010
2. Leslie Jackson, "Instrumentation and Control Systems", 3rd Edition, Thomas Reed Publication Ltd., London, 1992.
3. Krishna Rao, T., "Design of Machine Elements', 1<sup>st</sup> Ed., Vol.2., I K International Publishing House Pvt. Ltd., 2010

#### **REFERENCES**

1. Indian Register of Shipping Part 1 to Part 7, "Rules and Regulations & Classification of steel ships" 1st Edition, Mumbai, 1999.
2. Sam Had Dad, Neil Watson, "Design and Application in Diesel Engines", 1st Edition, Ellis Horwood Limited, London, 1984.
3. Pandya & Shah, "Machine Design", 13th Edition, Charotar Publishing House, Gujarat, 1997.
4. D.A. Taylor, "Marine Control Practice", 2nd Edition, Butter worth & Co (Publishers) Ltd., London, 1987
5. ASME Standard Technology , " A Guide to American Crane Standards", ASME, 2008
6. Smith.S.G, "Application Of Automatic Machinery And Alarm Equipment In Ships", Marine Engineering Practice, Vol 1, Part 06, IMarEST, London, 2002
7. Pearson, G.H., "Valve Design", 1<sup>st</sup> Ed., Mechanical Engineering Publications", 1978

**MV 8702**

**MARINE ELECTRICAL TECHNOLOGY**

L	T	P	C
4	0	0	4

#### **OBJECTIVE:**

- To develop skills of students in Marine Electrical Technology. The students will be imparted training in handling various electrical instruments to find out faults on various electrical equipments onboard ships and rectify such faults.

## **UNIT I                      POWER DISTRIBUTION AND REGULATIONS                      12**

The marine environment – effects of inclination – Generators – Power supply commonly available – main switchboard – motor controls – emergency services – emergency stop panel – ships auxiliary services – load analysis – electrical diagrams – inherent dangers and avoidance of disastrous consequences – active and passive safety measures – Do's and Don'ts – Electric shock – first aid – conditions of shock risk – selection of AC and DC generators for use on ships – merits and demerits – location and Installation of generator sets. Requirements & Regulations – safe electrical equipments for hazardous areas – American safety standards – common definitions – British and European standards –tanker installations – Installations Ashore – Indian Standards. Systems of AC distribution – general concept – single, two and three phase systems with 2,3 and 4 wires – power distribution – general Distribution scheme – specific systems for ship's service – High Voltage Installation - tankers schemes – primary power bus – need for emergency power supply – method of supply – passenger and cargo vessels requirements – shore supply –precautions to be taken while consuming shore supply –arrangement to ensure proper phase supply – remote switches to ventilating fans – fuel pumps – lubricating oil pumps and purifiers.

## **UNIT II                      INSTRUMENTATION AND SWITCHGEAR                      12**

Insulated & Earthed neutral systems – introduction – circuit faults – causes –prevention – earth fault indicators – detection and clearance – alternators. AVR: excitation systems – carbon pile regulator – vibrating contact and static automatic regulator – transient voltage dip and alternator response – effect of kW and Kvar Loading. Panel instrumentation: Introduction – system terminology – phase sequence indicators. Paralleling of Alternators: Manual and auto synchronizing – lamps – parallel operation – excitation and throttle control – load sharing – kW, kVAR and Manual. Switchboards & Switchgear: Main and sub switchboard-Rating and Characteristics of Main switchboards – group starter boards – distribution Fuse boards – bus bars – instrumentation & controls – circuit breakers – alternator CB's – MCCB's – miniature CB's- RCCB's – arc fault Current Interrupts – fused Isolators – fault protection devices – introduction – over-voltage-surge-transients – ripple – spikes – DC generator protection – alternator and system protection – protection through fuses – protection Discrimination Motor Protection.

## **UNIT III                      CABLES AND LIGHTING SYSTEMS                      12**

Electrical Cables: Cables- conductors – Wire Sizes-Current Rating – testing-codes- Practical tips. Insulation – protection and temperature ratings – insulation classes – A, B, E, F, H Insulation for High temperatures – Insulating Materials – Cable insulation & Sheath– Cable gland – Degrees of Protection – Temperature Ratings – Temperature Rise – Determination of hot temperature. Lighting Systems: Introduction – Incandescent Lamps – Discharge lamps – HCLPMF lamps – High pressure Mercury Fluorescent lamps – High and Low pressure sodium vapour lamps – Lamp caps – Effect of voltage on lamp performance – Navigation & signal lights – Signals for a power driven ship under way (At night) – Emergency lighting – Requirement of lighting of Deck and pump house of oil tankers. Alarm Indication Systems: Fire alarms and Detection – Heat detectors – Smoke detectors – Combustion detectors – Miscellaneous alarm indicator systems – Scanning type system – Sequential starting and cut outs for an automatic fired boiler incorporating safety devices and combustion control equipments – incinerators – Sewage plants – Bilge oil separators.

## **UNIT IV                      PROPULSION AND STEERING SYSTEMS                      12**

Propulsion Systems: Auxiliary propulsion systems – Layout and Optimizing storage space – Electrical Propulsion – Advantages & Disadvantages DC constant current systems – DC motor supplied from alternators – Turbo – electric propulsion – AC single speed and Induction motor drives – Fixed speed alternators – Cycloconverter device-Diesel Electric propulsion – Thruster and Water jet propulsion.

Steering Systems & Gyrocompasses: Fundamentals – Auto Navy steering Systems – Type P – Electro hydraulic Steering – Control systems-Typical system configuration- Components-Auto Steer-Types, Structure – Gyroscopes – Compass Considerations.Deck Machinery & Cargo Equipment: Anchor Windlass – Cargo winches – Hydra lift Marine cranes-Maritime GMC A.S.- Hagglunds Drives & H.W. Carlsen AB-Magnetic disc brakes.

Automation of Air Compressors: Selection – Choice of a correct machine-Oil-free and non-oil free air – Instrument air – Air Vs Water cooled - Reciprocating Compressors-Starting & control-Safety protection Equipment – Automatic Operation.

## **UNIT V                      AUXILIARIES AND MAINTENANCE                      12**

Batteries & Battery charging: Battery supplies – Lead-acid batteries – Electrical Characteristics – Nickel – Cadmium batteries – Sealed Ni-Cd batteries – Battery charging – Charging from AC and DC mains – Standby Emergency batteries – Voltage Regulators – Battery insulation & safety measures – First Aid treatment – Rotary generators.

Gas analysers - Combustible gas indicator – Portable oxygen analyzer – CO<sub>2</sub> Analysis – Tank scope – Fixed oxygen Analyser. Miscellaneous Systems: Cathodic protection system-Crankcase oil mist detector – Air drier – Dynic Water purity meter – Salinometer – Electric Tachometer – Rudder position Indicator – Ship's roll stabilizer – Galley Equipment – Laundry Equipment – Refrigerating Machinery – Temperature monitoring for R & AC systems.

Maintenance & Troubleshooting: Introduction – Planned Preventive Maintenance – Life, Breakdown and Condition maintenance, Troubleshooting, Maintenance of specific equipments – Recommended list of spares, tools & Accessories.

**TOTAL :    60    PERIODS**

### **OUTCOMES:**

- Different Types of Electrical distribution Systems
- Regulations observed onboard ships regarding electrical equipments
- Different types of electrical Instruments and Switch Gear used on board Ship
- using electrical instruments, to find out and rectify various kinds of faults onboard ships.
- Specification of cables and Type of Lighting systems fitted on board
- Steering systems
- maintenance of electrical equipments, instruments, system components etc.,

### **TEXT BOOKS:**

1. BOWIC C.T., Marine Electrical Practice, 5th Edition, "Butter Worth", London, 1981.
2. LAW S.W., "Electricity applied to Marine Engineering", 4th Edition, "The Institute of Marine Engineers", London, 1998.

### **REFERENCES**

1. Elstan.A. Fernandez., "Marine Electrical Technology", 1st Edition, "Sterling Book House", Mumbai, 2002.
2. Elstan.A. Fernandez., "Marine Electrical Technology", 4<sup>th</sup> Edition, "Shroff Publishers & Distributors Pvt. Ltd.,Mumbai, 2007.
3. Surinder Pal Bali," Electrical Technology Machines and Measurements", Vol II, 1<sup>st</sup> Ed. Pearson, 2013
4. Surinder Pal Bali," Electrical Technology Machines and Measurements", Vol.I, 1<sup>st</sup> Ed. Pearson, 2013



<b>MV 8703</b>	<b>MARINE CONTROL ENGINEERING AND AUTOMATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

#### **OBJECTIVE:**

- To provide knowledge about Automation and Controls fitted in ships.

#### **UNIT I CONTROL SYSTEM 9**

Introduction to control terms, Block diagrams for control systems, open loop and closed feedback control, comparison of closed and open loop, feed forward control. Feed forward modification. ON-OFF control, sequential control, Proportional plus integral plus derivative controls. Use of various control modes, Mathematical Model: Developing Mathematical Models for Mechanical, Hydraulic, Pneumatic, Thermal, Electrical and Electro mechanical Systems

#### **UNIT II GRAPHICAL REPRESENTATION OF SIGNALS 9**

Inputs of step, Ramp, Sinusoid, Pulse and Impulse, Exponential Function etc Error Detector, Controller output elements. Dynamics of a simple servomechanism for Angular position Control: Torque Proportional to error, Different responses of servomechanism.

#### **UNIT III PROCESS CONTROL SYSTEMS 9**

Automatic closed loop process. Control system Dynamic characteristics of processes. Dynamic characteristics of controllers.

Electronic Instrumentation for measurement and control analog computing and simulation: Introduction, Basic concepts. Analog computers. Simulation. The use of Digital computer in the simulation of control system. Hybrid computers.

#### **UNIT IV TRANSMISSION 9**

Pneumatic and electric transmission - suitability for marine use. Pneumatic and types of controllers hydraulic, electric and electronic controllers for generation of control action Time function controllers.

Correcting Units- Diaphragm actuators, Valve positioners, piston actuators, and Electro pneumatic transducers. Electro- hydraulic actuators and Electric actuator control valves.

#### **UNIT V APPLICATION OF CONTROLS ON SHIPS 9**

Marine Boiler - Automatic Combustion control, Air - Fuel ratio control, feed water control single, two and three-element type, steam pressure control, fuel oil temperature control, Control in Main Machinery units for temperature of lubricating oil, jacket cooling water, fuel valve cooling water, piston cooling water and scavenge air, fuel oil viscosity control. Bridge control of main machinery, Instruments for UMS classification.

**TOTAL : 45 PERIODS**

#### **OUTCOMES:**

- Basics of Control systems.
- Graphical representation of signals.
- Electrical, Electronics, Pneumatic and Hydraulic control systems.
- Design aspects of control systems on board ships.

#### **TEXT BOOKS:**

1. D.A. Taylor, "Marine Control Practice", 2nd Edition, Butter worth & Co (Publishers) Ltd., London, 1987.
2. Leslie Jackson, "Instrumentation and Control Systems", 3rd Edition, Thomas Reed Publication Ltd., London, 1992.
3. Bolton, "Control Systems", 1<sup>st</sup> Ed. Elsevier, Indian reprint 2011( Yesdee Publishing)

## REFERENCES

1. L.F. Adams, "Engineering Instrumentation and Control", 1st Edition, English Language Book Society (ELBS), Hodder, Stoughton, Great Britain, 1984.
2. Peter Harriott, "Process Control", 26th reprint, Tata McGraw Hill Publishing Co. Ltd., 2005
3. Bhattacharya, S.K., "Control System Engineering", 2<sup>nd</sup> Ed., Pearson, 2012
4. Sinclair, "Sensors and Transducers", 3<sup>rd</sup> Ed. Elsevier, Reprint 2011 (Yesdee Publishing)
5. Smith.S.G, "Application Of Automatic Machinery And Alarm Equipment In Ships", Marine Engineering Practice, Vol 1, Part 06, IMarEST, London, 2002

**MV 8704**

**MARINE AUXILIARY MACHINERY – II**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVE:

- To impart knowledge on the Working Principle of Marine Auxiliary Machineries

### **UNIT I                      OPERATION & MAINTENANCE                      9**

Prevention of oil, garbage, sewage, air pollution and IMO requirement as per MARPOL act. Operation, construction, maintenance of oil water separator both manual and automatic versions. Construction, operation, maintenance of incinerator and the of sewage plant.

### **UNIT II                      THEORY OF OIL PURIFICATION/AIR COMPRESSOR                      9**

Construction, operation, maintenance of fuel oil and lub oil purifiers, clarifiers together with self de sludge operation. Theory of air compression and uses of compressed air on board. Construction, operation, maintenance of main air compress and emergency air compressors. Types of bow thrusters, operation, maintenance of the same and Deck machinery, operation, maintenance of cargo winches, windless mooring winches.

### **UNIT III                      METHODS OF SHAFT ALIGNMENT                      9**

Construction, operation, maintenance of - thrust block. - intermediate shaft. Construction, operation, maintenance stern tube and stern tube bearing both water cooled and oil cooled together with sealing glands .Stresses in shafting, i.e. intermediate shaft, thrust shaft and screw shaft.

### **UNIT IV                      DRY DOCKING                      9**

Preparation and procedure to dry docking vessel. Maintenance of hull, underwater fittings and machine maintenance and repairs during dry dock Removal and maintenance of rudder and propeller. Removal and maintenance of tail shaft and stern tube bearing.

### **UNIT V                      MAINTAINENCE AND REPAIR AT MANAGEMENT LEVEL,                      9** **LEADERSHIP AND MANAGERIAL SKILLS**

- A) Theory of marine eng. Practice and maintenance of machinery, dealing with wear and tear, both electrical and mechanical., Alignment of components, temporary and permanent repairs. Detection of machinery malfunction and action to prevent damage.
- B) Planned maintenance, preventive maintenance, condition monitoring, Principles of tribology, dry docking, risk assessment, trials and safe working practices.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- The Construction, operation, maintenance of incinerator and sewage plant.
- The Construction, operation, maintenance of Oily water Separator and Purifiers
- The Construction operation, maintenance of sewage plant.
- Alignment of shafting system
- Dry docking of ships
- Maintenance and repair of Equipments , Machinery fitted in ships

**TEXT BOOKS:**

1. DW Smith "Marine Auxiliary Machinery", 6th edition, Butter Worths,London,1987.
2. HDMcGeorge,"Marine Auxiliary Machinery"7thedition, Butter Worths,London,2001.

**REFERENCES**

1. D.K. Sanyal, " Principle and practices of Marine Diesel Engine" 2nd Edition, Bhandarkar Publication, Mumbai, 1998
2. MARPOL 73/78, IMO Publications , 2001.
3. Wood Yard , Doug, "Pounder"s Marine Diesel Engine" 7thedition, Butter Worths Heinemann Publications ,London 2001
4. " Pumping and Piping systems, Publisher, Sea Fish Industry Authority 2012
5. Heinz P. Bloch, Fred K. Geitner, "Machinery Component Maintenance and Repair" 3<sup>rd</sup> Ed. An imprint of Elsevier, 2010

**MV 8705****SHIP'S FIRE PREVENTION AND CONTROL**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To provide knowledge an understanding of advanced Fire Prevention and Control to the students.

**UNIT I FIRE PROTECTION BUILT IN SHIPS****9**

SOLAS convention, requirements in respect of materials of construction and design of ships, (class A, B, type BHDS), fire detection systems, fire test, escape means, electrical installations, ventilation system and venting system for tankers. Statutory requirements for fire fighting systems and equipments on different vessels, fire doors & fire zones.

**UNIT II DETECTION AND SAFETY SYSTEMS****9**

Fire safety precautions on cargo ships, tankers and passenger ships during working. Types of detectors, selection of fire detectors and alarm systems and their operational limits. Commissioning and periodic testing of sensors and detection system. Description of various systems fitted on ships including micromist and extinguishing system.

**UNIT III FIRE FIGHTING EQUIPMENT****9**

Fire pumps, hydrants and hoses, couplings, nozzles and international shore connection, construction, operation and merits of different types of portable, non-portable and fixed fire extinguishers installations for ships, properties of chemicals used, water-mist fire suppression system. Advantages of various fire extinguishing agents including vaporizing fluids and their suitability for ship's use. control of class A, C & class D fires, Combustion products & their effects on life safety.

**UNIT IV FIRE CONTROL****9**

Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, cargo holds and galley. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, Rescue operations from affected compartments. First aid, fire organization on ships, shipboard organization for fire and emergencies. Combustion products and their effects on life safety, fire signal and muster. Fire drill. Leadership and duties, Fire control plan, human behaviour.

**UNIT V SAFETY MEASURES****9**

Special safety measures for preventing, fighting fire in tankers, chemical carriers, oil rigs, supply vessels, and fire fighting ships - Safe working practice with respect to fire on board ships and first aid for hazards arising from fire in ships.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Fire protection, Detection and Safety systems in ships.
- Construction, Operation and Maintenance of Fixed and portable Fire Extinguishers in ships.
- Fire prevention and control in oil tankers, LPG / LNG carriers, Chemical tankers, oil rigs, supply vessels
- Operation of Fire fighting ships

**TEXT BOOKS:**

1. Frank Rush Brook, "Fire Aboard", 3rd Edition, Brown, son & Ferguson Ltd., Glassgow 1988.
2. Victory.G, Owen.I.H, "Fire Fighting Equipment And Its Use In Ships", Marine Engineering Practice, Vol 1, Part 05, IMarEST, London, Reprint 1998
3. M.G. Stavitsky, V.I. Vostryakov, M.F.Kortunov, V.I. Martynenko & V.M. Sidoryok., "Fire Fighting Aboard ships Vol. I & Vol. II, Structural Design and Fire Extinguishing System", 1st Ed. Gulf publishing company, Houston, London, 1983.

**MV 8711****FIRE FIGHTING, CONTROLS AND SIMULATOR  
LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVE:**

- To impart Practical knowledge of fire fighting , control systems on board . To train the students in simulator so as to have knowledge of correct operation of Engines, machinery , Equipments fitted on board ships

**MARINE ENGINEERING FIRE FIGHTING LABORATORY****LIST OF EXPERIMENTS**

1. Fire hazard aboard ships – inflammability, fire extinguishing use. Control of class A, B & C fires.
2. Fire protection built in ships, extinction systems, and escape means.
3. System for tankers, statutory requirements for fire fighting systems and equipments on different vessels.
4. Fire fighting equipment: fire pumps, hydrants and hoses, couplings, nozzles and International shore connection, Construction, Operation and merits of different types of portable extinguishers.

5. Non-portable and fixed fire extinguishers, installation for ships. Properties of chemical used, bulk carbon-di-oxide, and inert gas systems.
6. Firemen outfit its use and care, maintenance, testing and recharging of appliances, preparation, and fire appliance survey.
7. Fire Control: Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, Cargo holds, galley etc.,
8. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, rescue operations from affected compartments.
9. First aid, Fire organisation on ships. Fire signal and muster.
10. Fire drill.

**TOTAL: 60 PERIODS**

#### **OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Operating Different types of fixed and portable type of fire extinguishers
- Fighting different types of fire on board ships
- Refilling all types of fire extinguishers
- operating different types of fire fighting equipments Viz. fire pumps, hydrants and hoses, couplings, nozzles and International shore connection,
- First aid
- Operating Hydraulic and Pneumatic control equipment , systems and components
- Starting ,Operating , watch keeping, Keeping the machinery with in the operating parameters by controlling the system components and equipments, corrective action during fault , malfunction, and stopping of all machinery and Engines.

#### **REFERENCES:**

1. Laboratory Manual
2. M.G. Stavitsky, V.I. Vostryakov, M.F.Kortunov, V.I. Martynenko & V.M. Sidoryok., "Fire Fighting Aboard ships Vol. I & Vol. II, Structural Design and Fire Extinguishing System", 1st Ed. Gulf publishing company, Houston, London, 1983.
3. Frank Rush Brook, "Fire Aboard", 3rd Edition, Brown, son & Ferguson Ltd., Glassgow 1988.

#### **PNEUMATIC AND HYDRAULIC CONTROL LABORATORY**

**L T P C  
0 0 4 2**

1. Symbols of Hydraulics
2. Hydraulic Power Pack
3. Double acting Cylinder Operation 4/3 Direct Control valve
4. Pilot operated check valve.
5. Speed control of cylinder with throttle valve.
6. To study the cracking pressure pilot operated check valve.
7. Meter-in-Circuit.
8. Meter - Out-Circuit
9. Bleed of Circuit
10. Direct operated relief valve.
11. Hydraulic motor operation.
12. Speed variation of hydraulic motor.
13. Sequence Circuit.
14. Symbols in Pneumatics.
15. Single acting cylinder with 3/2 Valve.
16. Quick exhaust Valve.

17. Time Delay circuit.
18. Impulse operation of single acting cylinder
19. Impulse operation of double acting cylinder
20. Pressure switch operation pneumatic system
21. Series connection of electro pneumatic Contacts
22. Parallel connection of electro pneumatic Contacts

**REFERENCES:**

1. Laboratory manual
2. Shanmuga Sundram, "Hydraulics and Pneumatics Controls", S. Chand group, 2010

**SIMULATOR LAB. EXPERIMENTS**

1. Description of basic engine functions and their simulation.
2. Manual Method of operation of engine from engine room station.
3. Engine operation from Remote stations – i.e. engine control room and Navigation Bridge.
4. Safety and interlocks in UMS – ships and effect of malfunction of main engine auxiliaries.
5. Electronic logic circuits in remote control stations.
6. Simulation of engine functions in logic circuits.
7. Study and adjustments of Logic circuits for remote control operation of main engine

**REFERENCES:**

1. Laboratory Manual
2. Original Equipment ( Simulator) Manufacturers manual
3. Ganesan,V., "Computer Simulation of Compression – Ignition Engine Processes", 1<sup>st</sup> Ed., Universities Press, Reprint 2013
4. Ganesan, V., "Computer Simulation of Spark – Ignition Engine Processes", 1<sup>st</sup> Ed., Universities Press, Reprint 2013

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

**MARINE FIRE FIGHTING LABORATORY**

Sl.No	Description of Equipment	Qty
01	Fixed CO2 fire fighting system	01
02	Smoke Detection Unit	01
03	Fire main system	01
04	Fire call point & Gong Bell	01
05	Portable extinguishers (Water, CO2, dry powder, mechanical type extinguishers)	01
06	Non-Portable Extinguisher – Mechanical Extinguisher	01
07	Smoke & Heat detectors	01
08	C.A.B.A	01
09	Bellow type foot pump	01
10	First aid kit and stretcher	01

Sl.No	Description of Equipment	Qty
01	Transparent Hydraulic Trainer	01
02	Transparent Pneumatic Trainer	01
03	Electro Hydraulic and Pneumatic Trainer	01
04	PID Trainer – Hydraulic	01
05	PID Trainer – Pneumatic	01
06	PC Interface	01
07	Air Compressor Suitable for above system	01

Sl.No	Description of Equipment	Qty
01	Engine Room Simulation Master Panel	01
02	Engine Room Simulation Trainee Panels	04

**OBJECTIVE:**

- ## MARINE ENGINE

1. Study of Lubricating oil cooler
2. Study of Jacket water cooler
3. Study of Scavenge Air cooler
4. Study of crank case inspection and bearing clearances
5. Fuel injection valve and pump
6. starting air valve
7. cylinder relief valve and indicator cock

8. Study of Turbo charger
9. Study of Cylinder Head and fittings
10. Study of Fuel Injection pump

11. Study of Lubricating oil screw pump
12. Study of S.W. Centrifugal pump
13. Reciprocating Bilge pump
14. Study of Boiler safety valve and water level gauge glass
15. Study of 2 RAM hydraulic steering gear
16. Study of various types of valves, filters, oil separators, Incinerator, Heat Exchange etc.
17. Study of boilers, cargo oil pump, F.W. Generator.

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**OUTCOME:**

**Upon Completion of the course, the students will be able to:**

- To open ,clean, repair and refit all the equipments associated with Main Engines, Auxiliary engines and auxiliary machines

**REFERENCES**

1. Sterling.L, "Selection Installation & Maintenance Of Marine Compressors", Marine Engineering Practice, Vol 1,Part 01, IMarEST, London, Reprint 1996
2. Gopalakrishnan & Banerji, "Maintenance and Spare Parts Management", PHI Learning Pvt. Ltd., 2010
3. Mishra and Pathak, " Maintenance Engineering and Management," 2<sup>nd</sup> Ed. , PHI Learning Pvt. Ltd., 2012
4. Venkataraman, "Maintenance Engineering and Management," 1<sup>st</sup> Ed., PHI Learning Pvt. Ltd., 2010
5. Bloch, "Machinery Component Maintenance and Repair",3<sup>rd</sup> Ed. Elsevier, Indian Reprint 2010, (Yesdee Publishings Pvt. Ltd.)
6. H D McGeorge, "MarineAuxiliary Machinery" 7thedition, Butter Worths,London,2001

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS  
MARINE PROPULSION LABORATORY**

<b>Sl.No</b>	<b>Description of Equipment</b>	<b>Qty</b>
01	Fuel Oil Separator	01
02	Lub Oil Separator	01
03	Bilge Pump	01
04	Ballast Pump 130 cu.m/hr	01
05	Main Engine Sea Water Pump	01
06	Sludge Pump	01
07	Fuel Oil Transfer Pump	01
08	Ballast Pump 65 cu.m /hr	01
09	Lub Oil Filter	01
10	Fuel Oil Filter	01
11	Lub Oil Cooler	01
12	Sea Water Cooler	01
13	Main Engine	01
14	Air Compressor with bottle	01
15	Main Engine Lub Oil Pump	01
16	Portable Compressor	01
17	Diesel Generator 300 KW / 100 KW	01

**MARINE AUXILIARY MACHINERY LABORATORY**

<b>Sl.No</b>	<b>Description of Equipment</b>	<b>Qty</b>
01	Air Compressor	01
02	Heat Exchanger	01
03	Incinerator	01
04	Oily Water Separator	01
05	Steering Gear	01
06	Cargo Turbine Oil Pump	01
07	Cargo Winch	01
08	Governor	01
09	Thermostat	01
10	Crankshaft	01



### MARINE DISMANTLING AND ASSEMBLING LABORATORY

Sl.No	Description of Equipment	Qty
01	Heleshaw Pump	01
02	Piston Pump	01
03	Centrifugal Pump	01
04	Gear Pump	01
05	Fire & G.S Pump	01
06	Screw Displacement pump	01
07	Sewage Treatment Plant	01
08	Cargo Oil Pump	01
09	Different types of valves (quick closing valve, non-return valve, butterfly valve)	01Each
10	Water gauge glass	01

### MARINE BOILER WORKSHOP

Sl.No	Description of Equipment	Qty
01	Auxillary Water Tube Boiler	01
02	Fresh Water Generator	01

**MV 8713      MEASUREMENT AND INSTRUMENTATION LABORATORY      L    T    P    C**  
**0    0    4    2**

#### OBJECTIVE:

- To impart knowledge on the use of Measuring Techniques ,Measuring equipments and Instruments and the Operation of Refrigeration plant

### MEASUREMENT LABORATORY

#### LIST OF EXPERIMENTS

1. Use of precision measuring instruments like micrometer, vernier, height and depth gauges, surface plate, etc.
2. Checking dimensions of a part using slip gauge.
3. Use of sine bar for measuring angles and tapers.
4. Measurement of tooth thickness by gear tooth vernier.
5. Calibration of dial gauge.
6. Taper and bore measurement-using spheres.
7. Fundamental dimension of a gear using contour projector.
8. Testing squareness of a try square using slip gauges.
9. Checking straightness of a surface plate using autocollimator.
10. Measurement of angles between centre lines of holes drilled radially on a shaft.
11. Measurements of thread parameters using floating carriage micrometer.
12. Use of pneumatic comparator and mechanical comparator.

### INSTRUMENTATION LABORATORY

Pressure measuring devices-pressure and vacuum gauge calibration.

Temperature measuring devices like Platinum resistance thermometer, thermocouple, radiation pyrometer, etc.

Flow measuring devices like orifice meter, rotameter, etc.

Speed measuring devices like tachometer, stroboscope, etc.

Force measuring devices, load cells and proving rings.

Torque measuring devices

Power measurement using rope, prony brake, mechanical, hydraulic and electrical dynamometers.

Study and use of strain, displacement devices-strain gauge indicator, LVDT.

Study and use of velocity and acceleration-accelerometer.

Study and use of vibration devices-vibrometer.

**TOTAL: 60 PERIODS**

### OUTCOMES:

**Upon Completion of the course, the students will be able to:**

- using the Different types of measuring equipments instruments
- Method of measurements using the instruments
- Power measurement using rope, prony brake, mechanical, hydraulic and electrical dynamometers.
- Measurement of Vibrations of Machines
- Operation and watch keeping duties of Refrigeration plant

### LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

#### MEASUREMENT LABORATORY

Sl.No	Name of the Equipment	Qty.
01	Slip Gauge and Dial gauge	6 set
02	Sine Bar	2 nos
03	Four sphere & Two sphere height gauge	2 nos
04	Bore Dial gauge	1
05	Sphere	2
06	Vernier caliper	12
07	Profile projector	1
08	Tri-square.	2
09	Bevel protractor	2
10	Floating carriage Micrometer	1
11	Pneumatic comparator.	1
12	Optical flat interferometer.	1
13	Gear tester.	1
14	Auto collimator	1
15	Tool Maker's Microscope	1
16	Surface test 301	1

## INSTRUMENTATION LABORATORY

SL.NO	NAME OF THE EQUIPMENT	QTY.
01	1. Dead weight type pressure gauge 0-2kgf/cm <sup>2</sup>	1
02	2. Bourdon type Pressure gauge 0-400kgf/cm <sup>2</sup>	1
03	Vacuum pressure gauge – McLeod gauge.	1
04	Thermocouple	4
05	Resistance Temperature Detector	2
06	Proving ring mechanical type	2
07	Speed stroboscope	1
08	Strain gauge	4
09	Linear Variable differential transformer □20mm	4
10	Static torque meters	1
11	Piezoelectric sensor analog	1
12	Piezoelectric Crystal Sensor	2
13	Orifice meter, Venturimeter, Rotameter	3

**MV 8801**

**MARINE VEHICLES PERFORMANCE**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVE:

- To impart Knowledge to students about Marine Vehicle Performance while sailing

### UNIT I RESISTANCE 9

Types of resistance, frictional, residuary - wave making, eddy and form resistances and total resistance, air, appendage, model testing, propeller tests in open water, admiralty coefficient, fuel coefficient and consumption, sea trials – Problems.

### UNIT II PROPELLER THEORY 9

Types and theory of propellers, apparent slip, real slip, wake, thrust, relation between powers and speed, measurement of pitch, cavitations, built and solid propellers, interaction between the ship and propeller, hull efficiency over all propulsive efficiency – problems.

### UNIT III RUDDER THEORY 9

Types of rudders, model experiments and manouvering trials, area and shape of rudder, position of rudder, bow rudders vs stern rudder, forces on rudder, torque on stock, angle of heel, due to force on rudder and angle of heel when turning – problems.

### UNIT IV WAVE THEORY 9

Theory of waves, trochoidal waves, relationship between line of orbit centres and the undisturbed surface, sinusoidal wave, Irregular wave pattern, wave spectra, wave amplitudes, rolling in unresisting media, rolling in resisting media, practical aspects of rolling, Anti rolling devices, forces caused by rolling, pitching, heaving and yawing.

**UNIT V SHIP VIBRATION & NOISE****9**

Hull vibration, Engine vibration, vibration of shafting system, engine noise reduction.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Ships Model Tests and Sea Trials .
- Various types of Propellers and Rudders
- Wave motions and the Ships Vibrations

**TEXT BOOKS:**

1. "Principles of Naval Architecture", SNAME Publication, 2000
2. Eric C. Tupper, "Introduction to Naval Architecture", 3<sup>rd</sup> Edition, Butter worth – Heinemann, London, 2001.
3. EA Stokoe, E.A, "Naval Architecture For Marine Engineers", Vol.4, Reeds Publications, 2000

**REFERENCES**

1. R. Battacharjee. "Dynamics of Marine vehicles "SNAME Publication, year
2. Srikant Bhawe, "Mechanical Vibrations", Pearson, 2010
3. Malcolm, J. Crocker, "Handbook of Noise and Vibration Control", John Wiley & Sons, 2007
4. Singiresu S. Rao, "Mechanical Vibrations", Pearson, 4<sup>th</sup> Ed., Pearson, 2013
5. K.J. Rawson and E.C. Tupper, "Basic Ship Theory" (Vol. II), 5th Edition, Butterworth Heinemann, London, 2001.
6. John Carlton, "Marine Propellers and Propulsion", Butterworth-Heinemann, 2012

**MV 8802****SHIP OPERATIONAL MANAGEMENT AND IMO REQUIREMENTS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To teach the students about management of ships and impart knowledge on statutory regulations.

**UNIT I STRUCTURE OF A SHIPPING COMPANY****9**

Structure of a shipping company and functioning of its various departments, ownership of vessels, registration of ships, flags of convenience, IMO identification number.. Maritime Declarations of Health and the requirements of the International Health Regulations.

**UNIT II COMMERCIAL SHIPPING PRACTICE****9**

Planning sailing schedules and voyage estimates, liner and tramp shipping services, conference systems, chartering and charter parties, ship's papers for arrival and departure, port procedures, role of agents, theory of freight rates, bills of lading, cargo surveys and note of protests, International labour organization (ILO) and Maritime Labour Convention,2006,COLREG 1972

**UNIT III MARINE INSURANCE****9**

Underwriting and loss adjusting principles applied to Marine cargo insurance, hull / machinery policy, particular average, general average, P & I Clubs – making claims.

#### **UNIT IV                      STATUTORY REGULATIONS                      9**

IMO Conventions, legislations, MARPOL acts and conventions, annexes I to VI, SOLAS 1974 and amendments, main objectives, overview of all chapters and articles with an emphasis on ISM and ISPS codes,. Maritime security policy, security responsibilities, vessel security assessment, security equipment, threat identification vessel security actions and security administration. Load Lines Convention 1966, Tonnage Convention 1969.

Responsibilities under International Instruments Affecting the Safety of the Ships, Passengers, Crew or Cargo, Ballast Water Management

#### **UNIT V                      STCW                      9**

International convention on STCW for seafarers 1978 with 1995 amendments, an overview of all sections, manning of ships, engagement and discharge of ship's crew, ship's articles, Merchant shipping act, Role of Maritime administration(DGS) and its functions: DGS Rules and MS Notices Port state control, PSC mandatory certificate check list, grounds for PSC inspection criteria for detention. Emergency Preparedness, drills and excercises, ERM(engine room resource management)

**TOTAL :    45    PERIODS**

#### **OUTCOMES:**

- Structure and functioning of a shipping company.
- Planning and estimating of a voyage besides executing the same.
- Marine Insurance as applicable to ship, cargo and crew.
- Statutory regulations applicable to shipping industry.
- Manning of ships, STCW and Port state control.
- Security Training with designated Security Duties as per STCW 2010

#### **TEXT BOOKS:**

1. E.F. Stevens & C.S.J. Butterfield "Shipping Practice" 11th Edition, Sterling Book House, Mumbai, 1999.
2. John.M.Downard, "Ship Management Series - Managing Ships", I Edition, Fairplay Publications, Coulsdon, Surrey - 1990.
3. Capt.Dara E Driver, "Advanced Shipboard Management", I Edition, Rumar Publications, Mumbai, 1985.

#### **REFERENCES**

1. Nilima, M.Chanidiramani, "Carriage of goods by Sea and Multimodal Transport", 1<sup>st</sup> Edition, Saptarang Publication, Mumbai, 1996.
2. SOLAS – 1974 - International Maritime Organisation Publications
3. MARPOL – 1973/78 - International Maritime Organisation Publications
4. STCW -1978/95 - International Maritime Organisation Publications
5. G.Raghuram, "Shipping Management", 1st Edition, Vasant J.Sheth Memorial Foundation, Delhi, 1992
6. Pinto, "Maritime Law", Bhandarkar Publications, 1998

**OBJECTIVE:**

- To impart knowledge to the students in Watch-keeping of Engine Room in various types of ships and to prepare for Class IV MOT Examination

**UNIT I                      SAFE WATCH KEEPING                      9**

Definition of watch, operating principles, requirements of watch keeping, requirements of certification, duties of engineer officers – operation of engine room in general, log book writing – watch keeping under way – watch keeping at port – at unsheltered anchorage, fitness for duty, preparation of Diesel Engines for a long voyage – bad weather precautions, safe working practices – during overhauling at port, and during bad weather, change over from diesel oil to heavy oil and vice versa.

**Trouble shooting during watch keeping:** Emergency measures taken in case of –flooding of engine room, engine room bilge fire, general fire, In case of any system failure or breakage of pipe lines, etc.

**UNIT II                      TROUBLE SHOOTING IN AUXILIARY MACHINERIES                      9**

Malfunctioning, partial or total failure of auxiliary machineries – such as, auxiliary engines, purifiers, heat exchangers, air compressors, reefer and air conditioning compressors and systems, boilers and accessories, fresh water generators, hydrophore tanks and systems, all pumps & systems.

Repairs and maintenance of propeller, rudder, drydocking methods, drydocking inspection and repair works.

**UNIT III                      TROUBLE SHOOTING IN MAIN ENGINE                      9**

Trouble shooting related to various types of marine diesel engines and condition monitoring – causes, effects, remedies and prevention of engine not turning on Air and Fuel, knocking at TDC and BDC, black smoke in funnel, poor compression and combustion, early or advanced injection, turbocharger surging, scavenge fire, Air starting line explosion, crank case explosion, exhaust uptake fire, failure of bottom end bolts.

**UNIT IV                      MAINTENANCE OF ENGINE COMPONENTS                      9**

Checking of holding down bolts, resin chocking – Tie-rods tensioning, checking and tightening of 2-stroke and 4-stroke bottom end bolts.

Inspection and maintenance of crankshaft and cam shaft, dismantle inspection and reassemble of main bearings, cross head bearings & bottom end bearings, connecting rod, piston and piston assembly, stuffing box, cylinder head and all mountings, governor and over speed trip – checking of all clearances, adjustments, effect of improper clearances, prevention and rectification.

Cylinder liner and cylinder lubrication, thrust bearing, running gears inspection, engine alignment, chains drive adjustment and tensioning.

**UNIT V                      TROUBLE SHOOTING AND MAINTENANCE OF ELECTRICAL MACHINERIES                      9**

Circuit testing, shore supply arrangement, maintenance of circuit breakers, transformers, electrical motors, navigational lights, batteries, starters, electrical equipments, maintenance of switchboard. Maintenance of electrical equipments in oil tankers, LNG / LPG carriers.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- STCW standards of training, requirements of officers and ratings.
- Watch-keeping in various ships.
- Prevention, rectification and maintenance with respect to trouble shooting of machineries in the Engine Room.

**TEXT BOOKS:**

1. Vikram Gokhale & N.Nanda, "Marine Engineering Practice and Ship safety and Environmental protection", 3rd Edition, Engage Enterprises Mumbai, 2002.
2. Sulzer brothers, "Sumitomo – Sulzer Diesel Engines", Service Instruction for Sumitomo Sulzer Diesel Engines RND Sumitomo ship building & Machining co., Ltd., Japan.
3. Heinz P. Bloch, Fred K. Geitner, "Machinery Component Maintenance and Repair" 3<sup>rd</sup> Ed. An imprint of Elsevier, 2010

**REFERENCES**

1. IME Manuals and Ship's Marine Manuals.
2. Manual instruction for MAN Diesel Engine and spare parts, 1968.
3. Instruction Manual for Mitsui – B & W Diesel Engine data, Mitsui Engineering & Ship Building co., Mitsui B & W, 1976.
4. Manual De Maintenance & operation MAN type K.270 120E DMR.
5. Daihatsu Diesel Engine instruction book, Operation & maintenance manual for Daihatsu Diesel Engine Model – DV26, Model 6 PKT – TB-16.

**MV8804****OFFSHORE TECHNOLOGY**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To understand different type of offshore structure.
- To understand different design factor of offshore structure

**UNIT I INTRODUCTION OF OFFSHORE STRUCTURES 9**

Introduction- Definition of Offshore Structures – Selection of Deepwater Production Concepts – Functions of Offshore Structures – Exploratory Drilling Structures – Production Structures – Storage Structures – Export Systems - Offshore Structures Configurations – Bottom – Supported Structures - Floating Offshore Structures – Floating Vs Fixed Offshore Structures – Bottom – Supported Fixed Structures – Minimal Platforms – Jacket Structures – Gravity Base Structures – Jack – Ups – Subsea Templates – Subsea Pipelines – Complaint Structures – Articulated Platforms – Complaint Tower – Guyed Tower - Floating Structures – Floating Platform Types – Drilling Units – Production Units – Drilling And Production Units – Platform Configurations .

**UNIT II OCEAN ENVIRONMENTS 9**

Introduction – Ocean Water Properties – Density ,Viscosity d Salinity, Temperature – Linear Wave Theory – Second – Order Stokes Wave Theory – Stream Function Theory – Wave Theory – Breaking Waves – Internal Waves.

Discussion of Selected Innovative Field Development Concept:

Field Development Concept – Discussion Of Selected Innovative structures – Structures Selected for In – Depth Discussion – Construction and Construction Schedules – Transportation and Installation – In – Service Response and Utilization – Capital and Operating Expenditures – Post – Service Utilization – Residual Value and Risk Factors.

## 9

## UNIT IV      FIXED OFFSHORE PLATFORM DESIGN FACTORS

9

## UNIT V      FLOATING OFFSHORE PLATFORM DESIGN FACTORS

9

**TOTAL : 45 PERIODS**

1. Handbook Of Offshore Engineering – 1, Elsevier publication, Edition 2006 by Subrata K. Chakrabarti.
2. D Faulkner; M J Cowling; P A Frieze, "Integrity of offshore structures", Publisher, Englewood,N.J.,Applied Science, 1981
3. American Petroleum Institute, "Recommended practice for planning, designing, and constructing fixed offshore platforms : load and resistance factor design ; API recommended practice 2A-LRFD (RP 2A-LRFD)" Publisher, American Petroleum Institute , Washington, DC: 1993

<b>MV 8001</b>	<b>ADVANCED MARINE HEAT ENGINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

To impart the knowledge of Latest Designed Marine Heat Engines

## 9

## UNIT II COMBUSTION AND FLAME STABILISATION

9

Combustion of liquid fuels, atomisation, mixing, combustion curve and different methods of flame stabilisation, design and combustion chamber. Spray of fuel. Pre-mixing of gaseous fuels for combustion. Stability of the flame. introduction of simulation of engine.





**OBJECTIVE:**

To ensure awareness regarding Environmental Protection at Sea and to impart aspect of commitment.

**UNIT I OIL POLLUTION PREVENTION 9**

Pollution of the Marine environment while bunkering, loading/discharging oil cargo – tank cleaning – pumping out bilges etc., - knowledge of construction and operation of oil pollution prevention equipment in engine room and on tankers.

**UNIT II LEGISLATIONS 9**

MARPOL 73/78 and other country legislations like OPA-90 MARPOL equipment – Knowledge of Codes of Safety Working practices as published – Knowledge of type of information issued by D.G. Shipping with regard to safety at sea & safe working practices.

**UNIT III SURVIVAL TECHNIQUES AND LIFE SAVING APPLIANCES ON SHIP 9**

Introduction and safety – Emergency situations – Principles of survival – Use of survival equipment – Survival craft and rescue boat – Methods of helicopter rescue – Launching arrangements – Lifeboat engine and accessories – Evacuation – Signalling equipment and pyrotechnics – First aid – Radio equipment – Launching and handling survival craft in rough weather – Understand practical applications of medical guides – Understand process of radio medical advice – Demonstrate knowledge of actions to be taken in case of accidents or illnesses that are likely to occur on board ships.

**UNIT IV RULES & REGULATIONS 9**

IMO & its conventions – Indian Merchant Shipping Act & Rules – Classification society – Charterers – Personal relationship onboard ship.  
Knowledge of the appropriate statutes of concern to marine engineer officers: The administrative duties of a Chief Engineer – the organisation and training of staff for both normal and emergency duties. The various statutory certificates and documents to be carried onboard ships by all ships: Dangerous goods codes– Carrying more than 2000 tonnes of oil – Chemical tankers and Gas carriers.

**UNIT V PERSONNEL MANAGEMENT 9**

Principles of controlling subordinates and maintaining good relationship – staff attitudes – Exercise of authority – Group behaviour – Conditions of employment.  
Organisation of Staff: Manning arrangements – Analysis of work – Allocation of staff – Organisation of safety and emergencies, staff duties, maintenances, Ship's records, communication on the ship, meeting techniques.  
Training on board ships: Training methods – Training in safety – Emergency drills – Training in ship operations.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Learn precautions required for oil tanker operations.
- Learn about MARPOL 73/78 requirements and Safe Working Practices.
- Learn Life Saving and Survival at Sea techniques.
- Learn about IMO, its conventions and statutory certificates of ships.
- To understand Personnel Management, Training and Emergency drills of ships

**TEXT BOOK:**

1. STCW – 1995 Hand Book

**REFERENCES**

1. Bhandarkar V.K. "MS & M Notices", 1<sup>st</sup> Edition, Bhandarkar Publishers, Mumbai, 1998.
2. International Maritime Organisation, "SOLAS consolidated Edition 1997", 2<sup>nd</sup> Edition, Sterling Book House, Mumbai, 1997.
3. International Maritime Organisation, "MARPOL 73/78 consolidated edition 1997", 2<sup>nd</sup> Edition, Sterling Book House, Mumbai, 1997.
4. R. H. B. Sturt, "The Collision Regulations", 2<sup>nd</sup> Edition, Lloyd's of London Press Ltd., London, 1984.

**MV 8003****PRESSURE VESSELS AND PIPING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To apply the Mathematical knowledge gained in the design of pressure vessels and piping
- To carry out the stress analysis in pressure vessels and piping. To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I INTRODUCTION****9**

Types of stresses ,Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

**UNIT II STRESSES IN PRESSURE VESSELS****9**

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

**UNIT III DESIGN CRITERIA OF PRESSURE VESSELS****9**

Design criteria of Tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement for Pressure Vessel Design.

**UNIT IV BUCKLING AND FRACTURE ANALYSIS IN Pressure VESSELS****9**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading

**UNIT V PIPING****9**

Introduction – Flow diagram – piping layout and piping stress Analysis

**TOTAL : 45 PERIODS****OUTCOMES:**

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

- Apply the mathematical fundamentals for the design of pressure vessels and pipes.
- Analyse and design pressure vessels and piping

**TEXT BOOKS:**

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987

**REFERENCES**

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987
2. Stanley, M. Wales, "Chemical process equipment, selection and Design. Buterworths series in Chemical Engineering", 1988
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.

**GE8074****HUMAN RIGHTS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE :**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I****9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II****9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

**UNIT III****9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

**UNIT IV****9**

Human Rights in India – Constitutional Provisions / Guarantees.

**UNIT V****9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS****OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

**OBJECTIVE:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I INTRODUCTION****9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES****9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I****9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II****9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM****9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

**TOTAL: 45 PERIODS****OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

- Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

- James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
- Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
- Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
- ISO 9001-2015 standards

**OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS****9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)****9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT****9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA****9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS****9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.

- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

#### TEXT BOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

#### REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

<b>MV 8004</b>	<b>SPECIAL DUTY VESSELS AND TYPE OF OPERATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

#### OBJECTIVE:

To impart knowledge to the students about special duty ships operation and classification society regulations.

#### UNIT I INTRODUCTION 9

Need for special duty vessels with reference to development of trade and necessities of the trade. Operation of Bulk carriers – Bulk Grain and ore etc., - Banana carriers – Coal Carriers – Forest Products carriers – Timber carriers – Container vessels.

#### UNIT II OIL TANKER CARGO OPERATIONS 9

Pipeline systems – Ring main – Direct Line – Combined – Free flow system – Stripping lines. Lining up pipe lines and cargo operations – loading more than one grade – discharging – ballasting – precautions – ship / shore check list safety goods – sources of ignition on – static electricity – precautions to prevent ignition due to static electricity cargo operations when not secured alongside – procedure if oil spill occurs – oil record books.

#### UNIT III OIL TANKERS ROUTINE OPERATIONS 9

Inert Gas system – principle – components of system, plant and distribution system – uses of inert gas during tanker operating cycle.

Tank washing: Procedure – portable and fixed machines – tank washing with water –washing atmospheres – crude oil washing (COW) – advantages and disadvantages of COW – operating and safety procedures – gas freeing – pressure vacuum values – "Load on Top" system (LOT) regulations and operation – Segregated Ballast Tanks (SBT).

#### UNIT IV INTRINSICALLY DANGEROUS CARGOS 9

- Dangerous goods – loaded in bulk – packaging – IMDG code – emergency procedures – 'MS & M' notices – general fire precautions, during loading / discharging, - fire fighting and detection system. Liquefied gas cargoes – regulations types of cargo and carriers – LPG and LNG – cargo handling equipments tank monitors and controls – operational procedures loading and discharging of LPG/LNG cargoes – chemical cargoes regulations, operations – bulk chemical

carriers – tank material and coatings – tank washing – cargo record book – equipment items precautions to be observed during cargo operations in port – fire protection – personnel protection.

## **UNIT V RULES AND REGULATIONS 9**

Classification societies for hull, equipment and machineries of Cargo ships and oil tankers – requirements of various types of surveys and certification of Merchant Ships.

**TOTAL : 45 PERIODS**

### **OUTCOMES:**

- History of trade of special duty vessels.
- Cargo Operations of Oil tankers.
- About Inert Gas Systems and Tank Washing Operations of Tankers.
- Cargo Operations of Chemical tankers, LPG / LNG vessels.
- About rules of classification societies for Cargo Ships and Tankers.

### **TEXT BOOKS:**

1. Lavery, "Ship board operation", 2<sup>nd</sup> Edition, Butter Worth- Heinemann, London, 1990.
2. V.K. Bhandarkar, "MS & M Notices to Mariners", 1st Edition, Bhandarkar Publications, Mumbai, 1998.
3. D.J. Eyres, "Ship Construction", 4<sup>th</sup> Edition, Butter worth – Heinemann, Oxford, 1994.

### **REFERENCES**

1. Indian Register of Shipping Part1 to Part7, "Rules and Regulations for the construction and classification of steel ships", 1st Edition, Indian Register of Shipping, Mumbai, 1999.
2. International of Maritime Organisation, "SOLAS consolidated Edition 1997", 2<sup>nd</sup> Edition, Sterling Book House, Mumbai, 1997.

**MV 8005**

**MARINE ROBOTICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **OBJECTIVES:**

- To provide the students an advanced knowledge in various types of marine robots and its applications a relatively nascent field
- To impart knowledge in students in the areas of marine robotics design, development and deployment in the real world applications

## **UNIT I MARINE ROBOTS 9**

Types and classification of marine robots – robotic sailing – submersibles, applications of sailing robots and submersibles, Limitations in marine autonomy

## **UNIT II ROBOTIC SAILING 9**

History and recent developments in robotic sailing – miniature sailing robot platform (MOOP) – autonomous sailing vessel – design, development and deployment

## **UNIT III SUBMERSIBLES 9**

Unmanned submersibles- towed vehicles – Remotely Operable Vehicles (ROV) – The ROV business – Design theory and standards – control and simulation – design and stability – components of ROV - applications



**UNIT IV AUTONOMOUS UNDERWATER VEHICLE (AUV) 9**  
 Gliders – construction – buoyancy driven – Control strategies, AUV – construction – components – control strategies

**UNIT V UNDERWATER VEHICLE GUIDANCE AND CONTROL 9**  
 Modelling of marine vehicles – kinematics – rigid body dynamics – hydrodynamic forces and moments – equation of motion – stability and control of underwater vehicles

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Students will have knowledge in various types of marine robots.
- Students should get an introduction about designing, developing and deploying marine robots in the field

**TEXT BOOKS:**

- 1 Alexander Schlaefler and Ole Blaurock, "Robotic sailing", Proceedings of the 4<sup>th</sup> International sailing conference, Springer, 2011
- 2 Sabiha A. Wadoo, Pushkin Kachroo, "Autonomous underwater vehicles, modelling, control design and Simulation", CRC press, 2011
- 3 Robert D. Christ, Robert L. Wernli, Sr. "The ROV Manual A User Guide for Remotely Operated Vehicles", Elsevier, second edition, 2014
- 4 Thor I Fossen, "Guidance and control of ocean vehicles", John Wiley and Sons, 1999

**REFERENCES**

- 1 Mae L. Seto, "Marine Robot Autonomy", Springer, 2013
- 2 Richard A Geyer, "Submersibles and their use in oceanography and ocean engineering", Elsevier, 1997
- 3 Gianluca Antonelli, "Underwater robotics", Springer, 2014

<b>MV 8006</b>	<b>MARINE CORROSION AND PREVENTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVE:**

- To impart knowledge on the Type of corrosion and how this is being controlled in marine environment

**UNIT I INTRODUCTION 9**  
 Cathodic Protection – Sacrificial anodes protection – Impressed current system protection – Bimetallic corrosion – Design faults causing corrosion – corrosion of metals in sea water, metallic corrosion.

**UNIT II HULL PLATE PREPARATION 9**  
 Plate preparation during building and repair periods -Atmospheric corrosion Mill scale – flame cleaning – Acid Pickling – Blast cleaning – causes of paint failure – shipboard preparations for painting – power wire brushing – power discing – air hammer – high pressure water blasting – sand blasting shot blasting

**UNIT III MODERN PAINT TYPES****9**

Basic composition of paint Alkyd – bitumen or pitch – chlorinated rubber – coal tar epoxy – Epoxy – oleoresinous – phenolic – polyurethane – primers – vinyl – self polishing copolymers – shipboard paint systems – underwater AF paints – bottom anti corrosive paints – super structure paints.

**UNIT IV CORROSION IN BOILER****9**

Atoms & Ions, pH value electrochemical corrosion, Direct chemical attack – Electro chemical attack – reason – remedial measures. Effect of salts & Grease in feed water. Effect of corrosion while boiler not in service – preservation to avoid corrosion.

**CORROSION IN MARINE DIESEL ENGINES:**

Corrosive wear of cylinder liners – Reasons and remedies – corrosion of Main Engine Jacket cooling spaces – Reasons and remedies – corrosion in bearings.

**UNIT V CORROSION AND ITS PREVENTION****9**

Mechanism of corrosion – Chemical corrosion – Electro chemical corrosion – Anodic & cathodic protection – forms of metallic coatings – anodizing – phosphating.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Causes of corrosion
- Method of prevention during operation and during construction
- Anti-corrosive paints
- Corrosion in BOILERS and IC ENGINES

**TEXT BOOKS:**

1. Lavery, H.I., "Shipboard operations" Institute of Marine Engineers Publication, 1990
2. Schweitzer, ' Fundamentals of Corrosion', 1<sup>st</sup> Ed. Taylor & Francis, Indian Reprint 2012 (Yesdee Publishing Pvt. Ltd.)
3. M.E.P., "Corrosion For Marine & Offshore Engineers ", Marine Engineering Practice, Vol.02, Part 11, IMarEST, London
4. Francis Laurence LaQue , " Marine corrosion: causes and prevention", 1<sup>st</sup> Ed., Wiley, 1975
5. Claire Hellio, Diego M. Yebra, Pinturas Hempel S.A., "Advances in Marine Antifouling Coatings and Technologies", Woodhead Publishing, 2009

**REFERENCES**

1. Pierre R. Roberge, "Corrosion Engineering Principles and Practice", 1<sup>st</sup> Ed., McGraw-Hill, 2008
2. Zaki Ahmad, "Principles of Corrosion Engineering and Corrosion Control", 1<sup>st</sup> Ed. Elsevier Ltd., 2006

**GE8076****PROFESSIONAL ETHICS IN ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

## 10

## UNIT II ENGINEERING ETHICS

9

## UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION

9

## UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

9

## UNIT V      GLOBAL ISSUES

8

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

- ## REFERENCES:

- ### Web sources:

- 107

**OBJECTIVE:**

- To give an idea about IPR, registration and its enforcement.

**UNIT I INTRODUCTION****9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

**UNIT II REGISTRATION OF IPRs****10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III AGREEMENTS AND LEGISLATIONS****10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV DIGITAL PRODUCTS AND LAW****9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

**UNIT V ENFORCEMENT OF IPRs****7**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

**TOTAL :45 PERIODS****OUTCOME:**

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXT BOOKS**

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

**REFERENCES**

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

**OBJECTIVE:**

- To learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION****8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION****9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS****12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nanoclays- functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

**UNIT IV CHARACTERIZATION TECHNIQUES****9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

**UNIT V APPLICATIONS****7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

**TEXT BOOKS :**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Characterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCES:**

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

