

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
R - 2013
B.E. MARINE ENGINEERING
I – VIII SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS6151	<u>Technical English – I</u>	3	1	0	4
2.	MA6152	<u>Mathematics for Marine Engineering – I</u>	3	1	0	4
3.	PH6151	<u>Engineering Physics – I</u>	3	0	0	3
4.	CY6152	Chemistry for Marine Engineering	3	0	0	3
5.	GE6151	<u>Computer Programming</u>	3	0	0	3
6.	GE6152	<u>Engineering Graphics</u>	2	0	3	4
7.	MV6101	<u>Basics of Marine Engineering</u>	3	0	0	3
PRACTICALS						
7.	GE6161	<u>Computer Practices Laboratory</u>	0	0	3	2
8.	GE6163	<u>Physics and Chemistry Laboratory - I</u>	0	0	2	1
9.	MV6111	<u>Marine Engineering Practices Laboratory</u>	0	0	4	2
TOTAL			20	2	12	29

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS6252	<u>Technical English for Marine Engineering – II</u>	3	1	0	4
2.	MA6252	<u>Mathematics for Marine Engineering – II</u>	3	1	0	4
3.	PH6251	<u>Engineering Physics – II</u>	3	0	0	3
4.	GE6252	<u>Basic Electrical and Electronics Engineering</u>	4	0	0	4
5.	GE6253	<u>Engineering Mechanics</u>	3	1	0	4
6.	MV6201	<u>Marine Engineering Thermodynamics</u>	3	0	0	3
PRACTICALS						
7.	GE6261	<u>Computer Aided Drafting and Modeling Laboratory</u>	0	1	2	2
8.	GE6262	<u>Physics and Chemistry Laboratory - II</u>	0	0	2	1
9.	GE6263	<u>Computer Programming Laboratory</u>	0	1	2	2
10.	MV6211	<u>Workshop Fitting</u>	0	0	4	2
TOTAL			19	5	10	29

SEMESTER – III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6351	<u>Transforms and Partial Differential Equations</u>	3	1	0	4
2.	MV6301	<u>Marine Hydraulics and Fluid Machinery</u>	3	0	0	3
3.	MV6302	<u>Seamanship, Elementary Navigation and Survival At Sea</u>	3	0	0	3
4.	MV6303	<u>Marine Manufacturing Technology</u>	3	0	0	3
5.	MV6304	<u>Marine Electrical Machines – I</u>	3	1	0	4
6.	MV6305	<u>Marine Refrigeration and Air Conditioning</u>	3	1	0	4
7.	MV6306	<u>Marine Machinery Drawing</u>	1	0	4	3
PRACTICAL						
8.	MV6311	<u>Marine Hydraulics and Fluid Machinery Laboratory</u>	0	0	3	2
9.	MV6312	<u>Welding Techniques, Lathe and Special Machine Shop</u>	0	0	6	3
TOTAL			19	3	13	29

SEMESTER – IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6465	<u>Applied Mathematics for Marine Engineering</u>	3	1	0	4
2.	MV6401	<u>Mechanics of Solids</u>	3	1	0	4
3.	MV6402	<u>Marine Diesel Engines – I</u>	3	0	0	3
4.	MV6403	<u>Marine Steam Engines</u>	3	0	0	3
5.	MV6404	<u>Marine Electrical Machines – II</u>	3	0	0	3
6.	MV6405	<u>Marine Engineering Materials</u>	3	0	0	3
7.	MV6406	<u>Marine Electronics</u>	3	0	0	3
PRACTICAL						
8.	MV6411	<u>Strength of Materials and Applied Mechanics Laboratory</u>	0	0	4	2
9.	MV6412	<u>Heat Engines and Boiler Chemistry Laboratory</u>	0	0	4	2
TOTAL			21	2	8	27

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MV6501	<u>Marine Auxiliary Machinery I</u>	3	0	0	3
2.	MV6502	<u>Marine Diesel Engines II</u>	3	0	0	3
3.	MV6503	<u>Stability of Ships</u>	3	1	0	4
4.	MV6504	<u>Ship Construction</u>	3	0	0	3
5.	MV6505	<u>Mechanics of Marine Machines</u>	3	1	0	4
6.	MV6506	<u>Marine Boilers and Steam Engineering</u>	3	0	0	3
PRACTICAL						
7.	MV6511	<u>Computer Aided Marine Engineering Design and Analysis Laboratory</u>	2	0	3	4
8.	MV6512	<u>Electrical Engg., Electronics and Microprocessor Laboratory</u>	0	0	4	2
9.	MV6513	<u>Measurement, Instrumentation and Refrigeration Laboratory</u>	0	0	4	2
TOTAL			20	2	11	28

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	L	T	P	C
THEORY						
1.	MV6611	<u>Marine Workshop Practical and Afloat Training</u>	8hrs per day – 6 days a week, 26 weeks, 500 Marks. Sessional Marks 200 Report + Viva 300			12

SEMESTER –VII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MV6701	<u>Marine Systems and Machinery Design</u>	2	2	0	4
2.	MV6702	<u>Marine Electrical Technology</u>	3	0	0	3
3.	MV6703	<u>Marine Vehicles Performance</u>	2	2	0	4
4.	MV6704	<u>Marine Auxiliary Machinery – II</u>	3	0	0	3
5.	MV6705	<u>Ship's Fire Prevention and Control</u>	3	0	0	3
6.		Elective – I	3	0	0	3
PRACTICAL						
7.	MV6711	<u>Fire Fighting, Controls and Simulator Laboratory</u>	0	0	4	2
8.	MV6712	<u>Marine Propulsion and Auxiliary Machinery Overhauling Laboratory</u>	0	0	4	2
9.	GE6563	<u>Communication Skills - Laboratory Based</u>	0	0	4	2
TOTAL			16	4	12	26

SEMESTER –VIII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	GE6351	<u>Environmental Science and Engineering</u>	3	0	0	3
2.	MV6801	<u>Ship Operational Management and IMO Requirements</u>	3	0	0	3
3.	MV6802	<u>Marine Control Engineering and Automation</u>	3	0	0	3
4.	MV6803	<u>Safety Precautions and Watch Keeping</u>	3	0	0	3
5.		Elective II	3	0	0	3
PRACTICAL						
6.	MV6811	<u>Project Work, Technical Paper and Viva Voce</u>	0	0	12	6
7.	MV6812	<u>Comprehension</u>	0	0	2	1
TOTAL			15	0	14	22

**TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 202
ELECTIVES FOR B.E. MARINE ENGINEERING**

ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MV6001	<u>Advanced Marine Heat Engines</u>	3	0	0	3
2.	MV6002	<u>Ship Safety and Environmental Protection</u>	3	0	0	3
3.	MV6003	<u>Double Hull Tankers</u>	3	0	0	3

ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MV6004	<u>Special Duty Vessels and Type of Operation</u>	3	0	0	3
2.	MV6005	<u>Ship Recycling</u>	3	0	0	3
3.	MV6006	<u>Marine Corrosion and Prevention</u>	3	0	0	3

OBJECTIVES:

- To enable learners of Engineering and Technology develop their basic communication 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**9 + 3**

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**9 + 3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - 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 / lectures – Picture-based activities.

UNIT III**9 + 3**

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 - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - 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**9 + 3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; 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 - film scenes - dialogue writing.

UNIT V

9 + 3

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 - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed 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

TEXT BOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

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
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008

EXTENSIVE Reading (Not for Examination)

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

WEBSITES:

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>

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
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6152

MATHEMATICS FOR MARINE ENGINEERING – I

L T P C
3 1 0 4

OBJECTIVES:

- To provide the required knowledge on fundamentals of geometry integrals and integral calculus for engineering applications.

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, of products, quotient functions of a function and simple implicit functions.

Successive differentiation- intro. And notation, nth order derivatives of standard functions, nth order derivatives using (a) trig. identities and standard functions (b) partial fractions, Leibnitz theorem, Maclaurin's Theorem, and standard expansions, Expansions using standard expansions, 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. The 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 $\sin x$ and $\cos nx$. The 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:**

- The basic concepts of analytical geometry and differential and integral calculus learnt by the students will be applied to marine engineering

TEXT BOOKS:

- Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Third edition, Laxmi Publications(p) Ltd.,2008.
- Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, 2007.
- William Embleton and Leslie Jackson, "Mathematics for Engineers Vol- I", 7th Edition, Reed's Marine Engineering Serires, Thomas Reed Publications, 1997.

REFERENCES:

- Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
- Glyn James, "Advanced Engineering Mathematics", 7th Edition, Pearson Education, 2007.
- Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., 2007.

PH6151**ENGINEERING PHYSICS – I****L T P C
3 0 0 3****OBJECTIVES:**

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

UNIT I CRYSTAL PHYSICS**9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)- Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

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 Nano chemistry

UNIT I WATER TECHNOLOGY 9

Water and its impurities – Impurities in water – fresh water, sea water, distilled water impurities. Purpose of water treatment in boilers, scale formation and prevention.

UNIT II BOILER CHEMISTRY 9

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 III BOILER WATER TREATMENT 9

Lime and Soda treatment, PH treatment, salinometer, use of litmus paper, test for partial, total alkalinity, chloride, sulphite, phosphate test, caustic soda treatment, condensate lime treatment. De-salination of water, reverse osmosis and electro dialysis, priming, foaming and control, effects of salts and gases in feed water

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**OUTCOMES:**

- The knowledge gained on various aspects of water chemistry, energy sources and nano-chemistry 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, 4th Edition, Dhanpat Rai & Sons, New Delhi, 2002.
2. Milton and Leech , “Marine Boilers ”.Butter Worth Publishers, UK

REFERENCES:

1. Uppal. M.M., A Text book of Engineering Chemistry, 7th Editions, Khanna Publishing, 1988. Water Treatment by J.D. Skelly Imarest Publication , London.
2. Reed's General Engineering Knowledge for Marine Engineers by Leslie Jackson and Thomas D. Morton

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION**8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS**10**

Problem formulation – Problem Solving - Introduction to 'C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS**9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS**9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS**9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS**OUTCOMES:**

At the end of the course, the student should be able to:

- Design C Programs for problems.
- Write and execute C programs for simple applications

TEXTBOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. Rajaram.M. and Uma Maheswari, 'Computer programming with C', pearson 2014.

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design 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 FREE HAND SKETCHING

5+9

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, Scales: Construction of Diagonal and Vernier scales.

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

5+9

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+9

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 and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

5+9

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. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

6+9

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 and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

COMPUTER AIDED DRAFTING (Demonstration Only)

3

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS**OUTCOMES:**

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical constructions and multiple views of objects.
- Do orthographic projection of lines and plane surfaces.

- Draw projections and solids and development of surfaces.
- Prepare isometric and perspective sections of simple solids.
- Demonstrate computer aided drafting.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. 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.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.
5. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

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

MV6101

BASICS OF MARINE ENGINEERING

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

OBJECTIVES

On Completion of the course the Students are expected to

- 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.

GE6161

COMPUTER PRACTICES LABORATORY

L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

GE6163

PHYSICS AND CHEMISTRY LABORATORY – I

L T P C
0 0 2 1

PHYSICS LABORATORY – I
(Any FIVE Experiments)

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. (a) Determination of Wavelength, and particle size using Laser
(b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

OUTCOMES:

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee's Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster's bridge set up
(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

**CHEMISTRY LABORATORY- I
(Any FIVE Experiments)****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 vacometry

LIST OF EXPERIMENTS

- 1 Determination of DO content of water sample by Winkler's method.
- 2 Determination of chloride content of water sample by argentometric method
- 3 Determination of strength of given hydrochloric acid using pH meter
- 4 Determination of strength of acids in a mixture using conductivity meter
- 5 Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline / thiocyanate method)
- 6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer
- 7 Conductometric titration of strong acid vs strong base

TOTAL: 30 PERIODS**OUTCOMES:**

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

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore, 1994.
3. Jeffery G.H., Bassett J., Mendham J. and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

Sheet Metal Work:

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

Machine assembly practice:

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

Fitting – Exercises – Preparation of square fitting and vee – fitting models

Smithy and foundry

- (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.

GROUP B (ELECTRICAL & ELECTRONICS)**III ELECTRICAL ENGINEERING PRACTICE 18**

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 12

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, EOR 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:

- Ability to fabricate plumbing and carpeting components
- Ability to use welding equipments to join the structures.
- Ability to fabricate electrical and electronics circuits.

REFERENCES:

1. K.Jeyachandran, S.Natarajan & S, Balasubramanian, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
2. T.Jeyapooan, M.Saravanapandian & S.Pranitha, “Engineering Practices Lab Manual”, Vikas Pupliching House Pvt.Ltd, 2006.
3. H.S. Bawa, “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2007.
4. A.Rajendra Prasad & P.M.M.S. Sarma, “Workshop Practice”, Sree Sai Publication, 2002.
5. P.Kannaiah & K.L.Narayana, “Manual on Workshop Practice”, Scitech Publications, 1999.

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

OBJECTIVES:

- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.
- To understand and use technical and engineering publications

UNIT I**12**

Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:

1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings and predicting the content – Reading advertisements and interpretation.
4. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II**12**

Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication -Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

Suggested activities:

1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III**12**

Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types - accident, survey, breakdown of machinery, Letter to superintendant reporting the defects, damage and repair of machinery ; requirement of machinery spares,logistic and repair support on arrival at the harbour; monthly report on the condition of men and machinery.

structure, data collection, content, form, recommendations .

Suggested activities:

1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object –verb / object – noun)
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

UNIT IV**12**

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

UNIT V**9**

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TOTAL: 60 PERIODS**LEARNING OUTCOMES:**

- Learners should be able to employ English effectively for all their communicative purposes, both formal and informal contexts.
- Learners should be able to deploy specific English (Marine Engineering) skills required for all their professional work.
- Learners should be able to write and publish their research articles in refereed journals, including the international journals.

TEXT BOOK:

1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

REFERENCES:

1. Dutt P.K, Rajeevan G. and Prakash C.L.N, 'A Course in Communication Skills', Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson Education, 2007.

EXTENSIVE READING:

1. Robin Sharma, 'The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

NOTE:

The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

OBJECTIVES:

- To provide the required skill to apply the concepts of ordinary differential equations, vector calculus, complex variable and laplace transformation in marine engineering problems.

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 (nth) order linear differential equations - definition and complementary solution, Methods of obtaining PI, Method of variation of parameters, Method of undetermined coefficients, Cauchy's Homogeneous LDE 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 : $w= z+c$, cz , $1/z$, 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:**

- The basic and fundamental knowledge gained by the students in the application of ordinary differential equations vector fields and transformations will be applied by them in the process field related to marine engineering.

TEXT BOOK:

- Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (p) Ltd., 2008.
- Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, 2007.

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
2. Glyn James, "Advanced Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7th Edition, Wiley India, 2007.
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., 2007.

PH6251**ENGINEERING PHYSICS – II****L T P C
3 0 0 3****OBJECTIVES:**

- To enrich the understanding of various types of materials and their applications in engineering and technology.

UNIT I CONDUCTING MATERIALS**9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS**9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors -direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS**9**

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications
Superconductivity : properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High T_c superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS**9**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V ADVANCED ENGINEERING MATERIALS**9**

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials –Birefringence- optical Kerr effect – Classification of Biomaterials and its applications

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

TEXT BOOKS:

1. Arumugam M., Materials Science. Anuradha publishers, 2010
2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009

REFERENCES:

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011
2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011
3. Mani P. Engineering Physics II. Dhanam Publications, 2011
4. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009

GE6252**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING****L T P C****4 0 0 4****OBJECTIVES:**

- To explain the basic theories used in electrical circuits and the different components and function of electrical machine
- To explain the fundamentals of semiconductor devices and applications
- To explain the principles of digital electronics
- To impart knowledge of communication

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS**12**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS**12**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS**12**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS**12**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING**12**

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to identify the electrical components
- Explain the characteristics of electrical machines
- Ability to identify of electronics components and use of them to design circuits.

TEXT BOOKS:

1. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, (2002).
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, (2003).

GE6253**ENGINEERING MECHANICS****L T P C
3 1 0 4****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 BASICS AND STATICS OF PARTICLES**12**

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**12**

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**12**

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**12**

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 ELEMENTS OF RIGID BODY DYNAMICS**12**

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 : 60 PERIODS**OUTCOMES:**

- Ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- Ability to analyse the forces in any structures.
- Ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

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

REFERENCES:

1. Hibbeler, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11th Edition, Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., “Engineering Mechanics – Statics and Dynamics”, 4th Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., “ Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2”, Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, 1998.
6. Kumar, K.L., “Engineering Mechanics”, 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.

MV6201**MARINE ENGINEERING THERMODYNAMICS****L T P C****3 0 0 3****OBJECTIVES:**

- 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 FUELS**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

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

REFERENCES

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

GE6261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY**L T P C
0 1 2 2****OBJECTIVES:**

- To develop skill to use software to create 2D and 3D models.

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to use the software packages for drafting and modeling
- Ability to create 2D and 3D models of engineering components.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No	Description of Equipment	Quantity
1.	Pentium IV computer or better hardware, with suitable graphics facility	30 No.
2.	Licensed software for Drafting and Modeling.	30 Licenses
3.	Laser Printer or Plotter to print / plot drawings	2 No.

GE6262

PHYSICS AND CHEMISTRY LABORATORY – II

**L T P C
0 0 2 1**

OBJECTIVES:

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

**PHYSICS LABORATORY – II
(Any FIVE Experiments)**

LIST OF EXPERIMENTS

1. Determination of Young's modulus by uniform bending method
2. Determination of band gap of a semiconductor
3. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
4. Determination of Dispersive power of a prism - Spectrometer
5. Determination of thickness of a thin wire – Air wedge method
6. Determination of Rigidity modulus – Torsion pendulum

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Traveling microscope, meter scale, Knife edge, weights
2. Band gap experimental set up
3. Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
4. spectrometer, prism, sodium vapour lamp.
5. Air-wedge experimental set up.
6. Torsion pendulum set up.

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

OUTCOMES:

- The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

CHEMISTRY LABORATORY -II (Any FIVE Experiments)

OBJECTIVES:

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

LIST OF EXPERIMENTS

- 1 Determination of alkalinity in water sample
- 2 Determination of total, temporary & permanent hardness of water by EDTA method
- 3 Estimation of copper content of the given solution by EDTA method
- 4 Estimation of iron content of the given solution using potentiometer
- 5 Estimation of sodium present in water using flame photometer
- 6 Corrosion experiment – weight loss method
- 7 Conductometric precipitation titration using BaCl_2 and Na_2SO_4
- 8 Determination of CaO in Cement.

TOTAL : 30 PERIODS

OUTCOMES:

- The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York (2001).
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry, LBS Singapore (1994).
3. Jeffery G.H, Bassett J., Mendham J. and Denny R.C., "Vogel's Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, Mcmillan, Madras 1980

- Laboratory classes on alternate weeks for Physics and Chemistry.**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Potentiometer	-	5 Nos
2. Flame photo meter	-	5 Nos
3. Weighing Balance	-	5 Nos
4. Conductivity meter	-	5 Nos

Common Apparatus : Pipette, Burette, conical flask, porcelain tile, dropper (30 Nos each)

GE6263

COMPUTER PROGRAMMING LABORATORY

L T P C
0 1 2 2

OBJECTIVES:

The Students should be made to

- Be exposed to Unix shell commands
- Be familiar with an editor on Unix
- Learn to program in Shell script
- Learn to write C programme for Unix platform

LIST OF EXPERIMENTS

1. UNIX COMMANDS

15

Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING

15

Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX

15

Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students should be able to:

- Use Shell commands
- Design of Implement Unix shell scripts
- Write and execute C programs on Unix

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

- UNIX Clone Server
- 33 Nodes (thin client or PCs)
- Printer – 3 Nos.

Software

- OS – UNIX Clone (33 user license or License free Linux)
- Compiler - C

MV6211

WORKSHOP FITTING

L T P C
0 0 4 2

OBJECTIVES:

- On Completion of the Course The Students are expected to have the Knowledge of Metal Cutting and Joining Process Tools and equipments used in Smithy, Carpentry, Fitting, Foundry, Welding and Sheet Metal.

LIST OF EXPERIMENTS

SHEET METAL

20

Fabrication of tray, cone etc. with sheet metal.

WELDING

20

Arc Welding of butt joint, Lap joint, Tee fillet etc. Demonstration of gas welding.

FITTING

20

Practice in chipping, filing, drilling – Making Vee, square and dove tail joints.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to fabricate components using sheet metal.
- Ability to handle tools used in workshop
- Ability to use the welding process for forming
- Ability to make joint using fitting

REFERENCES:

1. V.S.Venkatachalapathy, First Year Engineering Workshop Practice, Raamalinga Publications, Madurai, 1999.
2. P.Kannaiah and K.C.Narayana, Manual on Workshop Practice, Scitech Publications, Chennai, 1999.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Surface plate		
V Block with clamp inside caliper	- 6 inch.	} 8 Nos
Outside caliper	- 6 inch.	
Spanner and Wrench		
Arc Welding unit of as Welding unit	-1 No.	
Hack Saw Frame	- 12 inch.	} 8 Nos
Flat Rough Files	-14 inch.	
Flat smooth file	- 6 inch.	
Flat smooth file	- 12 inch	
Half Round Rough file	-12 inch	
Half Round smooth file	-12 inch.	
Triangular Rough file	-12 inch.	
Flat chisel	-6 inch.	
Cutting pliers	-8 inch.	
Nose Pliers	- 8 inch.	

MA6351

TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L T P C

3 1 0 4

OBJECTIVES:

- 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 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 9+3

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 9+3

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 9+3

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 9+3

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 9+3

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

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The understanding of 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.

TEXT BOOKS:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd , 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

OBJECTIVES:

- 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 – Meta-centric height – stability of floating and submerged bodies.

UNIT II FLUID KINEMATICS AND DYNAMICS**11**

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**7**

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 – Hagen-Poiseuille’s equation – turbulent flow – Darcy-Weisbach equation – 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:**

At the end of the course the students are expected to have the knowledge of

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

TEXT BOOKS:

- Bruce, R.M., Donald, F.Y., Theodore, H.O., “Fundamentals Of Fluid Mechanics” 5th Edition, John Wiley & Sons (Asia) Pvt. Ltd. India, 2002
- Joy, “Hydraulic Power Transmission In Marine Machinery”, Marine Engineering Practice Vol-1, Part-07, IMarEST, London

3. Gupta, S.C., "Fluid Mechanics and Hydraulic Machines" 1st Ed. Pearson, 2011.
4. John F. Douglas, Janusz M. Gasiorek, John A. Swaffield and Lynne B. Jack, "Fluid Mechanics", 1st 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", 3rd Edition, University Press, 2013
3. James A. Fay, "Introduction to Fluid Mechanics", PHI Learning Pvt. Ltd., 1994
4. Anthony Esposito, "Fluid Power with Applications", 6th Ed. Pearson, 2003
5. R K Rajput, "Fluid Mechanics and Hydraulic Machines" 2nd revised Edition, S.Chand & Company Ltd., New Delhi, 2002

MV6302 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, fore-castle, 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 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:

On completion of the course the students are expected to

- 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", 11th Edition, Routledge, New york, USA and Canada, 1996.
2. Capt. J. Dinger, "Seamanship Primer", 7th Edition, Bhandarkar Publications, Mumbai 1998.
3. Kemp & Young, "Seamanship Notes", Stanford Maritime limited, 1997

REFERENCES :

1. A.N. Cockcroft, "Seamanship and Nautical knowledge", 27th 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"1st Ed. , Bhandarkar Publications ,2002

MV6303

MARINE MANUFACTURING TECHNOLOGY

L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I METAL JOINING PROCESSES

9

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. Gas welding, oxy acetylene cutting, brazing and soldering. Under water 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:

At the end of the course the students are expected to have the knowledge of

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

TEXT BOOKS:

1. Kemp & Young, “ Ship construction : Sketches and Notes”, 1st Ed. Standfor Maritime Limited, 1982
2. Jeffus, Welding and Metal fabrication”, 1st Ed. Cengage, Indian reprint 2012 (Yesdee Publishings Pvt. Ltd.).
3. Rao.P.N., “Manufacturing Technology, Metal Cutting and Machine Tools”, Tata McGraw-Hill, 2000.
4. Shan, H.S., “ Manufacturing processes”, Vol I, 1st Ed. Pearson, 2013

REFERENCES:

1. Jain K.C. Agarwal, L.N. “Metal Cutting Science and Production Technology”, 1st edition, Khanna Publishers, 1986.
2. Chapman W.A.J., “Workshop Technology”, Vol. II, Arnold Publishers.
3. H.M.T., “Production Technology”, Tata McGraw-Hill, New Delhi, 2000.
4. Serope Kalpakjian , Steven,R. Schmid, “Manufacturing Engineering and Technology,” 4th Ed. Pearson, 2011
5. Timings, “ Fabrication and Welding Engineering’, Elsevier, Indian Reprint 2011, Yesdee Publishings Pvt. Ltd.

MV6304

MARINE ELECTRICAL MACHINES – I

L T P C

3 1 0 4

OBJECTIVES:

- 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

8+3

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

8+3

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**10+3**

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+3**

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**10+3**

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.

TOTAL (L:45+T:15): 60 PERIODS**OUTCOMES:**

At the end of the course the students are expected to have

- 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 electrotechnology for marine engineers”, 4th Ed. Reeds Vol 06
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.
4. Bhag, S. Guru, Huseyin, R. Hiziroglu, “Electric Machinery and Transformers”, 3rd Ed. Oxford University Press, 2013

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”, 2nd Ed. Universities Press, 2009

MV6305**MARINE REFRIGERATION AND AIR CONDITIONING****L T P C
3 1 0 4****OBJECTIVES**

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

OBJECTIVES

- 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:**

At the end of the course the students would have learnt

- 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:

- 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.
- Beck, H.G., "Engineering Drawings for Marine Engineers", 2nd Ed., Reeds Vol 11, Adlard Coles Nautical, London
- N.D.Bhatt, "Machine Drawing", 18th Edition, Charotar Publication, Mumbai, 2001.

REFERENCES:

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

OBJECTIVES:

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

(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 : 45 PERIODS**OUTCOMES**

After completion of the Laboratory Experiments the students would have the skill to

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

REFERENCES

- Laboratory Manuals
- Anthony Esposito, “ Fluid Power with Applications”, 6th Ed. Pearson, 2003
- Schobeiri, “Fluid Mechanics for Engineers”, 1st Ed. Springer, Indian Reprint 2013(Yesdee Publishings Pvt. Ltd.)
- Shesha Prakash, “Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures”, 1st 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	Buoyancy Experiment	
	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

OBJECTIVES

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

WELDING TECHNIQUES

45

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

45

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 : 90 PERIODS**OUTCOMES**

At the end of this work shop training the students would have the skill

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

Sl. No.	Name of the Equipment	Qty.
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
13.	Gear hobber	01
14.	CNC Lathe Machine	01
15.	Capstan Lathe	01

16.	Cylindrical grinding m/c	01
17.	Power hacksaw	01
18.	Duplicating Lathe	01

WELDING WORK SHOP

Sl. No.	Name of the Equipment	Qty.
1.	Welding Transformer Air Cooled with Fan	04
2.	Maxi – MIG 400A Welding Set	01
3.	AOL make TIG Control Outfit	01
4.	Welding Rectifier Throluxe – 401 MMA	01
5.	Water Cooled Torch 0150102071 400 AMPS	02
6.	Bending Machine Pipe dia ½" to 3"	01
7.	Gas welding and cutting set	02

FITTING SHOP

Sl. No.	Name of the Equipment	Qty.
1.	Power Hacksaw	01
2.	Vernier Height Gauge	02
3.	Surface Plate with stand	02
4.	Fitting Bench Vice	40
5.	Hand tools (Different types)	-

TOTAL : 90 PERIODS

MA6465

APPLIED MATHEMATICS FOR MARINE ENGINEERING

L T P C
3 1 0 4

OBJECTIVES:

- To provide the required skill to apply the statistical and numerical tools in Marine engineering problems.

UNIT I BASIC STATISTICS

9+3

Measures of Central Tendency: Mean - Calculation of mean, Measure of Dispersion: Mean deviation - Standard deviation – Variance - calculation of Standard deviation of single group and two groups – Moments.

UNIT II PROBABILITY AND RANDOM VARIABLES

9+3

Correlation, Correlation coefficient, Regression lines, Rank correlation - Sample space and events, Probability, Axioms of Probability – conditional probability – total probability, Baye's theorem – Random variable – Discrete Probability distribution – Continuous probability distributions – Expectation – Moment generating function – probability generating function - Probability mass and density functions.

UNIT III STANDARD DISTRIBUTIONS

9+3

Binomial, Poisson, Normal, Geometric, Negative binomial, Uniform, Exponential, Gamma distributions and their properties.

UNIT IV TESTING OF HYPOTHESIS**9+3**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT V NUMERICAL METHODS**9+3**

Interpolation for equal and unequal integrals: Lagrange's methods – Newton's forward and backward different formulae - Divided difference method.

ODE: Taylor series – Euler– Runge-Kulta methods.

TOTAL (L:45+T:15): 60 PERIODS**OUTCOMES:**

- To acquaint the students with fundamental knowledge of the concepts from Statistics and Probability.
- To introduce standard distributions which can describe real life phenomenon.
- To introduce the notion of sampling techniques and numerical used in Marine engineering problems.

TEXT BOOKS:

1. Grewal, B.S, "Higher Engineering Mathematics", 42th Edition, Khanna publishers, Delhi, 2007.
2. Johnson, R.A., Miller & Fraund's probability & statistics for engineers, 8th edition, Printice Hall of India, 2011.

REFERENCES:

1. Jain, M.K. Iyengar, S.R.K., Jain, R.K., Numerical Methods for Engineering and Scientific computation 4th edition, Newage International Private Limited, New Delhi, 2003.
2. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th edition, (2012).
3. Sastry. S, "Introductory methods of Numerical analysis", 3rd edition Printice – Hall of India Private Limited, India, 2002.
4. Chapra S.C and Cannale R.P. Numerical methods for engineers, 4th edition tata McGraw Hill New Delhi, 2002.
5. Walpole, R.E., Myers, R.H., Myer, S.L, and Ye, K. Probability & Statistics for Engineers and scientists, 7th edition, Pearson Education, Delhi, 2002.

MV6401**MECHANICS OF SOLIDS****L T P C****3 1 0 4****OBJECTIVES:**

- To impart knowledge to the students about the Strength of Materials.

UNIT I CONCEPT OF STRESS**8+3**

Concept of stress- tensile and compressive stresses- shear stress- Elastic limit – Hooke's law- elastic constants and their relationship – Poisson's ratio – Generalized Hooke's law – elongation of simple and composite bars under external load – allowable stress – factor of safety- thermal stresses of simple members – strength of welded joints. resilience-suddenly applied loads, strain gauges. hydrostatic stress & corresponding strains.

UNIT II STRESSES IN BEAMS**9+3**

Stresses in beams – neutral axis- theory of simple bending- bending stresses in rectangular, I-sections and circular section beams. bending stresses in composite section beams. strain energy due to bending. shear stresses in beams – rectangular, I-sections and circular sections. stress

components on a general plane and oblique plane - principal stresses and principal Planes, Maximum shear stresses and their planes- Mohr's Diagram for stress & strain.

UNIT III BENDING MOMENT

10+3

Bending moment-shear force, BMD and SFD for statically determinate beams-cantilever simply supported--overhanging beams- with or without applied moments, point of contra flexure. Statically indeterminate beams-BMD and SFD for fixed beams, propped cantilever beams and continuous beams-clapeyron's theorem of three moments.

UNIT IV SLOPE, DEFLECTION AND TORSION

9+3

Slope and deflection of Cantilever, overhanging and simply supported beams – Double integration method – Macalay's Method - Moment area method- problems with various types of 14+load with or without applied moments and varying flexural rigidity (EI). Deflection due to shear, Deflection by graphical method.

Torsion of solid and hollow circular shafts – power transmitted by shafts – compound shafts - shafts subjected to both twisting and bending moment. torsion applied to closely coiled springs, plastic yielding of materials in torsion. torsion of shaft fitted with liner. combined bending & twisting, equivalent bending & twisting moments, shear, bending & torsion, theories of failure- open coil and closed coil helical springs.

UNIT V COLUMNS , STRUTS, CYLINDERS AND PRESSURE VESSELS

9+3

Columns and struts - long and short columns- Euler's formula for long column – equivalent length – slenderness ratio - Eccentric loaded long and short columns - Rankine Gordon formula, use of Strut formulae. thin cylinders and thin spherical shells under internal pressure-change in volume due to internal pressure. thick cylinders – simple treatment of thick cylindrical walled pressure vessels. lame's theory, compound cylinders. thin curved bar, strain energy due to bending, castigliano's theorem & its application to curved bar, strain energy due to twisting, applied problems.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

On completion of this course the students would have learnt

- The methods of determining various stresses and strains in simple and composite members under external load, strength of simple connections and strain energy stored in members.
- The concept of principal stresses and maximum shear stresses.
- To design beams which can resist bending and shearing stresses T
- To calculate the Shear force and Bending moment for the various types of statically determinate and indeterminate beams and the method of drawing the SFD and BMD.
- To calculate the deflections caused by the application of loads and design of solid, hollow shafts, open coiled and closed coiled helical springs based on shear and bending.

TEXT BOOKS:

1. S. Timoshenko, "Strength of Materials", 3rd Edition, CBS Publishers & Distributers, Delhi, 1986.
2. Rajput. R.K. "Strength of Materials", 2nd Edition, S. Chand &Co., New Delhi, 1999.
3. Jindal, U.C., " Strength of Materials', 1st Ed., Pearson, 2011

REFERENCES:

1. Andrew, Pytel, Singer, Ferdriand L., "Strength of Materials", 4th Edition, Harper & Ron Publishers, New York, 1980.
2. Gere & S. Timoshenko, "Mechanics of Materials", 2nd Edition, CBS Publishers & Distributors, New Delhi, 1986.
3. Purushothama Raj, P.,Ramasamy, V., " Strength of Materials", 1st Ed. Pearson, 2012

OBJECTIVES

- 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, aframes, welded construction for bedplates & frames and tie rods etc.

COOLING OF I.C. ENGINES:

Various cooling media, their merits and demerits, cooling of pistons, cylinder jackets & cylinder heads, bore cooling, coolant conveying mechanism and systems, maintenance of coolant and cooling system, cooling water: testing and treatment.

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 hydro carbons(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 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 – elasto hydrodynamic 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 infection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to have knowledge

- 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", 3rd Ed. Reeds Vol 12, Adlard Coles Nautical, London

REFERENCES:

1. M.E.P., "Low Speed Diesel Engines New", Marine Engineering Practice, Vol-2 Part-17,, IMarEST, London
2. S. H. Henshall, "Medium and High Speed Diesel Engines for Marine Use", 1st 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", 7th Ed. Dhanpat rai Publications, REPRINT 2002

MV6403**MARINE STEAM ENGINES****L T P C
3 0 0 3****OBJECTIVES:**

- To develop the knowledge of students in Marine Steam Engines and Turbines and Applied Thermodynamics.

UNIT I STEAM AND VAPOUR POWER CYCLES**7**

Carnot cycle for steam and ideal efficiency. Rankine cycle with dry, saturated and super heated steam. Modified Rankine, Reheat and Regenerative cycles. Binary vapour power cycles. Feed pump working. Isentropic efficiency, cycle efficiency, work ratio. Reheating and Regenerative feed heating and their effect on thermal efficiency.

UNIT II MARINE STEAM ENGINE**11**

Modified Rankine cycle for steam engines. hypothetical indicator diagram. mean effective pressure and work transfer – diagram factor. indicated power – specific steam consumption – indicated thermal efficiency – efficiency ratio. energy balance – compound steam engines.

UNIT III STEAM NOZZLES**7**

General flow analysis. velocity at exit. critical pressure ratio and maximum mass flow. convergent and convergent-divergent nozzles – isentropic flow –effect of friction. nozzle area at the throat and exit. problems of steam flow through nozzles.

UNIT IV MARINE STREAM TURBINE PLANTS**11**

General principle of Impulse and Reaction Turbines. Compounding of steam turbines - Pressure and Velocity compounding, stage efficiency overall efficiency and re-heat factor. Multi-Stage Turbine with regenerative and reheat cycles. Maximum work output condition. Typical steam plant with turbines, condensers and boilers. Thermal efficiency of steam turbine plant.

UNIT V BASIC PRINCIPLE OF HEAT TRANSFER**9**

Conduction: Fourier law of Conduction. One dimensional Heat Diffusion equation. **Convection:** Forced and Free Convection. **Radiation:** Stefan-Boltzmann's equation. Law of Radiation – Problems.

TOTAL : 45 PERIODS**OUTCOMES:**

At the end the course the students should have

- Completed the detailed study of steam cycles, steam engines, steam nozzle and Turbines
- The knowledge to calculate the efficiencies of Steam Turbine plant
- Learnt about basics of heat transfer.

TEXT BOOKS:

1. Thomas, D. Morton, "Steam Engineering Knowledge For Marine Engineers", 3rd Ed. Reeds Vol 09, Adlard Coles Nautical, London
2. Coats, "Marine Steam Turbines", Marine Engineering Practice, Vol 1, Part 08, IMarEST, London
3. P.K. Nag, "Basic & Applied Thermodynamics", 1st Edition, Tata McGraw–Hill Publishing Co., Ltd., New Delhi, 2002.
4. T.D. Eastop and McConkey, "Applied Thermodynamics for Engineering Technologist SI units", 2nd Edition, ELBS with DP Publications, London, 1993.

REFERENCES:

1. Y.V.C. Rao, "Thermodynamics", 2nd Edition, Wiley Eastern Ltd., New Delhi, 1993.
2. E. Ratha Krishnan, "Fundamentals of Engineering Thermodynamics", 1st Edition, Prentice – Hall of India, New Delhi, 2000.
3. Gordon Rogers, Yon Mayhew, " Engineering Thermodynamics Work and Heat Transfer", 4th Ed. Pearson, 2011
4. Marine Engineering Series, "Steam Turbines and Gearing", 1st Ed. Stanford Maritime limited, London, 1982
5. Naterer, "Heat Transfer in Single and Multiphase Systems", 1st Ed., Taylor & Francis, Indian reprint 2009, (Yesdee Publishings Pvt. Ltd.)

MV6404**MARINE ELECTRICAL MACHINES – II****L T P C
3 0 0 3****OBJECTIVES:**

- 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 difference – 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 etc.,

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:

After completing the course the students should have the knowledge of

- 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 GR Kraallavers , “Advanced Electro-technology For Marine Engineers”, 2nd Ed. Reeds Vol 07, Adlard Coles Nautical, London
2. W. Laws, “Electricity Applied To Marine Engineering”, 4th edition, The Institute Of Marine Engineers, London, 1998.
3. Ghosh, S., “Electrical Machines”, 2nd Ed., Pearson, 2012
4. I.Herman, “Electrical Transformers and Rotating Machines”, 3rd 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”, 2nd Ed., Pearson, 2002

OBJECTIVES:

- 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:**

At the end of the course the students are capable of knowing

- 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:

- Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
- Frederick, S.H. Capper,H. ,”Materials for Marine Machinery” Marine Media Management, 1st Edition, 1976
- Jindal,U.C., Atish Mozumder, “Material Science and Metallurgy”, 1st Ed. Pearson, Third Impression 2013.
- Todd , “Selecting Material For Sea Water Systems”, Marine Engineering Practice ,Vol-1,Part-10, IMarEST, London

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", 1st Ed. Pearson, 2012.
5. Higgins, "Materials for Engineers and Technicians"4th Ed. Elsevier, Reprint 2009 (Yesdee Publishings Pvt. Ltd.)
6. Sir Alan Cottrell, " An Introduction to Metallurgy", 2nd Ed. Universities Press, Indian Reprint 2013

MV6406

MARINE ELECTRONICS

L T P C
3 0 0 3

OBJECTIVES:

- 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.

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:

At the end of the course the students are expected to have learnt

- 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", 5th 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 jain, "Linear Integrated Circuits & Applications".
4. Rashid, " Power Electronics Handbook",3rd Ed. Elsevier, Indian Reprint 2013(Yesdee Publishings Pvt. Ltd.)

MV6411**STRENGTH OF MATERIALS AND APPLIED MECHANICS
LABORATORY****L T P C
0 0 4 2****OBJECTIVES:**

- 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

Tension Test on M.S. Rod.

Compression test – Bricks, concrete cubes.

Deflection Test - Bench type verification of Maxwell theorem.

Tension test on thin wire.

Hardness test on various machines.

Tests on wood - Tension, compression, bending, impact in work testing machine.

Tests on springs - Tension, compression.

APPLIED MECHANICS LAB

Impact test.

Double shear Test in U.T.M.

Load measurement using load indicator, load coils.

Fatigue test.

Strain measurement using Rosette strain gauge.

TOTAL : 60 PERIODS**REFERENCES**

1. Laboratory Manuals
2. Jindal, U.C., " Strength of Materials', 1st 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

TOTAL : 60 PERIODS

OUTCOMES:

At the end of this laboratory course the students are expected to have acquired the skill

- 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

MV6412

HEAT ENGINES LAB AND BOILER CHEMISTRY LABORATORY

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

OBJECTIVES:

- To impart skills to students to demonstrate the ability to carry out the different tests to understand the performance characteristics of heat engines and also to perform the tests on boiler feed water

HEAT ENGINES LAB

Flue gas analysis by Orsat apparatus.

Study and performance characteristics of steam turbine.

Dryness fraction of steam using calorimeters.

Performance characteristics of a constant speed air blower.

Verification of fan laws and static efficiency of air blower.

Test on Reciprocating compressor.

C.O.P. of a Refrigeration plant.

Performance test on A/C plant.

Testing of fuels - calorific value, proximate analysis

Testing of fuels - Ultimate analysis, octane number, cetane number.

Testing of lubricants - flash point, fire point, pour point.

Testing of lubricants- Viscosity index, corrosion stability, carbon residue.

Testing of lubricants - Mechanical stability, ash content.

Wind Tunnel - Drag and lift measurements.

Performance test on IC Engine as per BIS specifications.

BOILER CHEMISTRY LAB

To determine hardness content of the sample of boiler water in P.P.M. in terms of CaCO₃.

To determine Chloride Content of the sample of water in P.P.M. in terms of CaCO₃.

To determine Alkalinity due to Phenolphthaline, total Alk. and Caustic Alk. Of the sample of water (in P.P.M).

To determine Phosphate Content of the sample of water.

To determine dissolved Oxygen content of the sample of water.

To determine sulphate content of given sample of water.

To determine Ph-value of the given sample of water.

Boiler trial.

Water Testing - Dissolved oxygen, total-dissolved solids, turbidity.

Water Analysis (Fresh and sea water)- Chloride, sulphate, hardness.

Sludges and scale deposit - Silica, volatile and non-volatile suspended matter.

TOTAL : 60 PERIODS

OUTCOMES

At the end of the course the students are expected to have acquired the skill

- 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. M.E.P., “Water Treatment”, Marine Engineering Practice , Vol-2 Part-14, IMarEST, London
3. Mathur, M.L., Sharma, R.P., “Internal Combustion Engines”, 7th Ed. Dhanpat rai Publications, REPRINT 2002
4. Willard W. Pulkrabek, “ Engineering Fundamentals of the Internal Combustion Engines”, 1st Ed. , PHI Learnings Pvt. Ltd., 2011
5. Flanagan,G.T.H, ‘Marine Boilers’, 1st 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

Sl.No	Name of the Equipment	Qty.
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

Sl.No	Name of the Equipment	Qty.
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

Sl.No	Name of the Equipment	Qty.
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

Sl.No	Name of the Equipment	Qty.
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

MV6501

MARINE AUXILIARY MACHINERY – I

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

OBJECTIVES:

- 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 8

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 10

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, Raphson 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:

On completion of the course the students will acquire knowledge of

- 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.

MV6502**MARINE DIESEL ENGINES – II**

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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 defelections

UNIT IV FORCES AND STRESSES 8

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 10

Construction and Operation of Sulzer, B&W, MAN, Piel-stick, Doxford, 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:**

On completion of the course the students will have knowledge of

- 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:

1. C.C Pounder, "Marine Diesel Engines", 6th Edition, Butter worth – Heinemann, Scotland, 1995.
2. D.A. Taylor, "Introduction to Marine Engineering", 2nd Edition, Butter worth – Heinemann, London, 1996.
3. Christen Knak, "Diesel Motor Ships Engines and Machinery", 1st Edition, Marine Management Ltd., London, 1990.
4. 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 Publicatiion, 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.

MV6503**STABILITY OF SHIPS**

L	T	P	C
3	1	0	4

OBJECTIVES:

To impart the Knowledge on the Basic Hydrostatics and Stability Calculations of Ships

UNIT I HYDROSTATICS**9+3**

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**9+3**

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**9+3**

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**9+3**

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**9+3**

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

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

At the End of the Course the Students would have acquired the knowledge of

- 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", 1st Ed. SNAME, 2009
4. Kemp & Young Series, "Ship Stability Notes and Examples", 1st Ed. , Stanford Maritime Limited, 1998

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.

MV6504**SHIP CONSTRUCTION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- 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.

UNIT III FORE & AFT END ARRANGEMENTS**9**

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:

At the end of the course the students are expected to have learnt,

- 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. Richard Lee Storch, Colin P. Hammon, Howard McRaven Bunch, and Richard C. Moore, “Ship Production, 1st Ed., SNAME, 1995
4. Thomas Lamb, “ Ship Design and Construction”, 1st 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”, 1st Ed. SNAME, 2006

**MV6505 MECHANICS OF MARINE MACHINES L T P C
3 1 0 4**

OBJECTIVES:

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

UNIT I MECHANISMS 12+3

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+3

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+3

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+3

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+3

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: 60 PERIODS

OUTCOMES:

At the completion of the course the students are expected to have Knowledge of,

- 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. Gordon John Roy, "Steam Turbines and Gearing Marine Engineering Series", 1st Ed., Stanford Maritime limited, 1984
3. Sandhu Singh, " Theory of Machines", 3rd Ed., Pearson, 2012
4. Rao, J.S., and Dukkippatti, R.V., "Mechanism and machinery theory", 2nd Edition, New age international, Mumbai, 1992.
5. Srikant Bhawe, "Mechanical Vibrations", 1st Ed. Pearson, 2010

REFERENCES:

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

MV6506

MARINE BOILERS AND STEAM ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

- 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 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:

At the end of the course the students are expected to have learnt,

- 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", 3rd 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. L.Jackson & T.D. Morton, "General Engineering Knowledge for Marine Engineers", 4th Edition, Thomas Reeds Publication, United Kingdom, 1986.
4. M.E.P., "Operation Of Machinery In Ships Steam Turbines, Boilers", Marine Engineering Practice, Vol 2,Part 15, IMarEST, London

MV6511

COMPUTER AIDED MARINE ENGINEERING DESIGN AND ANALYSIS LABORATORY

**L T P C
2 0 3 4**

OBJECTIVES:

To impart practical knowledge to the students about Computer Aided Design and Drawing of Marine Machine Elements

UNIT I ENGINEERING DESIGN AND COMPUTER AIDED DESIGN

6+9

The design process, concept, analysis, feasibility, Selection of materials and manufacturing considerations in design, Design with reference to repairs and reconditioning, specifically for working out at sea with its restrictions and limitations. Role of computers - Computer Aided Engineering - Computer Aided Design - Design for Manufacturability – Computer Aided Manufacturing - Benefits of CAD.

UNIT II COMPUTER AIDED DESIGN AND FINITE ELEMENT ANALYSIS

6+9

Creation of Graphic Primitives - Graphical input techniques - Display transformation in 2-D and 3-D – Viewing transformation - Clipping - hidden line elimination – Mathematical formulation for graphics - Curve generation techniques - Geometric Modeling – Wire frame, Surface and Solid models - CSG and B-REP Techniques - Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis - Exposure to FEA packages.

UNIT III TYPES OF LOADING AND DESIGN CRITERIA 6+9

static loads, impact loads, repeated loads, variable and cyclic loads, combined and reversible loads. Stress concentration and design factors, fatigue strength, modes of failure, design stresses, factor of safety, theories of failure, wear, corrosion, design criteria, S-N curve Goodman and Soderberg equations.

UNIT IV JOINTS, SHAFTS AND COUPLINGS 6+9

Design of cotter joints, knuckle joints, bolted joints, welded joints, riveted joints. Design of shafts and couplings – Drafting using CAD packages

UNIT V BELTS, FRICTION CLUTCHES AND BRAKES 6+9

Design of Belt drives and hoists (Wire ropes), Multiple plate clutches, cone clutch, centrifugal clutch block brakes, internally expanding shoe brakes, external band brakes, differential band brakes - Solid modelling using CAD packages.

TOTAL: 75 PERIODS**OUTCOMES :**

At the end of the course the students are expected to have skill in

- Design concept, selection of materials and manufacturing considerations while designing.
- Computer Aided Design concepts and applications
- Design and Drawing of Fasteners and connection and Power transmission elements.
- Design and Drawing of Friction clutches and Brakes.

TEXT BOOKS:

1. Goutam Prohit and Goutam Ghosh,"Machine Drawing with AutoCAD", 1st Impression, Dorling Kindersley(India) Pvt., Ltd., New Delhi,2007ist
2. J.E.Shigley, "Mechanical Engineering Design", 1st metric edition, McGraw-Hill, New Delhi, 1986.
3. Sadhu Singh, "Computer Aided Design and Manufacturing ", Khanna Publishers, New Delhi, 1998.
4. Desai, Y.M.,Eldho,T.I. and Shah,A.H., " Finite Element method with Applications in Engineering", 1st Ed., Pearson, 2011

REFERENCES:

1. Abdulla Sharif, "Machine Design", 3rd Edition, Dhanpat Roy & Sons, New Delhi, 1995.
2. Pandya & Shaw, "Elements Of Machine Design", 1st Edition, Charotar Publishing, Mumbai, 1997.
3. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing ",Prentice Hall of India, New Delhi, 1994.
4. R.S.Khurmi and J.K.Gupta, "Machine Design", 5th Edition, Eurasia publishing, New Delhi, 2005.
5. Tirupathi R. Chandrupatla, " Finite Element Analysis for Engineering and Technology", 1 st Ed., Universities Press, 2013

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity Required
01	Desktop computers with following configuration CPU (High End), Main Memory (1GB), HDD 80 GB and above, High Resolution SVGA Graphics interface, 17" or 19" Monitor, Ethernet Card	40 Nos.
02	Licensed Operating System	Adequate
03	Licensed Application Software with 20 and above seats Softwares like AutoCAD, ProEngineer, CATIA etc.,	20 seats & above
04	A4/A3 Printer	1 No.
05	7.5/10 KVA online UPS	1 unit

OBJECTIVES:

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

(A) ELECTRICAL ENGG. LABORATORY**30**

Load Test on D.C. Shunt Motor

Load Test on D.C. Series Motor

O.C.C. & load characteristic of self/separately excited D.C. Generator.

Parallel operation of D.C. Shunt Generator

Speed control of D.C. Shunt Motor.

Load O.C. & S.C. test on single-phase transformer.

Parallel operation of single-phase transformers.

To connect similar single-phase transformers in the following ways.

Y-Y, A-A, A-Y and Y-A.

Load Test on Squirrel cage induction motor

Load Test on Slip ring induction motor

Pole changing motor for various speeds.

Synchronization of 3-phase alternator.

Trouble shooting in Electric Motors and Transformers.

Exercises in Power Wiring and earthing.

(B) ELECTRONICS / MICROPROCESSOR LABORATORY**30**

To study the volt-ampere characteristics of a high current semi conductor diode.

To study the volt-ampere characteristics of a diode and Zener diode.

To study the half wave and full wave rectification circuit without and with filter circuit.

To study the volt-ampere characteristics of a Transistor.

To study the volt-ampere characteristics of Field Effect Transistor.

To study the characteristics of Silicon Control Rectifier.

To study the Transistor Feed Back Amplifier.

To study the Integrated Circuit operational amplifier.

To study the logic training board.

To study the speed control of D.C. motor using Thyristor.

Arithmetic operations using 8085

Logical operations using 8085

Array operations using 8085

Speed & Direction Control of Stepper motor using 8085.

TOTAL: 60 PERIODS**OUTCOMES**

On completion of this laboratory course the students would have acquired the skill in

- 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

REFERENCES

1. Lab Manuals

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS
ELECTRICAL ENGINEERING LAB**

SI.No	Name of the Equipment	Qty.
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

SI.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

MV6513

**MEASUREMENTS, INSTRUMENTATION AND
REFRIGERATION LABORATORY**

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

OBJECTIVES:

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

(A) MEASUREMENTS LABORATORY

25

Use of precision measuring instruments like micrometer, vernier, height and depth gauges, surface plate, etc.

Checking dimensions of a part using slip gauge.

Use of sine bar for measuring angles and tapers.

Measurement of tooth thickness by gear tooth vernier.

Calibration of dial gauge.

Taper and bore measurement-using spheres.

Fundamental dimension of a gear using contour projector.

Testing squareness of a try square using slip gauges.

Checking straightness of a surface plate using autocollimator.

Measurement of angles between centre lines of holes drilled radially on a shaft.

Measurements of thread parameters using floating carriage micrometer.

Use of pneumatic comparator and mechanical comparator.

(B) INSTRUMENTATION LABORATORY**20**

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.

(C) REFRIGERATION LABORATORY**15**

1. Watch keeping: Parameters to be monitored during running of refrigeration unit.

2. Various cut-outs, viz, pressure, temperature

3. Determination of actual COP, theoretical COP and Carnot COP.

TOTAL: 60 PERIODS**OUTCOMES:**

On completion of the experiments in this laboratory course the students are expected to have the knowledge and skills in

- 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

REFERENCES:

1. Lab manuals

**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 ²	1
02	2. Bourdon type Pressure gauge 0-400kgf/cm ²	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

MARINE AC & REFRIGERATION LABORATORY

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

MV6611 MARINE WORKSHOP PRACTICAL AND AFLOAT TRAINING

L T P C
0 0 48 12

OBJECTIVES:

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

		Total hrs. of Training: 1152 hrs.

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

Total 500 Marks	

* 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”, 1st Ed. taylor & Francis, Indian reprint 2011(Yesdee Publishings Pvt. Ltd.)
3. Bloch, “Machinery Component Maintenance and Repair”, 3rd Ed. Elsevier, Indian Reprint 2010, (Yesdee Publishings Pvt. Ltd.)
4. Youssef, “ Machining Technology”, 1st Vol.,Taylor & Francis, Indian Reprint 2012(Yesdee Publishings Pvt. Ltd.)
5. Parrlin, “Steering Gear” Marine Engineering Practice, Vol 1,Part 09, IMarEST, London
6. M.E.P., “ Exhaust Emission From Combustion Machinery”, Marine Engineering Practice, Vol 3,Part 20, IMarEST, London

7. Jones, "A Practical Guide To Marine Fuel Oil Handling," Marine Engineering Practice, Vol 3,Part 19, IMarEST, London
8. Henshall, "Marine Medium Speed Diesel Engines," Marine Engineering Practice, Vol 1,Part 03, IMarEST, London
9. Norris, "Prime Movers For Generation Of Electricity(A) Steam Turbines", Marine Engineering Practice, Vol 1,Part 02, IMarEST, London
10. Sterling, "Selection Installation & Maintenance Of Marine Compressors", Marine Engineering Practice, Vol 1,Part 01, IMarEST, London
11. Gopalakrishnan & Banerji, "Maintenance and Spare Parts Management", PHI Learning Pvt. Ltd., 2010
12. Mishra and Pathak, " Maintenance Engineering and Management," 2nd Ed. , PHI Learning Pvt. Ltd., 2012
13. Venkataraman, "Maintenance Engineering and Management," 1st Ed., PHI Learning Pvt. Ltd., 2010
14. Alan Rowen, Raymond Gardner, Jose Femenia, David Chapman, and Edwin Wiggins, "Introduction to Practical Marine Engineering",1st Ed.,SNAME, 2005
15. Roy L. Harrington, "Marine Engineering", 1st. 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. M.E.P., "Operation Of Machinery In Ships Steam Turbines, Boilers", Marine Engineering Practice, Vol 2,Part 15, IMarEST, London
20. Edmund GR Kraallavers , "Advanced Electro-technology For Marine Engineers", 2nd Ed. Reeds Vol 07, Adlard Coles Nautical, London
21. W.Laws, "Electricity Applied To Marine Engineering", 4th edition, The Institute Of Marine Engineers, London, 1998.

MV6701

MARINE SYSTEMS AND MACHINERY DESIGN

L T P C
2 2 0 4

OBJECTIVES:

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

UNIT I SLIDING AND ROLLING CONTACT BEARINGS 11+3

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+3

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 7+3

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

UNIT IV VALVES & LIFTING DEVICES 7+3

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

UNIT V DESIGN CRITERIA FOR MARINE SYSTEMS**11+3**

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: 60 PERIODS**OUTCOMES:**

At the completion of the course the students are expected to have knowledge in,

- 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", 1st.Ed. , Pearson, 2010
2. Leslie Jackson, "Instrumentation and Control Systems", 3rd Edition, Thomas Reed Publication Ltd., London, 1992.
3. Smith, "Application Of Automatic Machinery And Alarm Equipment In Ships", Marine Engineering Practice, Vol 1, Part 06, IMarEST, London
4. Pearson, G.H., "Valve Design", 1st Ed., Mechanical Engineering Publications", 1978
5. Krishna Rao, T., "Design of Machine Elements', 1st 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, Gujarath, 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

MV6702**MARINE ELECTRICAL TECHNOLOGY****L T P C
3 0 0 3****OBJECTIVES:**

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**9**

The marine environment – effects of inclination – Generators – Power supply commonly available – main switchboard – motor controls – emergency services – emergency stop panel – ships auxillary 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 – 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 – fue pumps – lubricating oil pumps and purifiers.

UNIT II INSTRUMENTATION AND SWITCHGEAR 9

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 9

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 9

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**9**

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 – CO₂ 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: 45 PERIODS**OUTCOMES:**

On completion of the course the students are expected to have the knowledge of

- 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", 4th Edition, "Shroff Publishers & Distributors Pvt. Ltd., Mumbai, 2007.
3. Surinder Pal Bali," Electrical Technology Machines and Measurements", Vol II, 1st Ed. Pearson, 2013
4. Surinder Pal Bali," Electrical Technology Machines and Measurements", Vol.I, 1st Ed. Pearson, 2013

MV6703**MARINE VEHICLES PERFORMANCE****L T P C****2 2 0 4****OBJECTIVES:**

To impart Knowledge to students about Marine Vehicle Performance while sailing

UNIT I RESISTANCE**14**

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

UNIT II PROPELLER THEORY 12
Types of propellers, apparent slip, real slip, wake, thrust, relation between powers and relation between mean problem 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 10
Types of rudders, model experiments and turning 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 12
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 12
Hull vibration, Engine vibration, vibration of shafting system, engine noise reduction.

TOTAL : 60 PERIODS

OUTCOMES:

On Completion of Course the Students are expected to have knowledge about,

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

TEXT BOOKS:

1. K.J. Rawson and E.C. Tupper, “Basic Ship Theory” (Vol. II), 5th Edition, Butterworth Heinemann, London, 2001.
2. Eric C. Tupper, “Introduction to Naval Architecture”, 3rd Edition, Butter worth – Heinemann, London, 2001.
3. EA Stokoe, E.A, “Naval Architecture For Marine Engineers”, Vol.4, Reeds Publications, 2000
4. Singiresu S. Rao, “Mechanical Vibrations”, Pearson, 4th Ed., Pearson, 2013
5. John Carlton, “Marine Propellers and Propulsion”, Butterworth-Heinemann,2012

REFERENCES:

1. “Principles of Naval Architecture”,SNAME Publication, 2000
2. R. Battacharjee. ”Dynamics of Marine vehicles “SNAME Publication.
3. Srikant Bhave, “Mechanical Vibrations”, Pearson, 2010
4. Malcolm, J. Crocker, “Handbook of Noise and Vibration Control”, John Wiley & Sons, 2007

MV6704

MARINE AUXILIARY MACHINERY – II

L T P C
3 0 0 3

OBJECTIVES:

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.

OBJECTIVES:

To provide knowledge and 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 and extinction 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.

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, galley, etc. 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:**

At the end of the course the students will have learnt about,

- 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, "Fire Fighting Equipment And Its Use In Ships", Marine Engineering Practice, Vol 1, Part 05, IMarEST, London
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.

REFERENCES:

1. D.G. Shipping, Fire Fighting Appliances Rules (1969/1990), 3rd edition published by Bhandarkar Publications, Mumbai, 1996
2. IMO, SOLAS (Safety of Life At Sea) 3rd Edition, International Maritime Organization, London, UK, 2001.
3. Leslie Jackson, Reed's General Engineering Knowledge for Marine Engineers Vol.8, 4th Edition, Thomas Reed publication, Great Britain, 1986.
4. Gupta, R.S., "A Hand Book of Fire Technology", 2nd Ed., University Press, 2011

MV6711

FIRE FIGHTING, CONTROLS AND SIMULATOR LABORATORY

L T P C
0 0 4 2

OBJECTIVES:

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

25

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.

OUTCOMES:

On completion of this laboratory course the students are expected to have skills in

- 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 within 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 & HYDRAULIC CONTROL LAB

4. 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**20**

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 and troubleshooting.

TOTAL: 60 PERIODS**REFERENCES:**

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

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

MARINE FIRE FIGHTING LABORATORY

SI.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

MARINE CONTROLS LABORATORY

SI.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

MARINE SIMULATOR LABORATORY

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

MV6712

**MARINE PROPULSION AND AUXILIARY MACHINERY
OVERHAULING LABORATORY**

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

OBJECTIVES:

To impart knowledge about the overhauling of equipments associated with Main Engines, Auxiliary engines and auxiliary machines

MAINE ENGINE

Study of Lubricating oil cooler
 Study of Jacket water cooler
 Study of Scavenge Air cooler
 Study of crank case inspection and bearing clearances
 Fuel injection valve and pump
 starting air valve
 cylinder relief valve and indicator cock

AUXILIARY ENGINE

Study of Turbo charger
Study of Cylinder Head and fittings
Study of Fuel Injection pump

AUXILIARY MACHINES

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

TOTAL : 60 PERIODS

OUTCOMES:

At the end of the laboratory course the students would have the ability to

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

REFERENCES

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

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

SI.No	Description of Equipment	Qty
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

Sl.No	Description of Equipment	Qty
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

GE6563

COMMUNICATION SKILLS – LABORATORY BASED

L T P C
0 0 4 2

OBJECTIVES:

- To provide opportunities to learners to practice their communicative skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

UNIT I LISTENING / VIEWING

10

Listening and note-taking – Listening to telephonic conversations – Ted talks – Inspiring Speeches – Watching documentaries on personalities, places, socio-cultural events, TV news programmes and discussions to answer different kinds questions, viz., identifying key idea and comprehension questions... so on.

UNIT II SPEAKING 12
 Conversation practice – Interview – Group Discussion – Introducing oneself and others – Role play – Debate – Presentation – Panel discussion – Neutral accent.

UNIT III READING 10
 Different genres of text (literature, media, technical) for comprehension – Reading strategies like note-making – reading graphs, charts and graphic organizer – Sequencing sentences – reading online sources like e-books, e-journals and e-newspapers.

UNIT IV WRITING 12
 Blogs – Tweets – Online resume/ – e-mails – SMS and Online texting – Report writing – Describing charts and tables – Writing for media on current events.

UNIT V VOCABULARY 8
 Idioms and Phrases – Proverbs – Collocations – Chunks of language.

UNIT VI GRAMMAR 8
 Sentence structures – Subject-Verb agreement – Pronoun-Antecedent agreement – Tense forms – Active and passive voices – Direct and Indirect speeches – Cohesive devices.

TOTAL: 60 PERIODS

Teaching Methods:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.

LAB INFRASTRUCTURE:

S. No.	Description of Equipment (minimum configuration)	Qty Required
1	Server	1 No.
	• PIV System	
	• 1 GB RAM / 40 GB HDD	
	• OS: Win 2000 server	
	• Audio card with headphones	
• JRE 1.3		
2	Client Systems	60 Nos.
	• PIII or above	
	• 256 or 512 MB RAM / 40 GB HDD	
	• OS: Win 2000	
	• Audio card with headphones	
• JRE 1.3		
3	Handicam	1 No.
4	Television 46"	1 No.
5	Collar mike	1 No.
6	Cordless mike	1 No.
7	Audio Mixer	1 No.
8	DVD recorder/player	1 No.
9	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

Evaluation:**Internal: 20 marks**

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

Note on Internal and External Evaluation:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
 - a. Marketing engineer convincing a customer to buy his product.
 - b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics
4. Discussion – topics of different kinds; general topics, case studies and abstract concept

OUTCOMES:**At the end of the course, learners should be able to**

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

REFERENCES:

1. Barker, A. **Improve Your Communication Skills**. New Delhi: Kogan Page India Pvt. Ltd., 2006.
2. Craven, Miles. **Listening Extra – A resource book of multi-level skills activities**. Cambridge University Press, 2004.
3. Gammidge, Mick. **Speaking Extra - A resource book of multi-level skills activities**. Cambridge University Press, 2004.
4. Hartley, Peter. **Group Communication**. London: Routledge, 2004.
5. John Seely. **The Oxford Guide to Writing and Speaking**. New Delhi: Oxford University Press, 2004.
6. Naterop, Jean & Rod Revell. **Telephoning in English**. Cambridge University Press, 1987.
7. Ramesh, Gopalswamy and Mahadevan Ramesh. **The ACE of Soft Skills**. New Delhi: Pearson, 2010.

Web Sources:

www.humanresources.about.com
www.careerride.com

GE6351**ENVIRONMENTAL SCIENCE AND ENGINEERING****L T P C**
3 0 0 3**OBJECTIVES:**

To impart knowledge about the importance of keeping the environment ,ecosystems with out any kind of pollution and effective use of natural resourses

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – 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

10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry-Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO₂, NO_x, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies –
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 overutilization of surface and ground 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. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; 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. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.
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 – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in

environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. 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 –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course the students would have learnt about,

- Environment and its eco systems
- Types of pollution and the method of controlling the pollution
- Planning and methods of preserving the natural resources
- Health and the effect of environment on the health of humans
- Methods of disposal of different kind of wastes

TEXT BOOKS :

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

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Akola Debi, Environmental Science and Engineering, 2nd Ed. University press 2012.

MV6801 SHIP OPERATIONAL MANAGEMENT AND IMO REQUIREMENTS

L T P C
3 0 0 3

OBJECTIVES:

- 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 exercises, ERM (engine room resource management)

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would have learnt about,

- 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.
4. Pinto, "Maritime Law", Bhandarkar Publications, 1998

REFERENCES:

1. Nilima, M.Chanidiramani, "Carriage of goods by Sea and Multimodal Transport", 1st 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. Gill, J.S., "Manual on Merchant Shipping Act, 1958", 1st Ed., Bhandarkar Publications, 2003
7. Industry Guidelines on Best Management Practices Vol. 3 (revised June 2010)

OBJECTIVES:

- 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 :**

At the end of the course the students would have learnt,

- 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:

- D.A. Taylor, "Marine Control Practice", 2nd Edition, Butter worth & Co (Publishers) Ltd., London, 1987.
- Leslie Jackson, "Instrumentation and Control Systems", 3rd Edition, Thomas Reed Publication Ltd., London, 1992.
- Bolton, "Control Systems", 1st Ed. Elsevier, Indian reprint 2011(Yesdee Publishing)
- Smith, "Application Of Automatic Machinery And Alarm Equipment In Ships", Marine Engineering Practice, Vol 1, Part 06, IMarEST, London

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", 2nd Ed., Pearson, 2012
4. Sinclair, "Sensors and Transducers", 3rd Ed. Elsevier, Reprint 2011 (Yesdee Publishing)

MV6803

SAFETY PRECAUTIONS AND WATCH KEEPING

L T P C
3 0 0 3

OBJECTIVES:

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

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, Incase 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:

At the end of the course the students are expected to have learnt,

- 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, Engge 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" 3rd 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.

MV6811 PROJECT WORK, TECHNICAL PAPER AND VIVA VOCE

L T P C
0 0 12 6

OBJECTIVES:

To develop knowledge and skill in designing and fabricating a complete Engineering systems/machines /equipment and do experiments. To enhance the ability of students to analyse and conclude from the experimental data obtained

DETAILS

- It is mandatory on the part of the students to do a project and submit a report containing not more than 100 pages. A project should be undertaken by not exceeding 4 students in a batch.
- The project can be of working model, PC based training module and theoretical design and analysis. This will be evaluated by both Internal and External Examiners.
- The projects will be done in the eighth semester and will be reviewed three times by project guide and HOD. The internal mark of 100, for this will be allotted by the guide.
- The thesis work will be evaluated by both Internal and External Examiners for a maximum of 100 Marks.

UNIT IV HEAT EXCHANGER 9

Types – construction – design – applications.

UNIT V RECENT TRENDS 9

Diesel Engines using LNG vapour camless intelligent Engines , CRDI, NOX and SOX control by various types – Exhaust gas recirculation – water injection selective cat reduction – Emission variable injection timing.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the students are expected to have the

- Knowledge on the co- generation plant engines
- Design Concept of Turbo blowers and compressors
- Design Concept of Heat Exchangers
- Recent trends in the design changes of IC Engines and Propulsion engines

TEXT BOOKS:

1. Reed's Marine Engineering Series, "Heat and Heat Engines", Thomas Reed Publications Ltd., 1983
2. Gorla, "Turbomachinery" 1st Ed. Taylor & Francis, First Indian reprint 2011(Yesdee Publishing)
3. William Embleton, Leslie Jackson, "Applied Heat For Marine Engineers", 4th Ed. Vol 3,Reeds London
4. Kuppan Thulukkanam, "Heat Exchanger Design Handbook", 1st Ed., CRC Press, 2000

REFERENCES :

1. Turton, "Principles of Turbomachinery", 2nd Ed. Springer, Reprint 2010, (Yesdee Publishing)
2. Eric, M. Smith, "Advances in Thermal Design of Heat Exchangers", 1st Ed. Wiley Publishing, 2005
3. Ramesh K. Shah, Dušan P. Sekuli , "Fundamentals of Heat Exchanger Design", 1st Ed. John Wiley & Sons, Inc., 2003

**MV6002 SHIP SAFETY AND ENVIRONMENTAL PROTECTION L T P C
3 0 0 3**

OBJECTIVES:

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", 1st Edition, Bhandarkar Publishers, Mumbai, 1998.
2. International Maritime Organisation, "SOLAS consolidated Edition 1997", 2nd Edition, Sterling Book House, Mumbai, 1997.
3. International Maritime Organisation, "MARPOL 73/78 consolidated edition 1997", 2nd Edition, Sterling Book House, Mumbai, 1997.
4. R. H. B. Sturt, "The Collision Regulations", 2nd Edition, Lloyd's of London Press Ltd., London, 1984.

MV6003

DOUBLE HULL TANKERS

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

OBJECTIVES:

- To impart knowledge on the design features and utility of Double Hull Tankers

UNIT I	INTRODUCTION	9
Origin of double hull ships, their usefulness and superiority over conventional single skin ships, use of double hull tank ships for transport of different types of commodities, prevention of oil-spill and pollution of sea, IMO requirements, schedule for phasing out single hull tank vessels of different sizes.		
UNIT II	DESIGN	9
Main dimension, hull-weight estimate, double hull requirements, minimum depth of double bottom tank, wing tank width, clearance for inspection etc. maximum cargo tank size, capacity, effect of free surface, damage stability, hydrostatically balanced loading, sloshing loads, its elimination or minimization.		
UNIT III	STRUCTURAL ANALYSIS	9
Non-uniform and uniform stress distribution, unidirectional (longitudinal) structural members, elimination of transverse structural members (except transverse bulkheads), minimization of structural discontinuities and stress concentration zones, use of steel of higher strength, resistance to grounding and collision, classification society requirements, access to inside and bottom spaces.		
UNIT IV	CARGO HANDLING SYSTEM	9
Use of submerged pumps, ordinary pumps of new independent pumps, cargo transfer system, assurance of quality of cargo oil, complete elimination of risk of admixture of different grades of oil, concealed pipelines, easy maintenance, inspection and cleaning, elimination of explosion risks.		
UNIT V	ECONOMICAL OPERATIONS	9
Economical aspects, fast loading discharging or oil cargo, quicker cleaning, ballasting and de-ballasting, larger number of trips per year.		

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to have the knowledge on the

- Advantages and superiority of double hull tankers
- Design Consideration and Storage of Oil Space
- Structural design of double hull and oil handling devices
- Economic Aspect of Double Hull tankers

TEXT BOOKS:

1. Indian Register of Shipping Notes on Design of Double Hull Tankers
2. Lloyd Register of Shipping Notes on Design of Double Hull Tankers

MV6004	SPECIAL DUTY VESSELS AND TYPE OF OPERATION	L T P C
		3 0 0 3

OBJECTIVES:

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:

After the completion of the course the students will have learnt

- 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”, 2nd 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”, 4th 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”, 2nd Edition, Sterling Book House, Mumbai, 1997.

MV6005

SHIP RECYCLING

L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on the Ship Recycling

UNIT I SHIP BREAKING METHODS

9

Introduction on ship breaking, 'Afloat method', Dry dock method, type of components to be removed. Towing – Beaching – Preparation of diagram combustible and non-combustible - re usable materials and components, recovering metals, which are mixed with non-metal – metal cutting and scraping.

UNIT II SHIP BREAKING SAFE PRACTICES

9

Objective – definition of enclosed space – assessment of risk – authorisation – authorisation of entry – precautions – testing of atmosphere known unsafe space – additional precautions – hazardous cargo – fumigation – example of an enclosed space entry permit – potentially hazardous materials – hazardous wastes and substances.

UNIT III SHIP RECYCLING DOWNSTREAM

9

Define recyclable –recycled content, recycling plan, pollution prevention procedure for existing ships – Green passport – minimising reducing waste generation, for new ships – minimising hazardous substance, designing recyclable ships – minimising waste generation.

UNIT IV REGULATION ON RECYCLING

9

MEPC 53, MEPC 54, MEPC 55, Basel convention, Role of Flag State, Port State recycling state – ILO, London Convention 1972/ 1996 Protocol, Shipping Industry. Ship recycling industry, interested stakeholder, and operational safety hazard conventions, recommended code of practice.

UNIT V SHIP BREAKING INDUSTRY

9

Ship breaking industry in India, present scenario, Gujarat Maritime Board, Gujarat Enviro protection and Infrastructure Ltd. Growth of Ship breaking industry – Alang Ship Breaking Yard – Role of pollution control board – Alang –Sosiya Ship breaking yard, Valanar Ship breaking yard. Hazards associated with ship breaking metallurgical & engineering consultant (India) finding.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to have the knowledge on the

- Method of preparation and breaking of the Ships
- Hazards involved in while breaking the ships Method of controlling the same
- Types of Recycling and designing the ships Regulations in force for Recycling
- Ship Breaking Yards in INDIA

TEXT BOOKS:

1. Misra Dr.P., Ship Recycling, 1st Edition, Nanosa Publishers 2007.
2. IMO Guidelines on ship recycling

MV6006

MARINE CORROSION AND PREVENTION

L T P C
3 0 0 3

OBJECTIVES:

- 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 – coaltar epoxy – Epoxy – oleoresinous – phenolic – polyurethane – primers – vinyl – self polishing copolymers – shipboard paint systems – underwater AF paints – boot top 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:

On completion of the course the students are expected to have the knowledge on the

- 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
2. Schweitzer, ' Fundamentals of Corrosion", 1st Ed. Taylor & Francis, Indian Reprint 20129 (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", 1st 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", 1st Ed., McGraw-Hill, 2008
2. Zaki Ahmad, "Principles of Corrosion Engineering and Corrosion Control", 1st Ed. Elsevier Ltd., 2006