REVISED DRAFT CURRICULUM FOR FOUR-YEAR B. TECH.

PROGRAM IN

NAVAL ARCHITECTURE AND OCEAN ENGINEERING

Semester - I

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2101	English-I	4	3	1	0	72
2	UG12T2102	Engineering Mathematics-I	4	3	1	0	72
3	UG12T2103	Engineering Physics	4	3	1	0	72
4	UG12T2104	Engineering Chemistry	4	3	1	0	72
5	UG12T2105	Introduction to Shipping	3	3	0	0	54
6	UG12T2106	Engineering Drawing	3	1	0	4	90
7	UG12P2101	Workshop Practice-I	3	1	0	4	90
8	UG12P2102	Physics & Chemistry Lab	2	0	0	4	72
		Total for the semester	27				594

Semester – II

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2201	English –II	4	3	1	0	72
2	UG12T2202	Engineering Mathematics-II	4	3	1	0	72
3	UG12T2203	Basics of Civil Engineering	4	3	1	0	72
4	UG12T2204	Applied Mechanics	4	3	1	0	72
5	UG12T2205	Environmental Science	3	3	0	0	54
6	UG12T2206	Fundamentals of Naval Architecture and Ocean Engineering	4	3	1	0	72
7	UG12P2201	Computer Programming	4	2	0	4	108
8	UG12P2202	Workshop Practice-II	2	0	0	4	72
		Total for the semester	27				594

Note: **L = Lectures**

T = Tutorials

P = Practicals

C = Credits

Semester - III

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2301	Engineering Mathematics -III	4	3	1	0	72
2	UG12T2302	Material Science	3	3	0	0	54
3	UG12T2303	Hydrostatics & Stability	5	3	0	4	126
4	UG12T2304	Fluid Mechanics & Machines	4	3	1	0	72
5	UG12T2305	Strength of Materials	4	3	1	0	72
6	UG12T2306	Electrical & Electronics Engineering	4	3	1	0	72
7	UG12P2301	Electrical & Electronics Lab	2	0	0	4	72
8	UG12P2302	Material Testing Lab	2	1	0	2	54
		Total for the semester	28				594

Semester – IV

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2401	Engineering Mathematics-IV	4	3	1	0	72
2	UG12T2402	Hydrodynamics	4	3	1	0	72
3	UG12T2403	Applied Thermodynamics	4	3	1	0	72
4	UG12T2404	Ship Structures-I	4	3	1	0	72
5	UG12T2405	Ship Construction	4	3	1	0	72
6	UG12T2406	Marine Systems	4	3	1	0	72
7	UG12P2401	Fluid Mechanics Lab	2	0	0	4	72
8	UG12P2402	Basic Design Software Lab	3	1	0	4	90
		Total for the semester	29				594

Note: **L = Lectures**

T = Tutorials

P = Practicals

C = Credits

Semester - V

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2501	Resistance & Propulsion	4	3	1	0	72
2	UG12T2502	Ship Structures-II	4	3	1	0	72
3	UG12T2503	Design of Machine Elements	4	3	1	0	72
4	UG12T2504	Physical Oceanography	4	3	1	0	72
5	UG12T2505	Ship Production Technology	4	3	1	0	72
6	UG12T2506	Wave Hydrodynamics	4	3	1	0	72
7	UG12P2501	Structural Design Lab	3	1	0	4	90
8	UG12P2502	Ship Design Lab I	2	0	0	4	72
		Total for the semester	29				594

Semester – VI

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2601	Marine Materials	4	3	1	0	72
2	UG12T2602	Ship Design	4	3	1	0	72
3	UG12T2603	Marine Power Plant	4	3	1	0	72
4	UG12T2604	Ship Motion & Control	4	3	1	0	72
5	UG12T2605	Business Fundamentals	4	3	1	0	72
6	UG12E26XX	Elective I	3	3	0	0	54
7	UG12P2601	Marine Power Plant Lab	3	1	0	4	90
8	UG12P2602	Ship Design Lab II	3	1	0	4	90
		Total for the semester	29				594

Note: **L = Lectures**

T = Tutorials

P = Practicals

C = Credits

Semester - VII

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2701	Design of Offshore Structures	4	3	1	0	72
2	UG12E27XX	Elective II	3	3	0	0	54
3	UG12E27XX	Elective III	3	3	0	0	54
4	UG12E27XX	Elective IV	3	3	0	0	54
5	UG12E27XX	Elective V	3	3	0	0	54
6	UG12P2701	Ship Design Project	6	0	0	12	216
7	UG12P2702	Hydrodynamics Lab	2	0	0	4	72
8	UG12P2703	Industrial Training	2	0	0	0	00
9	UG12P2704	Comprehensive Viva Voce	2	0	0	0	00
		Total for the semester	28				576

Semester - VIII

	Code	Name of the Subject	C	L	T	P	Hrs
1	UG12T2801	Ship Vibration & Noise	4	3	1	0	72
2	UG12E28XX	Elective VI	3	3	0	0	54
3	UG12P2801	Vibration & Noise lab	2	0	0	4	72
4	UG12P2802	Project Work	10	0	0	20	360
		Total for the semester	19				558

Total Credits for the course = 216

List of Electives

Electives I	UG12E2601	Finite Element Method
	UG12E2602	Computational Fluid Mechanics
Electives II	UG12E2701	Dredging & Harbour Engineering
	UG12E2702	Computer Aided Design / Computer Aided Manufacturing
Electives III	UG12E2703	Metrology & Measuring Instruments
	UG12E2704	Operations Research
Electives IV	UG12E2705	Design of Small Crafts
	UG12E2706	High Performance Marine Vehicles
Electives V	UG12E2707	Port Planning & Infrastructure Facilities
	UG12E2708	Project Management
Electives VI	UG12E2801	Marine Painting and Corrosion Protection
	UG12E2802	Industrial Management

UG12T2101	English-1	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To build proficiency in writing, reading and speaking in English language.

Unit - I: Prose **15 Hrs**

1. Google Guys (Extract) – Richard L Brandt
2. Happiness 101 – Geeta Padmanabhan
3. Structured Procrastination – John Perry
4. The Refugee – K.A. Abbas
5. The Lion and the Lamb – Leonard Clarke

Unit - II: Poetry **15 Hrs**

1. The Blind Pedlar – Osbert Sitwell
2. An Old Woman – Arun Kolatkar
3. No Sentence – Anjum Hassan
4. The Solitary Reaper – William Wordsworth
5. Gift – Alice Walker

Unit - III: Short Stories **15 Hrs**

1. A Garden So Rich – Christie Craig
2. The Umbrella Man – Roald Dahl
3. The Bird – Amar Jalil
4. The Fortune Teller – Karel Capek
5. The Postmaster – Rabindranath Tagore

Unit - IV: Drama **17 Hrs**

1. A Boy Who Stopped Smiling – Ramu Ramanathan
2. While the Auto Waits – O' Henry
3. The Cellphone Epidemic – Claudia I. Haas
4. The Death Trap – 'Saki' (H.H. Munro)
5. The Dear Departed: A Comedy in One-Act – Stanley Houghton

Unit - V: Communicative Grammar **10 Hrs**

1. Seeking and Giving Information
2. Being Informal
3. Expressing Ability, Possibility Etc.

Text Books

1. CHANDRALEKHA RAO et al., (2016), *Spring Part One*, Emerald Publishers, Chennai.
2. USHA SAIKUMAR et al., (2017), *Panorama*, Emerald Publishers, Chennai.

Reference Books

1. BHASKARAN NAIR et al., (2016), *Reflections*, Cambridge University, New Delhi.

Websites

1. http://www.learnenglish.de/

UG12T2102	Engineering Mathematics I	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To acquaint the students with Mathematic tools needed in engineering fields.

Unit - I: Mean Value Theorem **10 Hrs**

Rolle's Theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders. Indeterminate forms - Concavity and convexity of a curve, points of inflexion - asymptotes and curvature.

Unit - II: Differential calculus of several variables **20 Hrs**

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

First order differential equations - exact linear and Bernoulli's form - Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

Unit – III: Analytic Functions & Complex Integration **22 Hrs**

Functions of a complex variable – Analytic functions Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation

Complex integration – Statement and applications of Cauchy's integral Theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue Theorem – Evaluation of real definite integrals as contour integrals around unit circle

and semi-circle (excluding poles on the real axis).

Unit - IV: Sequences and series **10 Hrs**

Sequences Definition and examples – Series Types and Convergence – Series of positive terms – Tests of convergence Comparison test, Integral test and D' Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

Unit – V: Multiple Integrals **10 Hrs**

Double integrals in Cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves. Change of variables in double integrals – Area of a curved surface – Triple integrals – Volume of Solids.

Text Books

1. GREWAL B.S., (2011), *Higher Engineering Mathematics*, Khanna Publications, New Delhi.
2. RAMANA B.V., (2008), *Higher Engineering Mathematics*, Tata McGraw Hill, Publishing Company, New York, USA

Reference Books

1. DASS H.K. & RAJNISH VERMA E.R., (2011), *Higher Engineering Mathematics*, S. Chand Private Ltd, New Delhi.
2. GLYN JAMES, (2012), *Advanced Modern Engineering Mathematics*, Pearson Education, India.
3. PETER V. O'NEIL, (2012), *Advanced Engineering Mathematics*, Cengage learning.
4. JAIN R.K. & IYENGAR S.R.K, (2007), *Advanced Engineering Mathematics*, Alpha Science International, Oxford.
5. ERWIN KREYSZIG, (2010), *Advanced Engineering Mathematics*, Wiley International, New Jersey.

UG12T2103	Engineering Physics	L	T	P	C	Hrs
		3	1	0	4	72

Objective: A basic course in understanding of concepts in heat, optics, waves, electromagnetism and fundamental properties of materials, with relevant applications.

Unit-I: Heat **12 Hrs**

Thermodynamics: Isothermal expansion of a gas- adiabatic expansion of a gas- change in internal energy of a gas or general gas equation- relation between pressure and volume in a adiabatic process- different forms of adiabatic equation- adiabatic curves are steeper than isothermal curves- work done by a gas in isothermal expansion- work done by a gas during adiabatic expansion- compressibility of a gas.

Transmission of heat: Modes of transmission of heat- convection- radiation- laws of black body radiations.

Unit-II: Optics **15 Hrs**

Optical instruments: microscope & telescope - sextant - spectrometer. Interference: Young's experiment - fringes - conditions for interference - types of interference - Fresnel's bi-prism.

Diffraction: difference between interference and diffraction - determination of wavelength by straight edge - resultant of 'n' simple harmonic motions

Polarization: Polarization of light waves - representation of various types of light - plane of polarization - theory of photo-elasticity

LASER: Lasers - spontaneous and stimulated emission - types of lasers – ruby laser - gas laser - semiconductor laser - CO_2 laser - uses of laser.

Unit-III: Waves **20 Hrs**

Wave motion: Wave motion - types of wave motion and characteristics of wave motion - definitions of important terms - relations between various

terms - sound as a wave - phase velocity - wave velocity - equation of plane progressive wave - particle velocity and wave velocity - differential equation of wave motion - distribution of velocity and pressure in progressive wave - energy of the progressive wave - absorption and attenuation of waves.

Superposition of waves: Principle of superposition of waves - interference of sound waves - stationary waves - beats - stationary waves - Lissajous figures and their significance - group velocity and phase velocity.

Transverse vibrations of stretched strings: Velocity of transverse waves along stretched string - frequency of a vibrating string - harmonics and overtones.

Doppler's principle: Doppler's effect - applications of Doppler's principle

Acoustics of buildings: Basic requirement for acoustically good halls - reverberation and time of reverberation - Sabine's formula - absorption coefficient and its measurement - transmission of sound and transmission loss - factors affecting architectural acoustics - sound absorbing materials.

Ultrasonics: Ultrasonic waves - production of ultrasonic waves - detection of ultrasonics - properties of ultrasonics - wavelength of ultrasonic - waves - application of ultrasonic waves.

Unit-IV: Electro-magnetism **10 Hrs**

Thermo-electricity: Seebeck effect - variation of thermoelectric e.m.f with temperature - Thermo-electric series - law of successive contacts , temperatures - Peltier effect - Thomson effect - total e.m.f in thermocouple - thermo-electric power - applications of thermoelectric effect

Maxwell's equation & electromagnetic waves: Vector fields – rotational and irrotational - source and sinks in vector fields - divergence theorem - basic laws of electricity and magnetism in differential form - oscillations -

charge conservation law - continuity equation - displacement current - Maxwell's equations - electromagnetic waves in free space - Poynting vector - propagation of electromagnetic waves in dielectric field and through conducting media.

Unit-V: Material properties **15 Hrs**

Crystal structure: Space lattice - basis of crystal structure - unit cell - crystal systems - Bravais space lattices - classification of crystal based on nature of forces - number of atoms per unit cell - coordination number - atomic radius - packing density - calculation of lattice constant - lattice planes and Miller indices - separation between lattice planes in simple - face-centered and body-centered lattices.

Classification of solids (metals - insulators - semiconductors - superconductors):Energy levels in solids - valence band - conduction band and forbidden band - conductors - semi-conductors and insulators - chemical bonds in semi-conductors like - Ge and Si - intrinsic and extrinsic semi-conductors - impurity semi-conductors - conductivity of semi-conductor - P-N junction diode - junction transistors - superconductivity - superconductors and their properties - types of superconductors - theories on superconductivity.

Text Books

1. GAUR R.K. & GUPTA S.L., (2015), *Engineering Physics*, Dhanpat Rai Publications, New Delhi.
2. AVADHANULU M.N. & KSHIRSAGAR P.G., (1992), *A Textbook of Engineering Physics*, S. Chand Publishing, New Delhi.

Reference Books

1. RESNICK, HALLIDAY & KRANE, (2001), *Physics*, John Wiley & Sons,
2. PALANISAMY P.K., (2009), *Engineering Physics*, SciTech Publications Pvt Ltd, Chennai.

3. THERAJA B.L., (2008), *Modern Physics*, S. Chand Publishing, New Delhi.
4. BHATTACHARYA, BHASKARAN, (2010), *Engineering Physics*, Oxford Publications, Oxford.

UG12T2104	Engineering Chemistry	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To introduce the student to the basic concepts of Chemistry in engineering applications.

Unit – I: Water and its Treatment **20 Hrs**

Source of water - hard and soft water - determination of hardness - softening water ion exchange process. Boiler feed water operation - caustic embrittlement - internal conditioning. Water for domestic purposes – sedimentation – coagulation - filtration and sterilization - chlorination and its advantages and disadvantages. Disinfection with Ozone. Desalination Pollution – chemical characteristics - sewage treatment biological oxygen demand (BOD) - chemical oxygen demand (COD) - total dissolved solids (TDS).

Unit- II: Energy sources **15 Hrs**

Solid, liquid and gaseous fuels - calorific value of fuels - calorific intensity. Coal – analysis of coal - carbonization of coal - metallurgical coke and its manufacture - hydrogenation of coal. Petroleum Origin and refining of petroleum - cracking and polymerization - requisites of a good petrol. Diesel oil – Petrochemicals - Gaseous fuels - natural gas – LPG - Producer gas - combustion zone - reduction zone, water gas - Batteries and fuel cells -Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- fuel cell H_2 -O_2 fuel cell- applications.

Unit-III : Engineering Materials **15 Hrs**

Lubricants -Introduction -Mechanism of lubricants –Classification – Properties of lubricants - Refractories – Manufacturing – Properties – Classification etc -Glass – Introduction- Properties of glass – Manufacturing of glass & their types - Cement –Introduction – Manufacturing –Gypsum –Mortar and concretes

Unit – IV : Electrochemistry **12Hrs**

Introduction –Electrolysis – Conductance –Conductometric titrations – Electrochemical cells – EMF –Measurement of EMF-Applications of EMF – Reference Electrodes-Hydrogen electrode –Calomel electrode –Nernst equations etc.,

Unit – IV : Environmental Chemistry **10 Hrs**

Composition of atmosphere – chemical and petrochemical reactions – Green House effect – composition of lithosphere – wastes and pollutants in soil – impact of toxic chemicals in the environment – air pollution – water pollution – quality parameters and standards

Text Books

1. NKRISHNAMURTHY, VALLINAYAGAM D.MADHAVAN (2014) *Engineering Chemistry 3rd Edition*, PHI learning Pvt Ltd Eastern Economy Edition, New Delhi.
2. OG PALANNA (2009) *Engineering Chemistry* , Tata Mc Graw Hill Education Private Limited New Delhi.

Reference Books

1. JAIN & JAIN (2016) *Engineering Chemistry (16th Edition)*, Dhanpat Rai, New Delhi.
2. SHASHI CHAWLA (2006) *A text Book of Engineering Chemistry 3rd Edition*, Dhanpat Rai, New Delhi.
3. A.K. DE (2008) *Environmental Chemistry* , New Age International P. Ltd Publishers, New Delhi.
4. K.S. VENKATESWARLU (2005) *Water Chemistry*, New Age International P. Ltd Publishers, New Delhi

UG12T2105	Introduction to Shipping	L	T	P	C	Hrs
		3	0	0	3	54

Objective: To introduce commercial aspects of shipping in general in relation to world trade and also expose to the students to basic economic aspects of shipping and shipbuilding.

Unit - I: Commercial Geography 10 Hrs

Continents; geographical regions e.g. Far East, Mediterranean, S.E. Asia - Location of major countries and ports - All the continents, the major centers of which they are comprised of and the manner in which they are grouped in geographical regions- - Oceans of the World and the seas of which they are comprised - The effects of tides- currents, climate and weather - An awareness of different map projections - latitude and longitude. The location of major ports, canals and waterways, functions of ports, canals and waterways. Relationship between efficiency and cost and the importance of ship/port time. Investment criteria and economic factors including cost and tariff structure

Unit - II: Geography of Trade 12 Hrs

Major trade routes and the type of ships used for transportation of the five primary raw materials, namely, coal, ores, grains, fertilizers and oil, as well as general cargo (manufactured goods) - with names and locations of the principal ports involved- Characteristics and/or hazards involved in the transport of these commodities-Factors of choice of the most favoured transport modes for these commodities - such as palletisation, unitisation, containerization, refrigeration, multimodal transport - Shore side facilities and infrastructure-Location and seasons of major natural phenomena affecting sea transportation - Particularly storms and ice - Rationale behind load line zones and how these can affect voyage planning and estimating.

Unit - III: Basic Economic Concepts **10 Hrs**

Basic economic concepts- basic definitions of economics and maritime economics. Distinction between the micro-economic theory of shipping and macro-economic factors affecting international trade and shipping, and the differences between them. Factors of production, utility and price, opportunity cost. Price mechanism and the relationship between demand, price and quantity. Competitive models and demand factors.

Unit – IV: The Demand & Supply for Shipping **10 Hrs**

Understanding of how the demand for shipping arises. Understanding the basic measures of economic activity (GNP and GDP). Understanding demand measurement – distance, ton/miles and tonnes / kilometers- Understanding the factors influencing the supply of shipping – tonnage, number and fleet. Understand the trends in development of the world fleet – new buildings and scrapping. Supply trends – surplus tonnage, active fleet and market segments. Understanding of short- and long-run supply, supply responsiveness and the concept of elasticity.

Unit-V: Economics of Shipbuilding & Scrapping **12 Hrs**

Role of Shipbuilding & Scrapping industries, History of world shipbuilding, Shipbuilding Market cycles, Market supply & demand models, Shipbuilding costs, competitiveness & productivity, Introduction to ship breaking industry- Finance and Insurance-Understanding of the different ways a buyer may raise funds to finance shipbuilding / purchase. Understanding of the sources of such funds and the type of information such financiers will require. Role and function of a mortgage when used as security for a loan to finance the purchase.

Text Books

1. INSTITUTE OF CHARTERED SHIP BROKERS (2014) *Introduction to shipping*, Institute of Chartered Ship Brokers, UK.

2. INSTITUTE OF CHARTERED SHIP BROKERS (2015) *Economics of sea Transport &International Trade* Institute Of Chartered Ship Brokers, UK

Reference Books

1. INSTITUTE OF CHARTERED SHIP BROKERS (2013) *Ship sale & Purchase*, Institute Of Chartered Ship Brokers, UK.
2. MARTIN STOPFORD (2003) *Maritime Economics*, Tayler & Francis, 2nd Edition, UK.
3. INSTITUTE OF CHARTERED SHIP BROKERS (2010) *Shipping Finance*, Institute of Chartered Ship Brokers, UK.

UG12T2106	Engineering Drawing	L	T	P	C	Hrs
		1	0	4	3	90

Objective: To provide the basic knowledge about Engineering Drawing - projections, technical drawing, views, dimensioning and specifications, useful for an engineering career.

Unit - I: Introduction to Engineering Drawing 10 Hrs

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Unit - II: Orthographic Projections covering, 30 Hrs

Principles of Orthographic Projections Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Unit - III: Projections of Regular Solids 20 Hrs

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views;

Unit - IV: Sections and Sectional Views 10 Hrs

Sections and Sectional Views of Right Angular Solids covering,Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

Unit - V: Isometric Projections 20 Hrs

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Text Books

1. BASANT AGARWAL, CM AGARWAL (2008), *Engineering Drawing* TMH education Pvt ltd, New Delhi
2. Bhatt N D and V M PANCHAL (2016) *Engineering Drawing* , Charotar Publishers.

Reference Books

1. SHAH M B and B C RANA (2009) *Engineering Drawing.* Ed. 2. Pearson Publishers
2. JEYAPOOVAN T (2015) *Engineering Graphics using Auto CAD,* VIKAS Publishing House.
3. BHATT, N.D (2016) *Engineering Drawing Plane and Geometry*, Charotar Publishing House
4. GILL P S (2014) Engineering Drawing, Kataria & Sons.

UG12P2101	Workshop Practice-I	L	T	P	C	hrs
		1	0	4	2	90

To impart hands-on practice on basic engineering trades and skills.

Trade:

Carpentry

1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tennon Joint

Fitting

1. Vee Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

Black Smithy

1. Round rod to Square
2. S-Hook
3. Round Rod to Flat Ring
4. Round Rod to Square headed bolt

Tin Smithy

1. Taper Tray
2. Square Box without lid
3. Open Scoop
4. Funnel

UG12P2102	Physics & Chemistry Lab	L	T	P	C	Hrs
		0	0	4	2	72

Physics

1. Oscillation in potential well
2. Normal modes of coupled oscillators
3. Measurement of velocity of acoustic waves
4. Newton's rings
5. Specific rotation of an optically active source
6. Diffraction with laser
7. Dispersive power of a prism
8. Fresnel Bi prism
9. Franck Hertz experiment
10. Photoelectric effect
11. Measurement of band gap in semiconductors
12. Measurement of Hall effect

Chemistry

1. Estimation of chloride ion
2. EDTA Titration
3. Alkalinity
4. Estimation of D.O.
5. Estimation of Phosphate
6. Conductometric titrations (HCl VS NaOH)
7. Estimation of Fe2+
8. Determination of Viscosity of a lubricating oil using Red wood Viscometer
9. Estimation of Hydrazine
10. Estimation of Sulphate

UG12T2201	English-II	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To build proficiency in writing, reading and speaking in English language.

Unit - I: Prose **15 Hrs**

1. Cities within a City – Ramachandra Guha
2. Life is a Journey – Helen S. Garson
3. Rejuvenating the Heart of India – A.P.J Abdul Kalam
4. The Lady or the Tiger? – Frank R. Stockton
5. The Sky is the limit! – Kalpana Chawla

Unit - II: Poetry **15 Hrs**

1. Growing Old – Winston Farrell
2. Winter, Delhi 1997 – Arundhati Subramanian
3. Aftermath – Siegfried Sassoon
4. O What is that Sound – W.H. Auden
5. Ode to the West Wind – Percy Bysshe Shelley

Unit - III: Short Stories **14 Hrs**

1. Behind the Mirror – Laura Reilly
2. Head and Shoulders – F. Scott Fitzgerald
3. A desire to see the sky – MotilalJotwani
4. The Modern Millionaire – Oscar Wilde
5. The Adventures of the Dying Detective – Sir Arthur Ignatius Conan Doyle

Unit - IV: Drama **14 Hrs**

1. The Girl who touched the Stars – Mahesh Dattani
2. The Best Laid Plans – Farell Mitchell
3. The Trick: One Act Play – ErisaKironde
4. The Sheriff's Kitchen – Ronald Gow

5. The Anniversary – Anton Checkhov

Unit - V: Group Discussion **14 Hrs**

1. The Communication Process
2. Barriers to Communication
3. Group Talk.

Text Books

1. CHANDRALEKHA RAO et al., (2016), *Spring Part Two*, Emerald Publishers, Chennai.
2. USHA SAIKUMAR et al., (2017), *Panorama*, Emerald Publishers, Chennai.

Reference Books

1. SHARDA KAUSHIK, (2016), *Spring Board*, Orient Blackswan, Hyderabad, India.

Websites

1. http://www.learnenglish.de/

UG12T2202	Engineering Mathematics-II	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To provide the basic knowledge for solving Partial differential equations, Transformations and vector calculus.

Unit – I: Matrices **15 Hrs**

Eigen values and Eigen vectors of a real matrix – Characteristic equation – Properties of eigen values and eigen vectors – Statement and applications of Cayley - Hamilton Theorem – Diagonalization of matrices – Reduction of quadraticform to canonical form by orthogonal transformation – Nature of quadratic forms.

Unit - II: Vector Calculus **15 Hrs**

Gradient - divergence and curl–Directional derivative – Irrational and solenoid 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 - III: Laplace Transform **20 Hrs**

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms – Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform – Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques - Fourier series Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval'sidentity – Harmonic analysis

Unit - IV: Partial Differential Equations **15 Hrs**

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 and Applications

Unit - V: Fourier Transforms **7 Hrs**

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

Text Books

1. BALI N. P & MANISH GOYAL, (2011), *A Text book of Engineering Mathematics*, Laxmi Publications Pvt Ltd, New Delhi.
2. GREWAL B.S, (2011), *Higher Engineering Mathematics*, Khanna Publications, New Delhi.

Reference Books

1. SIVARAMA KRISHNA DAS P. & RUKMANGADACHARI E., (2011) *Engineering Mathematics Volume II*, PEARSON Publishing, London, UK.
2. PETER V. O'NEIL, (2012), *Advanced Engineering Mathematics, 7th Edition*, Cengage learning, Boston, USA.
3. GLYN JAMES, (2012), *Advanced Modern Engineering Mathematics, 3rd Edition*, Pearson Education, London, UK.
4. ERWIN KREYSZIG, (2010), *Advanced Engineering Mathematics*, Wiley International, New Jersey

UG12T2203	Basics of Civil Engineering	L	T	P	C	Hrs
		3	1	0	4	72

Objective : To expose the students on elements of Civil ngineering relevant to shipping industry and harbours.

Unit – I: Civil Engineering Materials **15 Hrs**

Types of cementitious material – Portland cement – hydraulic cements – Mortar and Grouts – Types of Concrete – Reinforced and Plain Cement Concrete. Metallic materials – masonry units – organic materials – joint seals – paints and coatings – composite materials – matrix systems – sandwich systems, continuous filament systems – laminated materials – Environmental influences on materials – thermal effects – corrosion and oxidation - degradation control and prevention – irradiation.

Unit – II: Basic Structural Theory **15 Hrs**

Stress-Strain relation – poisons ratio – thermal stresses – axial stresses in composite materials – stresses in pipes and pressure vessels – Stress components – two dimensional stress – principal stress – maximum shearing stress at a point – Mohr Circle – Torsion. Straight beams – types of beams – reactions – internal forces – shear and Bending moment diagram - shear and moment relation – moving loads and influence lines – Bending stress – moment of Inertia, section modulus, shear and bending stress in beams – eccentric loading – curved beams – columns – long and short columns

Unit – III: Geotechnical Engineering **15 Hrs**

Soil and rock classifications – engineering properties of soil – site investigations – shallow foundations – stress distribution nd settlement analysis (cohesive and non-cohesive soils) – Deep foundations – pile types – basic pile design concepts – pile testing – retaining methods – caissons, dikes, cofferdams – soil solidification - foundations for water front structures – foundations for offshore structures

Unit – IV: Environmental Engineering **15 Hrs**

Prevention of pollution – major sources of water pollution – types of sewers – estimating wastewater flow – sewer design – storm water inlets – outfalls waste water pumps – wastewater treatment and disposal – filtration – sludge treatment – disinfectoin – industrial wastewater treatment – urban sewage marine disposal – outfall design – environmental issues in marine disposal

Unit – V: Structures for shipping industry **12 Hrs**

Types of harbours – layout – mooring structures – warf and jetty – dock and gates – ship yard - coastal structures – breakwaters – groynes – revetment – dykes – shore protection schemes – geosynthetic elements

Text Books

1. Frederick S. M, M Kent Loftin and T. R. Jonathan, (2002), Standard Handbook for Civil Engineers, Mc Graw – Hill
2. Gregory Tsinker, (1996), Handbook of Port and Harbour Engineering

Reference Books

1. Punmia B. C , Ashok Kumar Jain, Arun Kr. Jain (2003) *Basic Civil Engineering*, Lakshmi Publications
2. Vazirani, V N and S.P Chandola, (1998), Civil Engineering Hand book, Khanna Publishers.

UG12T2204	Applied Mechanics	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To impart the fundamental principles of equilibrium of bodies under action of forces and apply the same to physical systems.

Unit-I: Introduction to Engineering Mechanics **15 Hrs**

Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction.

Unit-II: Geometric Properties **12 Hrs**

Properties of Surfaces and Volumes: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus.

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes -thin plates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

Unit-III: Structures Analysis **15 Hrs**

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Virtual Work: Equilibrium of ideal systems, work done by a force, work done by a couple, principle of virtual work.

Unit-IV: Kinetics **15 Hrs**

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.
Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse, impact - types of impact.

Unit-V: Kinematics **15 Hrs**

Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity -projectile motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis, introduction to plane motion.

Text Books

1. TIMOSHENKO S., YOUNG D.H, RAO J. V., (2008), *Engineering Mechanics*, Tata McGraw Hill, USA.
2. KUMAR K.L., (2010), *Engineering Mechanics*, Tata McGraw Hill, USA.

Reference Books

1. FERDINAND BEER, E. RUSSELL JOHNSTON, JR., DAVID MAZUREK, PHILLIP CORNWELL, (2012), *Vector Mechanics for Engineers: Statics & Dynamics*, McGraw Hill Higher Education, USA.
2. BHAVIKATTI S.S., (2008), *Engineering Mechanics*, New Age International Publishers, New Delhi.
3. LAKSHAMANA RAO C., LAKSHMINARASIMHAN J., SETHURAMAN RAJU, SRINIVASAN M. SIVAKUMAR, (2003), *Engineering Mechanics: Statics and Dynamics*, Prentice Hall of India, New Delhi.
4. SHARMA D.P., (2010), *Engineering Mechanics*, Pearson Education, UK.

UG12T2205	Environmental Studies	L	T	P	C	Hrs
		3	0	0	3	54

Objective: To familiarize the students with the environmental issues associated with development

Unit I: Introduction and Natural Resources **10 Hrs**

Multidisciplinary nature and public awareness - Renewable and nonrenewal resources and associated problems - Forest resources - Water resources - Mineral resources - Food resources - Energy resources - Land resources - Conservation of natural resources and human role.

Unit II: Ecosystems **10 Hrs**

Concept - Structure and function - Producers composers and decomposers - Energy flow - Ecological succession - Food chains webs and ecological pyramids - Characteristics structures and functions of ecosystems such as Forest - Grassland - Desert - Aquatic ecosystems.

Unit III: Biodiversity and Conservation **10 Hrs**

Definition - Genetic - Species - and Ecosystem diversity - Bio-geographical classification of India - Value of biodiversity at global - national - local levels - India as a mega diversity nation - Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - In-situ and ex-situ conservation of biodiversity.

Unit IV: Environmental Pollution **12 Hrs**

Definition - Causes - effects and control of air pollution - water pollution - soil pollution - marine pollution - noise pollution - thermal pollution - nuclear hazards - human role in prevention of pollution - Solid waste management - Disaster management - floods - earthquake - cyclone and landslides.

Unit V: Social issues and Environment **12 Hrs**

Unsustainable to sustainable development - Urban problems related to energy - Water conservation and watershed management - Resettlement and rehabilitation - Ethics - Climate change - Global warming - Acid rain - Ozone layer depletion - Nuclear accidents - holocaust - Waste land reclamation - Consumerism and waste products - Environment protection act - Wildlife protection act - Forest conservation act - Environmental issues in legislation - population explosion and family welfare program - Environment and human health - HIV - Women and child welfare - Role of information technology in environment and human health.

Text Books:

1. Agarwal K.C., (2001), *Environmental Biology*, Nidi Publication Ltd., Bikaner.
2. Bharucha Erach, (2002), *Biodiversity of India*, Mapin Publishing Pvt. Ltd., Ahmadabad.

Reference Books:

1. Clark R.B. (2002), *Marine Pollution*, Clanderson Press, Oxford.
2. Cunningham W.P. et al, (2003), *Environmental Encyclopedia*, Jaico Publishing House, Mumbai.

UG12T2206	Fundamentals of Naval Architecture and Ocean Engineering	L	T	P	C	hrs
		3	1	0	4	72

Objective: To provide basics of ocean environment, structures and ship building.

Unit – I: Introduction to Ocean Environment 10 Hrs

Resources - Oil and gas - mineral nodules – energy - food source etc, Ocean Environment - waves - tides and currents. Introduction to Naval Architecture - the art and science. Brief history of shipbuilding.

Unit -II: Evolution of ships and Shipbuilding materials 20 Hrs

General purpose vessels to specialized vessels. Category of ships according to nature of cargo - defense and surveillance, Engineering activities. Transportation passengers- pleasure crafts- service crafts- Categories according to type of support - Hydrostatic - Hydrodynamic, aerostatic - Aerodynamic.

Materials for construction – Wood – steel – Aluminium - Composites. Transition from Riveting to welding. progress in propulsion systems – prime movers and propulsors – turbines - IC engines - Marine screw propellers - water jets – Voith Schneider Propeller - SRP.

Unit - III: Form and Geometry 10 Hrs

The hull of ship - streamlining of hull forms. main particulars – displacement - form coefficients - tonnage. Layout and representation in different views - weights & CG - volume & capacities. laws of flotation and stability. Strength of the hull girder and systems of framing - functions of the shell - decks – shear and camber - bulk heads and hatches. Dynamic effects such as slamming – pounding – panting - racking and shipping green water.

Unit –IV: Terminology of various parts **12 Hrs**

Parts of the hull, interior parts, superstructure, deck house, cargo gear and deck machinery. Outfits and their purpose - anchor, rudder, propeller, bollard, windlass and other deck fittings- Life saving appliances- boats rafts and lifebuoy Fire fighting appliances - fire pump - fire main, extinguishers etc. Navigational and communication equipments. Lights, shapes and sound signals.

Unit –V: Practical applications in ocean engineering **20 Hrs**

Introduction to offshore structures-gravity platforms- jacket platforms - tension leg platforms- marine risers- submersibles- offshore pipelines Instrumentation for ocean applications - pressure sensors - current meters CTD -depth sounder - buoy systems - mooring systems etc.

Text Books

1. TUPPER E.C., (2013), *Introduction to Naval Architecture*, Elsevier Publishers.
2. Graff W. J.,(1981), Introduction to Offshore Structures, Gulf Publishing Company.

Reference Books

1. LARIC D. FERREIRO, (2007), Ships *and Science,* MIT Press Cambridge.
2. THOMAS C. GILLMER BRUCE JOHNSON, (1982), *Introduction to Naval Architecture*, Naval Institute Press, US.
3. ROBERT B. ZUBALY, (1996), *Applied Naval Architecture*, Schiffer Publishing.
4. Shields, M. J., (1992), Offshore Structures, Vol. I, Springer-Verlag.

UG12P2201	Computer Programing	L	T	P	C	Hrs
		2	0	4	4	108

Objective: To introduce the student on basics of computing and programming language - C

Unit – I: Introduction to computers **6 Hrs**

Computer Organization – Characteristics – Hardware and Software – Modes of operation – Types of programming languages – Developing a program. Compiler and Interpreter

Unit -II: Algorithms **6 Hrs**

Characteristics – Flowcharts – Pseudo Code- Heuristics - Principles of Structured programming – Sequential, selective structures - Repetitive structures –Bounded, Unbounded and Infinite iterations – Examples for each.

Unit - III : Introduction to C **6 Hrs**

C character set – Identifiers and Keywords – Data types – Constants – Variables – Declarations – Expressions – Statements – Symbolic constants – Operators– Library functions- Strings

Unit–I: Input and output data **6 Hrs**

Entering input data – Writing output data – gets and puts functions. Control statements – Branching - if-else – Looping while – do-while – for; Nested control structures – switch statement – break statement – continue statement – comma operator – go to statement – initialization of strings – string handling functions

Unit - V : Modular Programming **12 Hrs**

Functions and Procedures – Examples – Parameter passing methods. Arrays – Defining an array – Processing an array – Multidimensional

arrays-Pointers – Variable definitions and initialization – Pointer operators – Pointer expressions and arithmetic – Pointers and one-dimensional arrays- Functions - Defining a function – Accessing a function – Function prototypes Passing arguments to a function –Passing arrays to a function – Passing pointers to a function – Recursion – Iteration Vs Recursion

Practical **72 Hrs**

1. Programs using sequence construct
2. Programs using selection construct
3. Programs using Iterative construct
4. Programs using nested for loops
5. Programs using functions with Pass by value
6. Programs using functions with Pass by reference
7. Programs using recursive functions
8. Programs using one dimensional Array
9. Programs using two dimensional Arrays
10. Programs using Pointers and functions
11. Programs using Pointers and Arrays

Text Books

1. RAJARAMAN V & ADABALA N, (2014), *Computer Fundamentals*, Prentice Hall India Learning Pvt. Ltd.
2. KERNIGHAN.B.W & DENNIS RITCHIE, (2015), *The C Programming Language*, Second Edition, Pearson Education India.

Reference Books

1. BYRON GOTTFRIED, (2010), *Programming with C*, Third Edition, Tata McGraw Hill Education.
2. R.G.DROMEY, (2001), *How to Solve it by Computers*, Prentice-Hall.
3. J.R. HANLY & E.B. KOFFMANN, (2009), *Problem Solving and Program Design in C*, Sixth Edition, Pearson Education.

4. PAUL DEITAL & HARVEY DEITAL, (2012), *C How to Program*, Seventh Edition, Prentice-Hall.
5. YASHAVANT KANETKAR, (2012), *Let Us C*, twelfth Edition, BPB Publications.

UG12P2102	Workshop Practice-II	L	T	P	C	hrs
		0	0	4	2	72

1. Turning- Taper turning using tailstock offset method and taper turning attachment Eccentric external turning using a four jaw chuck.
2. Boring- Using a boring tool – both concentric and eccentric. Boring using a boring bar in a centre lathe. Square and hexagonal hole drilling using die-sinking EDM.
3. Grindind- Cylindrical grinding using grinding attachment in a centre lathe
4. Thread Cutting- Internal and external thread cutting using a single point cutting tool.
5. Gears- Cutting teeth of spur gears using form milling cutter in a universal milling machine, Gear hobbing, Gear shaping.
6. Welding- Introduction. Edge/Joint preparation in welding and joining using shielded metal arc welding. Hands-on practice on metal inert gas welding (MIG) or gas metal arc welding. Hands-on practice on tungsten inert gas welding (TIG) or gas tungsten arc welding. Hands-on practice on submerged arc welding

UG12T2301	Engineering Mathematics -III	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To provide basic concepts of statistical methods and procedures for solving problems occurring in engineering and technology.

Unit - I: Probability **12 Hrs**

Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes Theorem and independence.

Unit – II: Random Variables **12 Hrs**

Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's Inequality-

Unit - III: Distributions **18 Hrs**

Special Distributions - Discrete uniform, binomial, geometric, Poisson, exponential, gamma, normal distributions, function of a random variable.

Joint Distributions - Joint, marginal and conditional distributions, product moments, independence of random variables, bi-variate normal distribution.

Unit – IV: Sampling Distributions **12 Hrs**

The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and f distributions. Estimation: The method of moments and the method of maximum likelihood estimation, confidence intervals for the mean(s) and variance (s) of normal populations.

Testing of Hypothesis - Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Newman - Pearson Fundamental Lemma, tests for one sample problems for normal populations

Unit – V: Curve Fitting, Regression and Correlation 18 Hrs

Curve fitting, the method of least squares, the least squares line, least, square line in terms of Sample variance and covariance, regression lines, regression coefficients, the least square parabola, multiple regression, standard error of estimate, linear correlation coefficient, Probabilistic interpretations of regression and correlation, interpretations of regression and correlation

Text Books

1. BALI N.P. & MANISH GOYAL, (2011), *A Text Book of Engineering Mathematics*, Eighth Edition, Laxmi Publications Pvt. Ltd.
2. ERWIN KREYSZIG, (2010), *Advanced Engineering Mathematics*, Tenth Edition, Wiley International.

Reference Books

1. JAY L. DEVORE, (2010), *Probability & statistics for Engineering & Scientist*, Eighth Edition, Cengage Learning.
2. WAL POLE H. MYERS & L. MYERS, (2010), *Probability and Statistics for Engineering & Scientists*, Ninth Edition, Pearson Education.
3. R.K. JAIN & SRK IYENGAR, (2007), *Advanced Engineering Mathematics*, Third Edition, Narosa Publications.
4. GREWAL B.S, (2011), *Higher Engineering Mathematics*, Khanna Publications.

UG12T2302	Material Science	L	T	P	C	Hrs
		3	0	0	3	54

Objective: To understand the structure, properties and transition of engineering materials under different physical conditions.

Unit –I: Crystal Structure **8 Hrs**

Atomic structure- Atomic bonding in solids, Unit cells and Space lattices, Crystal structures, Concept of amorphous, single and polycrystalline structures, Miller Indices, Crystal Defects, point, line, surface and volume defects.

Unit –II: Polymers and Composites **10 Hrs**

Introduction – Classification of Polymers – Types of Polymerization – Preparation - Properties and uses of Some important polymers – Fabrication of plastics – Rubber – Synthetic rubbers -Composites

Unit–III: Solid Solutions Phase Diagram **18 Hrs**

Types of Solid solutions – Hume Rothery ratio – Intermediate phases – Solid solution alloys - Phase Diagrams- Introduction –Cooling curves – Gibbs Phase rule – Classification of equilibrium diagrams - Eutectic – Peritectic reactions – Equilibrium diagram for common non – ferrous alloys-Ferrous alloys – Micro constituents of iron - Iron –Carbon equilibrium diagram - TTT diagram etc., Non Ferrous alloys - Introduction – Copper – Aluminium alloys - Nickel alloys – Properties – Composition and its applications

Unit - IV: Heat Treatment **10 Hrs**

Definition – Purpose of heat treatment - Annealing – Normalizing – Hardening -Tempering- Martempering – Austempering etc., Case Hardening and Surface Treatment - Carburizing - Cyaniding – Nitriding – Flame Hardening etc.

Unit - V: Corrosion and its control **8 Hrs**

Corrosion - Introduction – Cause of corrosion – Theories of Corrosion – Differential aeration corrosion - Factors influencing corrosion –Types of corrosion – Corrosion control

Text Books

1. RAGHAVAN V, (2015), *Material Science and Engineering A first course,* Prentice Hall of India.
2. VIJAYA M.S. & RANGARAJAN G, (2003), *Material Science*, Tata Mc Graw Hill.

References Books

1. WILLIAM D CALLISTER & DAVID G RETHWEISCH, (2013), Materials science and Engineering An Introduction, John Wiley and Sons
2. NARULA G.K., NARULA K.S., & Gupta V.K., (2007), *Material science*, Tata Mc Graw Hill.
3. MILTON OHRING, (1995), *Engineering Materials Science*, Academic Press.
4. RAJENDRAN.V, (2011), *Material Science*, Tata Mc Graw Hill.

UG12T2303	Hydrostatics & Stability	L	T	P	C	Hrs
		3	0	4	5	126

Objective: To Understand the basic concepts of stability of ship

Unit – I: Introduction **5 Hrs**

Hull form definition of ships, offset table; laws of floatation and equilibrium.

Unit - II: Integration rules **8 Hrs**

Numerical integration formulae to obtain areas, volumes, moments and moment of inertia and buoyancy; Bonjean calculations and curves; hydrostatic calculations and curves.

Unit –III: Stability **15 Hrs**

Initial stability of floating and submerged body, stability at small angles of inclinations, wall sided formula, stability at large angles of inclinations. Curve of static stability - angle of loll, cross curves of stability - effect of addition and removal of weights, internal shift of weights - suspended weights - free surface effect due to partial filling of tanks. Effect of free flooding of a compartment - permeability – determination of GM - inclining experiment.

Unit –IV: Dynamic Stability **12 Hrs**

Work done against wind heeling moment, heeling during turning, heeling during asymmetric towing - IMO stability criteria - instability during dry docking and grounding.

Unit–V: Damaged stability **14 Hrs**

Longitudinal sub-division of ships – standards of sub-division - margin lines - criterion of service - factor of subdivision – permeability - floodable length and curves - permissible length - Probabilistic and deterministic damage stability-Launching calculations.

Practical **72 Hrs**

An assignment will be given to manually project any given ship data in the form of offsets table into three orthogonal 2D views and inter-match them by cross fairing.

Calculations will be performed to obtain the Bonjeans and Hydrostatics.

Text Books

1. EDWARD V. LEWIS, (1988), *Principles of Naval Architecture series Intact Stability Volume I: Stability & Strength*, Society of Naval Architects and Marine Engineers.
2. RAWSON K J. and E.C. TUPPER, (2001), *Basic Ship theory Volume I*, Fifth Edition, Butterworth Heinmann.

Reference Books

1. COLIN S. MOORE, (2010), *Principles of Naval Architecture series: Intact Stability*, Society of Naval Architects and Marine Engineers.
2. ERIC TUPPER, (2013), *Introduction to Naval Architecture*, Fifth Edition, Butterworth Heinmann.
3. ADRAIN BIRAN RUBEN LPEZ PULIDO, (2013), *Ship Hydrostatics and stability*, Second edition, Butterworth Heinmann.
4. BELENKY V.L. and N.B. SEVASTIANOV, (2007), *Stability and safety of ships Risk of Cap sizing*, Society of Naval Architects and Marine Engineers.

UG12T2304	Fluid Mechanics & Machines	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To understand the fundamentals of fluid properties, flow kinematics, conservation laws and applications of fluid fundamentals to practical aspects like pipe flow, fluid machines.

Unit-I: Basics of flow **24 Hrs**

Properties of fluids - pressure measurement and manometers - hydrostatic forces on surfaces - buoyancy and floatation - liquids in relative equilibrium. Classification of flows - fluid kinematics - continuity equation - acceleration of a fluid particle - rotational and irrotational flow - circulation and vorticity - velocity potential - stream function.

Equations of motion and energy equation - Euler's equation of motion - conservation of energy - Bernoulli's equation - applications – venturimeter - pitot tube - other flow measurement devices - vortex motion - free liquid jet. Impulse momentum equations - force on a pipe bend - jet propulsion - momentum theory of propellers - moment of momentum equation.

Dimensional Analysis and Modelling Similitude - Fundamental and derived dimensions - Rayleigh method - Buckingham theorem - formation of dimensionless groups.

Unit-II: Flow through pipes **16 Hrs**

Types of flow – Reynold's experiment - laws of fluid friction - Froude's experiments - Darcy-Weisbach equation and other formulae for head loss in pipes due to friction - other energy losses in pipes - pipes in series and parallel - equivalent pipe - concept of siphon - concept of water hammer in pipes.

Unit-III: Impact of Jets & Turbines **16 Hrs**

Hydrodynamic force of jets on stationary and moving plates – flat - inclined and curved vanes - jet striking centrally and at tip - velocity triangles - inlet and outlet - expressions for work done and efficiency;

Hydraulic Turbines - Classification of hydraulic turbines - impulse and reaction turbines –working and application - Pelton wheel - reaction turbines - inward radial flow - Francis turbine - axial flow reaction turbine - Kaplan turbine. Performance of Turbines - Specific Speed - determination - significance. unit quantities - unit speed - unit discharge and unit power - performance and characteristic curves of hydraulic turbines - main - operating and constant efficiency curves - governing of hydraulic turbines.

Unit-IV: Pumps **10 Hrs**

Rotodynamic Pumps - Classification – mixed – axial – principle and application. Centrifugal Pumps - Main parts - work done by the impeller and head of the pump – efficiency – minimum speed for starting - specific speed of acentrifugal pump - priming of a centrifugal pump. Performance of pumps - Characteristic curves - concept of Net Positive Suction Head (NPSH) - cavitation. Positive Displacement Pumps - Fundamentals principle of positive displacement pumps –reciprocating type - advantages and disadvantages.

Unit-V: Hydraulic Devices **6 Hrs**

Hydraulic press - hydraulic accumulator - differential hydraulic accumulator - hydraulic intensifier - hydraulic ram - hydraulic lift - hydraulic crane - fluid coupling - hydraulic torque converter.

Text Books

1. MODI P.N. & SETH S.M. (2007), *A Text Book of Fluid Mechanics and Hydraulic Machines*, Standard Book House New Delhi.

2. BANSAL R.K., (2005), *Fluid Mechanics and Hydraulic Machines*, Laxmi Publications, New Delhi.
3. SUBRAMANYA, K. (2010), *Fluid Mechanics & Hydraulic Machines Problems and Solutions*, Tata Mc-Graw Hill Publishers.

Reference Books

1. RAJPUT R.K., (1998), *A Text Book of fluid Mechanics and Hydraulic Machines*, S. Chand & Co., New Delhi.
2. SOM S.R., & BISWAS, (1998), *Introduction to fluid Mechanics and fluid Machines*, Tata Mc Graw Hill Publishers.
3. MOHANTY A.K., (1994), *Fluid Mechanics*, Prentice Hall of India.
4. WHITE FRANK M., (2011), *Fluid Mechanics*, Tata Mc Graw Hill.

UG12T2305	Strength of Materials	L	T	P	C	hrs
		3	1	0	4	72

***Objective: To understand the fundamentals of how materials behave under action of forces like tension, compression, shear, bending, and torsion*.**

Unit-I: Stresses and Strains **15 hrs**

Concept of Stress and Strain - relationship in deformable solids - Normal, shear and hydrostatic stresses – strains - Poisson's Ratio --elastic constants - Uni-axial loading - Thermal Stress - Compound Stress and Strain - Principal plane & principal stresses - principal strains. Mohr's Diagrams –

Unit – II Shear and Torsion **15 Hrs**

Combined bending and Twisting, Equivalent bending moment and Torsion, shear, bending and torsion, Theories of failure. strain energy in Simple Stresses: Strain Energy - due to normal, Shear and Impact loads. - Resilience. Torsion - Twisting of solid and hollow shafts, Stiffness and Strength. Power and Torque relation. Torsion applied to closed coil springs, springs with axial load, Calculations for mean diameter of springs, wire diameter & number of coils. Strain Energy in torsion.

Unit-III: Bending Stress **12 Hrs**

Shearing Force and Bending Moment - Sign Convention, Relation between Intensity of Loading, Graphical construction of Bending Moment & Shear Force diagrams - Bending Stress - Pure Bending - 2^{nd} moment of area- Stresses due to bending -

Unit-IV: Beams **15 hrs**

Strain energy due to bending. Application of impact. Deflection by integration, Macaulay's Method. Moment area Methods of deflection coefficient. Deflection due to shear, Deflection by graphical method.

Applied problems. Built-in and continuous beams - Moment-area method, built-in beam with central concentrated load, built-in beam with uniformly distributed load, with load not at center, Macaulay's method, Continuous beam, Claperyron's three moment theorem. Applied problems.

Unit-V Shells and Columns **15 Hrs**

Thin Walled Shells: Shells subjected to internal pressure; submersibles. Strengthening of Thin Walled Shells. Effect of temperature; volumetric strain on capacity. Thin Curved bar - Strain energy due to bending Castigliano's theorem, and its application to curved bars, strain energy due to twisting. Applied problems. Thick Cylinders - Lame's theory, compound cylinders, solid shaft subjected to radial pressure, shrinkage allowance. Applied problems. Columns theory - Euler's theory and Euler's buckling load. Columns with different end conditions - eccentric load, Rankine-Gordon Formula.

Text Books

1. PRAKASH RAO, D.S. (2004), *Strength of Materials A Practical Approach Volume – I,* Universities Press
2. RATTAN, S.S. (2011), *Strength of Materials*, Tata Mc Graw Hill

Reference Books

1. BHAVIKATTI, S.S. (2013) , *Strength of Materials*, Vikas Publishing house
2. BANSAL R.K. (2010), *Strength of Materials*, Laxmi Publications.
3. JOHN CASE, LORD CHILVER, CARL T.F. ROSS (2003), *Strength Of Materials and structures*, Butterworth Heinmann.
4. MOTT R.L. (2015), *Applied Strength of Materials*, CRC Press.

UG12T2306	Electrical & Electronics Engineering	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To provide basics in Electrical circuits, electrical machines and principles of digital electronics

Unit – I: Introduction **18 Hrs**

Ohms law - Kirchhoff's Laws - series and parallel circuits - source transformations - delta-wye conversion -linearity and superposition theorem with simple examples - The venin's and Norton's theorem with simple examples - maximum power transfer theorem with simple examples -Mesh analysis - nodal analysis - super node - Basic principles of electrical machines - D.C. generators-construction details-principle of operation-emf equation-methods of excitation-simple problems - D.C. motors-principle of operation-back e.m.f.-speed and torque equations-characteristics-losses-efficiency-applications of shunt - series and compound wound motors-simple problems.

Unit – II: Poly phase circuits **9 Hrs**

Generation of poly phase voltage-phase - difference-vector representation comparison between single phase and three phase systems-star and delta connection-current - voltage and power in three phase systems-balanced and unbalanced three phase circuits- power measurements in three phase circuits using single wattmeter and three wattmeter methods.

Unit – III: AC Machines **9 Hrs**

Alternators- principle of operation-types-emf equation (winding factor need not be derived)-synchronous speed-Synchronous motors-principle of operation and method of starting-three phase induction motors-construction details of squirrel cage and slip ring motors-slip speed-single phase induction motors-principle of operation-types.

Unit - IV: Transformers **18 Hrs**

Principle and theory of an ideal transformer - Constructional features of single phase transformer-core type-shell-type- emf equation- turns ratio-no load vector diagram-transformer on load- equivalent circuit-impedance transformation- transformer losses - efficiency- open circuit and short circuit tests-estimation of equivalent circuit parameters. Auto transformer – working principle - basics of current transformer - potential transformer and three phase transformer -D.C. and A.C. transmission and distribution-two wire and three wire d.c. system - use of balancer - a.c. transmission single phase and three phase -three wire and four wire distribution - comparison of d.c. and a.c. transmission - effect of voltage drop - copper utilization under different systems - single and double fed distributors - fuses - d.c. air circuit breaker - a.c. air and oil circuit breakers - HV & LV switch gears

Unit - V: Semiconductor Diodes **18 Hrs**

Basic operating principle - current-voltage characteristics - rectifier circuits (half-wave - full-wave - and rectifier with filter capacitor) - Zener diode - clipper and clamper - LED -Bipolar junction transistor (BJT): Modes of Operation: NPN and PNP transistors in active mode - BJT as an amplifier and switch - Metal oxide semiconductor field effect transistor (MOSFET)-operation of N type and P-type MOSFET - MOSFET as an amplifier and switch.

Text Books

1. B.L THERAJA, A.K. THERAJA, (2006), *A Text Book of Electrical Technology Volume –I and II*, S. Chand Publishers.
2. KOTHARI, (2000), *Basic Electrical and Electronics Engineering*, McGraw Hills Publishers.

References Books

1. HUGHES EDWARD, (1995), *Electrical Technology*, Addison Weisley.

2. V.K. MEHTA, (1990), *Basic Electrical and Electronic Engineering*, PHI Publisher.
3. VINCENT DEL TORO, (2001), *Basic electrical Engineering*, Second edition, Prentice Hall of India, 2nd Edition.

UG12P2301	Electrical & Electronics Engineering Lab	L	T	P	C	Hrs
		0	0	4	2	72

Electrical Engineering:

1. To measure the armature and field resistance of a DC machine.
2. To calibrate a test (moving iron) ammeter and a (dynamometer) Wattmeter with respect standard (DC PMMC) ammeter and voltmeters.
3. Verification of circuit theorems, Thevenin's and superposition theorems (with DC sources only).
4. Measurement of current, voltage and power in R-L-C series circuit exited by single-phase AC supply.
5. Open circuit and short circuit tests on a single-phase transformer.
6. Connection and starting of a three-phase induction motor using direct on line (DOL) or star delta starter.
7. Connection and measurement of power consumption of a fluorescent lamp and voltage current characteristics of incandescent lamps.
8. Determination of open circuit characteristics (OCC) or a DC generator.
9. Two-wattmeter method of measuring power in three-phase circuit (resistive load only).

Electronics:

1. Familiarization of electronic equipment and components
2. Studies on Logic gates
3. Using studies on RC and CR networks
4. Studies on Rectifiers and Zener diode regulation
5. Studies on Op. Amp Applications
6. Studies on Flip-Flops and Counters
7. Design or a CE Amplifier
8. Application of Timer 555 chip

UG12P2302	Material Testing Lab	L	T	P	C	Hrs
		1	0	2	2	54

1. To study the stress strain characteristics (tension & compression) of metals by using UTM.
2. Determination of compressive strength of wood
3. Determination of hardness using different hardness testing machines-Brinell's, Vicker's, and Rockwell's scales.
4. Impact Test by using Izod and Charpy Methods.
5. Deflection test on beams using UTM.
6. Direct shear test on MS rods.
7. To find stiffness and modulus of rigidity of steel by conducting compression test on springs.
8. Torsion test on circular shafts.
9. Fatigue test on mild steel specimen

UG12T2401	Engineering Mathematics-IV	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To provide basic concepts of numerical methods and give procedures for solving complex engineering problems numerically.

Unit–I: Solution of Equations and Eigen Value 18 Hrs

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel –Matrix Inversion by Gauss Jordan method- Eigen values of a matrix by Power method.

Unit – II: Interpolation and Approximation 15 Hrs

Interpolation with unequal intervals -Lagrange's interpolation –Newton's divided difference interpolation – Cubic Splines – Interpolation with equal intervals -Newton's forward and backward difference formulae.

Unit-III: Numerical Differentiation and Integration 15 Hrs

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's rule – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

Unit –IV: Initial value problems for Ordinary Differential Equations 12 Hrs

Single Step methods -Taylor's series method - Euler's method – Modified Euler's method - Fourth order Runge–Kuttamethod for solving first order equations – Multi step methods - Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

Unit – V: Boundary Value problems in ordinary and partial differential Equations 12 Hrs

Finite difference methods for solving two – point linear boundary value problems –Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method

Text Books

1. ERWIN KREYSZIG, (2010), *Advanced Engineering Mathematics,* Wiley International.
2. GERALD C.F. & WHEATLEY P.O., (2006), *Applied Numerical Analysis, 6th Edition,* Pearson Education, New Delhi.

Reference Books

1. CHAPRA S.C. & CANALE R.P., (2007), *Numerical Methods for Engineers 5th Edition*, Tata McGraw Hill, New Delhi.
2. BRAIN BADIE, (2007), *A friendly Introduction to Numerical Analysis*, Pearson Education, New Delhi.
3. SANKARA RAO K., (2007), *Numerical Methods for Scientists and Engineers 3rd Edition,* Prentice hall of India Pvt Ltd, New Delhi.
4. GREWAL B.S. & GREWAL J.S., (2007), *Numerical Methods in Engineering Mathematics 9th Edition*, Khanna Publishers, New Delhi.

UG12T2402	Hydrodynamics	L	T	P	C	Hrs
		3	1	0	4	72

Objective:

- ***To understand fluids under dynamic conditions and effects of viscosity***
- ***To perform dimensional analysis and understand forces on bodies under dynamic condition***

Unit – I: Kinematics of fluid flow **18 Hrs**

Introduction **-** Types of fluid flow **-** continuity equation - Velocity and acceleration - potential and stream function - Types of motion - Vortex flow -Ideal Flow-Introduction - Important cases of potential flow - uniform flow - source - sink - free- vortex - super imposed flow – source and sink pair - doublet - plane source in uniform flow - source and sink pair in uniform flow - doublet in uniform flow - steady translation of a cylinder in an infinite fluid medium- magnus effect.

Unit – II: Dynamics of fluid flow **9 Hrs**

Introduction – Equation of motion – Euler's equation of motion – Bernoulli's equation – Assumptions - problems - practical application - Momentum equation – Problems.

Unit - III: Viscous Flow **9 Hrs**

Viscosity of fluids - Flow through a pipe of circular section - flow of fluid between parallel plates – Couette flow - Poiseuille flow - Navier-Stoke equation of motion - flow through pipes – major & minor losses - pipes in series & parallel - branched pipes with illustrations.

Unit – IV: Dimensional and modal Analysis **20 Hrs**

Introduction - Dimensional Homogeneity - Method of Dimensional Analysis - Modal Analysis - Similitude types - Dimensionless numbers - similarity laws - classification of models- Boundary Layer flow - Introduction -

Definitions drag force on flat plate due to boundary layer - turbulent Boundary Layer on flat plate - total drag on flat plate due to laminar and turbulent layer - Separation of Boundary Layer - problem.

Unit – V: Forces on Submerged Bodies **16 Hrs**

Introduction - Force Exerted by a flowing fluid on a stationary body - drag, lift forces – expression Drag on sphere – cylinder - Development of lift on circular cylinder, Aero foils - Lift – drag - circulation - pressure distribution - theory of thin air foils - wings of infinite and finite span - circulation distribution - Cavitation. Two dimensional aerofoils – Joukowski aerofoils

Text books

1. MODI P.N. & SETH S.M., (2007), *A text Book of fluid Mechanics and Hydraulic Machines*, Standard Book House, New Delhi.
2. BANSAL R.K., (2005), *Fluid Mechanics and Hydraulic Machines*, Laxmi Publications, New Delhi.
3. K.SUBRAMANYA, (2010), *Fluid Mechanics & Hydraulic Machines Problems and Solutions*, Tata McGraw Hill.

Reference books

1. BATCHELOR G.K., (2012), *An introduction to Fluid Dynamics*, Cambridge University Press, New Delhi.
2. SOM, S.R. & BISWAS, (1998), *Introduction to fluid mechanics and Hydraulic machines*, Tata McGraw Hill.
3. Milne Thompson L. M. (1996) *Theoretical Hydrodynamics*, Dover Publications.
4. WHITE FRANK M., (2011), *Fluid Mechanics*, Tata McGraw Hill.
5. Chorlton, F, (2004), Text of Dynamics, CBS Publications.

UG12T2403	Applied Thermodynamics	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To understand the principles, laws and properties associated with thermodynamic variables and apply the same to physical systems.

Unit-I: Entropy **15 Hrs**

Definition - Principles of increase of entropy - calculation entropy for various processes - Available Energy and Availability - Helmholtz and Gibbs functions - Availability in steady flow - Entropy equation for flow processes – irreversibility.

Unit-II: Thermal Cycles **15 Hrs**

Properties of Pure Substances - Definitions - p-V, p-T, T-s and h-s diagrams for a pure substance - quality – Steam Tables - Charts for thermodynamics properties - Measurement of steam quality - Vapour Power Cycles - Rankine cycle - Comparison of Rankine and Carnot vapor cycles - Regenerative cycles - Ideal working fluid for vapor power cycles.

Unit-III: Internal Combustion Engines and Compressors 15 Hrs

Air standard Otto - Diesel and Dual cycles - C. I. and S. I. engines - Four stroke and two stroke cycles - Indicated Power - Brake Power - Mechanical - Thermal and relative efficiencies. Valve timing Diagram. Gas turbine basic cycle- Brayton cycle - work done and efficiency. Stirling cycle - work done and efficiency

Air compressors: Working principles of reciprocating air compressors - volumetric efficiency - effect of clearance - single and multistage compressors with intercooling - optimum inter-stage pressure - air motors and other application of compressed air.

Unit-IV: Heat exchangers **12 Hrs**

types of heat exchangers and construction - basic heat exchanger flow arrangements – parallel - counter flow - mixed - multi-pass flow exchangers - heat transfer concepts - fouling - LMTD - effectiveness-NTU method

Unit-V: Refrigeration & Air-conditioning **15 Hrs**

Basic concept of vapour compression cycle - components of the vapour compression refrigeration system - refrigerants and their properties.

Need for air conditioning - comfort zone - use of psychrometric charts - basic air conditioning cycle - components of the system - components in AHU's various types of a.c systems - important factors for calculating the cooling load requirement.

Text Books

1. NAG P.K., (2010), *Basic & Applied* Thermodynamics, Tata McGraw Hill, New York, USA.
2. RAJPUT R.K, (2009), *Applied Thermodynamics*, Laxmi Publications, New Delhi.

Reference Books

1. EASTOP T.D, MCCONKEY A., (2009), *Applied Thermodynamics for Engineering Technologists*, Pearson Education, London, UK.
2. BOLES MICHAEL, CENGL YUNUS (2014), *Thermodynamics: An Engineering Approach*, McGraw Hill Education, New York, USA.
3. MICHAEL J. MORAN, HOWARD N. SHAPIRO, DAISIE D. BOETTNER, MARGARET B. BAILEY, (2011), *Fundamentals of Engineering Thermodynamics*, John Wiley & Sons, USA.
4. RUDRAMOORTHY R., (2003), *Thermal Engineering*, Tata McGraw Hill, New York, USA.

UG12T2404	Ship Structures - I	L	T	P	C	hrs
		3	1	0	4	72

Objective: To introduce basic principles of ship structural design with specific focus on beams, girders, plates, shells and stiffened panels.

Unit – I: Philosophy of Hull Structure Design **18 Hrs**

Importance of hull structure design - design procedure of structures - hull structure design policy - basic idea of hull structure design - studies on loads applied - reliable design -Structural Design Loads- Introduction - Longitudinal Strength Load - Transverse Strength – Load Ship Response Calculation in Waves - Strip Method - Short-Term Prediction - Long-Term Prediction – Materials - Hull Steel - Grades of Steel - Higher-Strength Steel - Steel Sections - Other Materials, Scattering of Material Properties - Scattering of Physical Properties - Residual Stress.

Unit - II: Design of Beams **10 Hrs**

Effective Breadth of Attached Plates - Span Point of Beams - Design of Cross Section - Bending Moment - Easy Solution of Statically Indeterminate Beams - Boundary Conditions - Cross-Sectional Area of Beams - Optimum Design of Beam Section - Simply Supported Beams and Continuous Beams - Effect of Struts - Additional Bending Moment due to Forced Displacement- Lateral Movement of Beams.

Unit - III: Design of Girders **10 Hrs**

Shearing Force, Rational Design of Girders - Bottom Transverses Supported by Centre line Girder - Deflection of Girders- Design of Pillars - Slenderness Ratio of Pillars - Sectional Shape of Pillars - Pillar Supporting Tensile Force - Connection of Pillar at Top and Bottom - Cross Ties - Radius of Gyration of Square Section.

Unit – IV: Theory of plates and shells **16 Hrs**

Love Kirchhoff assumptions - Implications - governing equation - solution using strain energy method - Levy' s method - Navier Method - Relevant equations for circular plates - Large deflection of plates - Buckling of plates - Analysis of stiffened plates - Buckling of stiffened plates - Linear and buckling analysis of unstiffened and stiffened cylindrical shells.

Unit – V: Design of Plates and stiffened Panels **18 Hrs**

Strength of Plates Under Lateral Loads - Strength of Plates by In-Plane Loads Plates Supporting Bending and Compression - Simultaneously - Stress Concentration Around Openings - Material and Roll Direction - Grillage Structure - Optimum Space of Girders - Optimum Space of Beams - Introduction to finite element method - Nodes - elements - mesh - shape functions - Development of relevant matrices - stiffness matrix - load vector - mass matrix and damping matrix - Examples of truss - beams - various plate finite elements.

Text Books

1. OKUMOTO Y, TAKEDA Y, MANO M, OKADA T, (2009), *Design of Ship Hull structures A practical Guide for Engineers,* Springer Publishers.
2. YONG BAI , WEI LIANG JIN, (2016), *Marine Structural Design*, Elsevier Publishers.

Reference Books

1. WILLIAM MUCKEL, (1967), *Strength of Ship Structures*, Edward Arnold Publications.
2. ALA MANSOUR, DONALD LIU, (2008), *Strength of Ship Ocean Structures*, SNAME Publications.
3. MOHAMMED SHAMA, (2010), *Torsion & Shear stresses in Ships*, Springer Publishers.

4. JEOM KEE PAIK, ANIL KUMAR, THAYAMBALLI, (2004), *Ultimate Limit State Design of Steel Plated Structures*, John Wiley & Sons Publishers.

UG12T2405	Ship Construction	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To impart the knowledge on shipbuilding materials, joining techniques, structural arrangement and outfitting of ships.

Unit –I: Shipbuilding materials and Joining techniques 10 Hrs

Ship building materials – transition from wood to steel, shipbuilding quality steels (properties, steel grades) – Riveting - Welding - Fusion welding methods – manual metal arc welding, gas metal arc welding, submerged arc welding, electro gas welding, electro slag welding, single side welding, multi electrode welding - Weld joints (butt joints, fillet joints, lap joints) - Welding symbols.

Unit – II: Ship structural systems 10 Hrs

Ship as stiffened plate structure – framing systems, common stiffener sections, corrugated construction, design of strakes (butts, seams), welding sequences, shell expansion - Structural subsystems – break up into bottom structure, side structure, deck structure, bulkhead structure, end structure, superstructure etc., general structural arrangements of different types of ships.

Unit –III: Bottom structure and Side structure 16 Hrs

Bottom structure – framing system, functions, single bottom and double bottom construction, structural components and scantlings, openings, cut outs, connection details, bilge keel - Side structure – framing system, functions, structural components - Decks and Bulkheads - Deck structure – functions, framing system, structural components, hatch ways, pillars - Bulkhead structure – type of bulkheads, functions, framing system, structural components.

Unit –IV: End structures **16 Hrs**

Fore end structure – functions, structural arrangements (panting), structural components - After end structure – functions, structural arrangements, structural components - Structural connections – compatibility, bottom & side, side & deck, bulkhead with deck, side & bottom - Chain locker and hawse pipe - Rudder construction.

Unit –V: Engine Room, Super structure, Outfitting **20 Hrs**

Engine room – functions, general arrangement, engine casing, foundations - Superstructure and Deckhouses – functions, structural arrangement, effectiveness of superstructure & deckhouse, expansion joints - Bulwarks - Outfitting – Hatch covers, closing appliances for openings on deck and exposed bulkheads, mooring equipment and arrangements, fenders, railings, deck fittings, masts, insulation and panelling.

Text Books

1. EYRES D.J., (2011), *Ship Construction*, William Heinemann Ltd, London.
2. N. R. MANDAL, (2017), *Ship Construction and Welding*, Springer.

Reference Books

1. YONG BAI, (2003), Marine Structural Design, Elsevier Science.
2. TAGGART, (1980), *Ship Design and Construction*, Society of Naval architects and Marine Engineers.
3. D A Taylor, 1992, Merchant Ship Construction, Institute of Marine Engineers.
4. RICHARD LEE STORCH, COLIN P. HAMMON, HOWARD MC, RAVEN BUNCH & RICHARD C. MOORE, (1995), *Ship Production*, Society of Naval Architects and Marine Engineers.

UG12T2406	Marine Systems	L	T	P	C	hrs
		3	1	0	4	72

Objective: To develop primary knowledge in Auxiliary Machinery and systems, Deck machinery, instrumentation and control.

Unit–I: Pumps and Pumping Systems 12 Hrs

General pumping system characteristics- Classification of Pumps- Displacement - Axial-flow - Centrifugal Pumps- Screw pumps - Ejectors- Piping – various types of piping system fitted in ships- Expansion arrangements for pipes - valves - types of valves and pipes used in Marine Practice- Materials and corrosion in pipes - colour coding for pipes.

Unit - II: Auxiliary Machinery & Systems 28 Hrs

Air compressors- heat exchangers- evaporators- distillers - hot water and drinking water systems - cooling water and sea water systems- Fuel systems - lubricating oil system - filters - coolers - centrifuges - purifiers – Sewage disposal - Oily water separator - incinerator - IMO/MARPOL regulations - Refrigeration system - HVAC. Design of typical ship systems such as Bilge - Fire & Ballast - SW and Fresh water-cooling systems - Ventilation systems - Safety systems – L.S.A. Boats & rafts - emergency equipment - firefighting systems & equipment - IMO/Class& Statutory Regulations.

Marine boilers: Types - fire tube - water tube boilers - Mounting on Boilers- auxiliary steam plant systems - exhaust gas boilers - composite boilers. Boiler mounting - combustion - feed system - feed water treatment - Boiler capacity - evaporation rate -Waste heat recovery from engine exhaust.

Unit - III: Cargo Handling & Deck machinery 12 Hrs

Mooring - anchor handling - Anchors - anchor chains - cargo handling - dry cargo handling equipment - winches - cranes - cargo hatch covers -

liquid cargo tanker systems - Gas cargo systems - cryogenic fluids handling systems - Ballast systems.

Unit–IV: Steering, Navigation & Communication 8 Hrs

Steering gears in marine use – different types – description. Shafting arrangements -stern tubes and glands - oil lubricated stern tubes - shaft seals - shaft alignment - keyless propellers/CPP system and Thrust block - reduction gearing- Shaft grounding system of ICCP. Roll stabilizers and bow thrusters - Auto Pilot - Magnetic & Gyro Compass - Doppler Log - Echo Sounder - RADAR - ARPA - GPS & DGPS - AIS and LRIT - Ariel's and Antennae fitted on board Ships - Communication systems - HF, VHF, SATCOM, NAVTEX and GMDSS - internet on ships - Introduction to EMI/EMC. Introduction to Ergonomics.

Unit –V: Basic Instrumentation & control 12 Hrs

Various Measuring instruments for Pressure - Temperature - Flow - Oxygen analyzer- Introduction to Control Theory- Closed loop - Two Step control - P,I,D control system - Basic theory - sensors - transmitters and actuators - typical control system for engine cooling water - boiler feed water -UMS and its requirements. Introduction to digital control systems -

Text Books

1. TAYLOR D.A., (1990), *Introduction to Marine Engineering*, second Edition, Butter worth Heinmann publication .
2. MC GEORGE H.D., (1995), *Marine Auxiliary Machinery*, 7th Edition, Butter Worth Heinmann.

Reference Books

1. HARRINGTON L.R., (1980), *Marine Engineering*, SNAME Publications
2. TECHNICAL & RESEARCH BULLETIN 3-49, (1990), *Marine Diesel Power Plant Practices*, SNAME Publishers.

3. ROWEN, ALAN I FEMENIA, JOSE, (2006), *Introduction to Practical Marine Engineering*, SNAME Publishers.
4. Anthony F. MOLLAND, (2008), *The Maritime Engineering*, Butterworth.

UG12P2401	Fluid Mechanics Lab	L	T	P	C	Hrs
		0	0	4	2	72

FLUID MECHANICS LABORATORY EXPERIMENTS

1. Calibration of Venturimeter
2. Calibration of orifices
3. Calibration of notches
4. Resistance characteristics of pipes – friction factor
5. Impact of a jet on a circular disc
6. Performance characteristics of centrifugal pump
7. Performance characteristics of reciprocating pump
8. Performance characteristics of Pelton Wheel turbine
9. To determine GM (metacentric height) of a floating body

UG12P2402	BASIC DESIGN SOFTWARE LAB	L	T	P	C	Hrs
		1	0	4	4	90

The student must complete the folllowing in any one of the ship design software Package

1. Hull modelling
2. Tanks and Compartment definition
3. Intact Stability calculation
4. Damage Stability calculations

UG12T2501	Resistance & Propulsion	L	T	P	C	Hrs
		3	1	0	4	72

Objective: Provide fundamental understanding of various ship resistance components, basics of ship propulsion and experimental methodologies

Unit – I: Ship resistance **20 Hrs**

Dynamic similarity- Froude hypothesis - Viscous resistance - Laminar and turbulent flows - Effect of roughness - Friction line- Form resistance - Wave resistance - Kelvin wave pattern and waves generated by a ship - Wave interference - effect of bulbous bow - Air resistance - Appendage drag Ship resistance in shallow water - Resistance data presentation; Estimation of effective power - methodical series and statistical methods- Hull form and resistance - Ship model tests and resistance data presentations- comparison of resistance prediction with results of full-scale trials.

Unit - II: Propeller Theory & propeller hull Interaction **12 Hrs**

Screw Propellers - Propeller Geometry - Propeller Blade Sections - Alternative Definition of Propeller Geometry – Pitch - Non-dimensional Geometric Parameters - Mass and Inertia. Axial Momentum Theory - Momentum Theory Including Rotation - Blade Element Theory - Circulation Theory. Propeller in Open Water **-** Laws of Similarity - Dimensional Analysis - Laws of Similarity in Practice - Open Water Characteristics - Methodical Series Data – Alternative Forms of Propeller Coefficient. Propeller Behind The Ship – Wake - Thrust Deduction - Relative Rotative Efficiency - Power Transmission - Propulsive Efficiency and its Components - Estimation of Propulsive Factors

Unit – III: Cavitation & Strength of Propellers **8 Hrs**

Phenomenon of Cavitation - Cavitation Number - Types of Propeller Cavitation - Effects of Cavitation - Prevention of Cavitation - Cavitation

Criteria – Pressure distribution on a Blade section. Strength of Propellers - Bending Moments due to Thrust and Torque - Bending Moment due to Centrifugal Force - Stresses in a Blade Section – Approximate Methods – classification society Requirements - Propeller Materials.

Unit – IV: Model Experiments & Ship Trials 18 Hrs

Resistance Experiments - Open Water Experiments - Self-propulsion Experiments - cavitation experiment. Propeller Design **-** Propeller Design Approaches - General Considerations in Propeller Design - Propeller Design Using Methodical Series Data – Design of towing duty propeller – engine propeller Matching- Ship Trials and Service Performance.

Unit - V: Unconventional Propulsion Devices 14 Hrs

Paddle Wheels - Controllable Pitch Propellers - Ducted Propeller - Contra-rotating Propellers- Tandem Propellers - Overlapping Propellers - Other Multiple Propeller Arrangements - Vane Wheel Propellers - Other Unconventional Screw Propellers - Cycloidal Propellers - Flow Improvement Devices.

Text books

1. EDWARD V. LEWIS, (1988), *Principles of Naval Architecture volume II: Resistance & Propulsion and Vibration*, Society of Naval Architects and Marine Engineers Publications.
2. GHOSE P. & GOKARN R.P., (2015), *Basic Ship Propulsion*, Knowledge World Publishers Pvt Ltd.

Reference Books

1. JOHN CARLTON, (2012), *Marine Propellers and Propulsion 3rd Edition*, Butterworth Heinmann.
2. SV.AA. HARVARD, (1983), *Resistance and Propulsion of ship*, Wiley Inter science Publications.

3. MOLLAND F., DOMINIC A. HUDSON & STEPHEN R. TURNOCK, (2011), *Ship resistance and Propulsion*, Cambridge University Press.

4. LARS LARSSON & HOYTE C. RAVEN, (2010), *Principles of Naval Architecture Ship Resistance & Flow,* Society of Naval Architects and Marine Engineers Publications.

UG12T2502	Ship Structures – II	L	T	P	C	Hrs
		3	1	0	4	72

***Objective: This course is a successor to the course Ship Structures-I, with the focus on the strength aspects of the hull girder, hull girder vibrations and reliability aspects in ship structures*.**

Unit – I: Deflection of Hull Structures 6 Hrs

Deflection of hull girder - deflection of beams with optimum section - deflection of girders and web frames - additional stress caused by deflection - shearing deflection.

Unit-II: Longitudinal Strength of Hull Girder 14 Hrs

Allowable stress for longitudinal strength - position of maximum longitudinal bending moment - calculation of section modulus of hull girder - longitudinal strength and hull steel weight - application of high tensile steel - longitudinal strength analysis in waves - arrangement of longitudinal strength members - stress concentration on longitudinal strength members - additional bending of local members due to hull girder bending - longitudinal bending stress in fore & aft parts of ship.

Unit – III: Transverse Strength of Ship 20 Hrs

Allowable stress for transverse strength - long taper &snake head - shape of bottom transverse in centre tank - shape of bottom transverse in wing tank - transverse strength of tanker - transverse strength of ore carrier - transverse strength of bulk carrier - transverse strength of container ships - torsion of hull girder **-** loads – cargo torque and wave torque - torsion of beams torsion in uniform thin walled cross sections - torsion in closed and open cross sections - torsion in thin walled multi cell cross sections - torsion warping - deformations and stresses - sectional properties of thin walled open sections - torsion of container ships.

Unit –IV: Hull Structural Vibration **18 Hrs**

Introduction - basic features of hull structure vibration - overview of ship vibration - boundary conditions of hull structure vibration - current boundary conditions of hull structure vibration - fatigue and fracture theory **-** fatigue - types of loading - S-N curves - fatigue damage - fracture mechanics principles - LEFM (linear elastic fracture mechanics) - non-linear fracture mechanics - fracture toughness - crack propagation by Paris equation.

Unit – V: Reliability Analysis **14 Hrs**

Introduction to reliability theory - reliability framework in marine structures - concept of limit states - levels of reliability - methods of reliability estimates and limitations - reliability index - basic idea of FORM (First Order Reliability Method) and SORM (Second Order Reliability Method) - Ultimate strength of plates - stiffened plates and hull girder.

Text Books

1. YASUHISHA OKUMOTO, YU TAKEDA, MASAKI, MANO, TETSUO OKADA, (2009), *Design of Ship Hull structures: A practical Guide for Engineers*, Springer Publishers.
2. YONG BAI, WEI LIANG JIN, (2016), *Marine Structural Design, Elsevier* Publishers.

Reference Books

1. WILLIAM MUCKEL, (1967), *Strength of Ship Structures,* Edward Arnold Publications.
2. ALA MANSOUR, DONALD LIU, (2008), *Strength of Ship Ocean Structures,* SNAME Publications.
3. MOHAMMED SHAMA, (2010), *Torsion & Shear stresses in Ships,* Springer Publishers.

4. JEOM KEE PAIK, ANIL KUMAR, THAYAMBALLI, (2004), *Ultimate Limit State Design of Steel Plated Structures*, John Wiley & Sons Publishers.

UG12T2503	Design of Machine Elements	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To understand the basic aspects of design of machine elements with applications specific to common elements like joints, couplings, bearings, gears, springs, clutches, screw jacks, etc.,

Unit – I: Fundamentals of machine design **20 Hrs**

Definitions - design process - design principles - design criteria - Stresses in machine parts - working stress - safe stress - factor of safety endurance limits - fatigue factors - design for fluctuating loads - general properties of materials.

Unit – II: Joints **18 Hrs**

Principles of force transmission - detachable joints (pins, keys and bolted joints) - integral and removable flange couplings - drive elements - shafts - torsion and bending of shafts – design of shafts - keys and couplings

Unit - III: Shaft Couplings **10 Hrs**

Rigid coupling (flange and compression couplings) - couplings with kinematics flexibility - slip couplings - fluid couplings.

Unit – IV: Bearings **10 Hrs**

Sliding bearings - introduction to lubrication - hydrodynamic bearings - bearing materials - design of slide bearings - roller bearings- types - static & dynamic load - capacity - bearing life and selection of bearings - applications in marine industry.

Unit - V: Gears & Miscellaneous elements **14 Hrs**

Gears: Types (spur and parallel helical gears) and function of gears - terminology of gear teeth - strength of gear teeth - forces acting in gear teeth - interference in gears and how to avoid interference.

Clutches: Types of clutches and basic aspects of design to transmit power.

Screw jacks: Application - basic concept in design of screw jack - efficiency of screw jack

Elastic springs: Classification and uses of springs-allowable stresses and deflections.

Text Books

1. BHANDARI V.B., (2007), *Design of Machine Elements*, Tata Mc Graw Hill Publishers.
2. JINDAL U.C., (2010), *Machine Design* , Pearson Publications.

Reference Books

1. MOTT R.L., (2009), *Machine Design in Mechanical Design*, Pearson Education.
2. NORTON R.L., (2009), *Machine Design an Integrated Approach*, Pearson Education.
3. JACK A. COLLINS, HENRY R. BUSBY, GEORGE H. STABB, (2003) *Mechanical Design of Machine Elements and Machines*, John Wiley & Sons.
4. LINGAIAH, (2003), *Machine Design Data Book*, Mc Graw Hill Publishers.

UG12T2504	Physical Oceanography	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To develop an understanding of ocean environment in terms of sea water, ocean currents, tides and physical setting

Unit – I: Physical properties of sea water **10 Hrs**

Salinity and conductivity - Temperature - Density effects - Sound and light in the sea - Colour of sea water. Observational techniques-various methods in the collection of data.

Unit - II: Distribution of water characteristics **16 Hrs**

Vertical and geographical distribution of temperature - salinity and Density, temperature, salinity and density profiles. Dissolved constituents – oxygen, Carbon-di-oxide. Seasonal variation of dissolved constituents – global warming and dissolved carbon – ocean acidification.

Unit – III: Ocean currents **12 Hrs**

Wind induced surface currents - Geostrophic Current and Ekman Wind Drift Current - Ocean Current Estimation - Current measurements - thermocline circulation - Dynamic computation - General circulation of ocean waters – Westward intensification - Stommel and Munk's circulation models – regional current patterns around India.

Unit – IV: Tides and extreme events **12 Hrs**

Tide producing forces - tidal theories – equilibrium and dynamic theory – oceanic propagation – deformation of tidal wave on propagation – Kelvin waves - amphidromic points - tidal bores - tidal currents – tidal observation - Harmonic analysis – prediction – factors influencing the prediction - Long term effects – Basin oscillations Tsunamis and storm surge.

Unit - V: Ocean dimensions and Geological aspects 22 Hrs

Ocean boundaries - Geomorphology and structure of the Ocean floor - continental slope and shelf. Marine sediments, their formation types, distribution and classification - Distribution of marine minerals along the Indian Coasts - Placer deposits hydrocarbon deposits and polymetallic nodules - Exploration and exploitation of natural minerals off the coast. Coastal Processes – littoral drift - sediment transport along shoreline – implications - coastal upwelling - estuaries – types- estuarine circulation - Problem session.

Text Books

1. ROBERT H. STEWART, (2008), *Introduction to Physical Oceanography*, Department of Oceanography Texas A & M University.
2. TOM GARRISON, (1998), *Oceanography: An Invitation to Marine Science*, Wadsworth Publishing, California, USA.

Reference Books

1. Mc CORMICK, J.M. & THIRUVATHUKAL J.V., (1976) Elements of Oceanography, W.B. Saunders Company, Philadelphia.
2. L.D. TALLEY G.L. PICKARD W.L. EMERY J.H. SWIFT 2011 Descriptive Physical Oceanography An Introduction. Elsevier Publishers
3. GEORGE L. MELLOR, (1996), *Introduction to Physical Oceanography*, Springer, New York
4. BRUCE A.WARREN CARL WUNSCH, (1980), *Evolution of Physical Oceanography*, MIT press.

UG12T2505	Ship Production Technology	L	T	P	C	Hrs
		3	1	0	4	72

***Objective: To impart the knowledge of ship production i.e., fabrication of parts, assembly, erection of ship hull, launching and different technologies adopted in ship production*.**

Unit -I: Characteristics of Ship Building 12 Hrs

Characteristics of shipbuilding process as heavy and one off kind maritime industry - General principles on layout of shipyards - Relation with supply industry - Subcontractors - Storage and preparation of material, material handling - Transport system in steel stockyard - Material preparation (straightening of plates and rolled sections, shot blasting, pre painting) - Material preparation flow line devices and their control systems.

Unit – II: Fabrication of component parts 18 Hrs

Cutting process, tools, physical and chemical background of the cutting process, mechanical cutting, devices for thermal cutting - General description of the various machines - Photoelectric and NC control devices - Edge preparation - Problems of accuracy - Bending of rolled and built up sections, general description of bending, control of the bending process - Automation of bending - Plate bending, uniaxial bending, biaxial bending (devices, cold bending, heat line bending) - Possibilities of automated plate bending.

Unit –III: Assembly of Ship Structures 20 Hrs

Prefabrication – general remarks, basic problems of prefabrication, pattern of prefabrication - Welding in prefabrication - Data generation for ship building - Basic welding in shipbuilding, welding positions (1G, 2G, 3G etc.), standards, weld symbols – Subassemblies, built up T bars, web frames, machine foundations etc. - Welding deformation and straightening - Prefabrication of flat sections - Panels, panel production

line, preassembly of biaxial stiffened panels, welding procedures - Assembly of flat and corrugated sections - Flat sections with curvature, Assembly jigs - Preassembly of volume units – Preassembly of double bottom sections - Preassembly of side tank units - Preassembly of the fore and aft end structure - Preassembly and outfit of superstructure - Outfitting shops (Mechanical, Piping, Insulation).

Unit – IV: Erection of ship's hull **12 Hrs**

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

Unit – V: Launching **10 Hrs**

General methods - Launching by floating off (dry dock, floating dock) - Mechanical launching methods – Ship lift - Launching from inclined building berths, stern launching, side launching, tipping, pivoting.

Text Books

1. THOMAS LAMB, (2003), *Ship Design and Construction-Volume I,* Society of Naval Architects and Marine Engineers.
2. RICHARD LEE STORCH, COLIN P. HAMMON, HOWARD MC, RAVEN BUNCH & RICHARD C. MOORE, (1995), *Ship Production*, Society of Naval Architects and Marine Engineers Publication.

References Books

1. ROBERT TAGGART, (1980), *Ship Design and Construction,* Society of Naval Architects and Marine Engineers Publication.
2. MANDAL. N. R., (2017), *Ship Construction and Welding*, Springer.

3. EYRES D. J., (2011), *Ship Construction*, William Heinemann Ltd, London.

UG12T2506	Wave Hydrodynamics	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To develop understanding about the basics of wave hydrodynamics and their effects on engineering structural elemenst.

Unit – I: Basics **8 Hrs**

Introduction; Types of flow - Continuity Equation and Conservation of Mass - Forces Acting on Fluids in Motion - Euler's Equation of Motion - Path lines and Streamlines; Velocity Potential - Stream Function - Bernoulli Equation (Theory Only).

Unit – II: Wave Motion **12 Hrs**

Classification of Waves - Derivation of the Velocity Potential - Dispersion Relationship - Celerity in Different Water Depth Conditions - Local Fluid Particle Velocities and Acceleration Under Progressive Waves - Water Particle Displacement Under Progressive Waves - Pressure Distribution Under Progressive Waves - Group velocity - Wave Energy - Wave Power - Simple Problems on Wave Motion. Water Particle kinematics for standing wave - partially standing wave Transformation of wave entering shallow waters - Wave Refraction - Wave Diffraction - Wave Breaking- Types of Wave Breaking - Waves on Currents - Simple Problems on Wave Deformation.

Unit – III: Wave Loads **20 Hrs**

Force Regimes - Design Wave Approach - Morison Equation- Fixed Cylinder in Waves, Fixed Cylinder in Waves and Current - Flexible Cylinder in Wave - Wave Forces on an Inclined Cylinder - Wave Force on a Vertical Cylinder in Deep water - Wave Forces on Piles in Shallow Water - Submarine Pipelines - Froude-Krylov Forces Diffraction Regime - Simple Problems on Wave Loads - Added mass - Definition derivation of added mass for sphere and cylinder in moving fluid, Application to Naval Architecture.

Unit -IV: Finite Amplitude Waves **16 Hrs**

Stokes Wave Theory- Comparison Between Wave Theories - Solitary Wave Theory; Conidial Wave Theory - Stream Function Theory - applicability range of wave theories under different conditions - Simple Problems on Finite Amplitude Waves.

Unit – V: Random Waves **16 Hrs**

Generation of Ocean Waves - Collection of Wave Data - Analysis of Ocean Waves- wave height distribution – Statistical Methods - Spectral Method - Fast Fourier Transform Method – relating wave statistics to spectral parameters – parametric representation of wave spectrum - Directional spectrum – examples of the use of spectral methods to find momentum flux.

Text Books

1. DEAN R.G. & DALRYMPLE RA., (1994), *Water wave mechanics for Engineers and Scientists*, Prentice-Hall Inc. Englewood Cliffs, New Jersey.
2. ROBERT M.SORENSEN, (1993), *Basics wave Mechanics for Coastal and Ocean Engineers*, John Wiley &Sons.

Reference Books

1. PAOLO BOCCOTTI, (2014), *Wave Mechanics and Wave loads on Marine Structures,* Elsevier.
2. SARPKAYA.T ISSACSON .M., (2008), *Mechanics of wave forces on offshore structures,* Van Nostrand Reinhold Co.
3. LEMEHAUTE BERNARD, (1976), *An Introduction to Hydrodynamics and Water waves*, Springer Berlin Heidi Berg.
4. J.J. STOKER, (1992), *Water Waves*: *The Mathematical theory written applications,* John Wiley & Sons.

UG12P2501	Structural Drawing Project	L	T	P	C	Hrs
		1	0	4	3	90

The student must complete the following

1. Scantling calculations
2. Decks and profile drawing
3. Shell expansion plan
4. Mid-ship & Bulkhead drawing

* All the drawing to be prepared in AutoCad

UG12P2502	Ship Design Lab - I	L	T	P	C	Hrs
		0	0	4	2	72

The Following calculations and drawings for vessels to be prepared by the students in Auto Cad

1. Resistance calculation using Guldhammer and Harvald series
2. Propeller design – Using Propeller charts – Using Regression Equation
3. Propeller Drawing
4. Preparation of Ship electrical system diagrams
5. Freeboard and tonnage calculations
6. Equipment Number calculations

UG12T2601	Marine Materials	L	T	P	C	hrs
		3	1	0	4	72

Objective: To provide the students with knowledge on different materials and their uses in Marine industry including material selection, treatment techniques, corrosion control and Composites.

Unit 1: Introduction **12 Hrs**

Introduction to different types of materials used in shipbuilding- Material fabrication and service requirement - Classification society requirement - Selection of material for marine construction - Types of shipbuilding quality steels - Mild steels, normal strength steels (A, B, D, E classes)- High Tensile Steels (HTS) (AH36, DH36, EH36 & AH70, DH70 & EH70 etc.) - High Strength Low Alloy (HSLA). Lattice Structures of materials- FCC, BCC and other Bravais Lattice structures - Co-ordination number and atomic packing factor - Materials for different other systems in ship building such as piping Valves, accommodation insulation, noise & vibration reduction etc.

Unit-2: Heat treatment techniques **20 Hrs**

Heat treatment techniques - effect of thermal cycles on their micro-structure, Material composition of MS, HTS etc. and their effect on weldability and corrosion - Phase diagrams of Iron & Iron Carbide, Aluminium and lead. Time-Temperature-Transformation (TTT) diagrams and their uses - Selection of proper heat treatment processes such as annealing, normalizing, hardening, tempering, carburizing and shot peening.

Unit-3: Aluminium alloys **12 Hrs**

Aluminium alloys - alloy designation - welding requirements - Differences between hardened and tempered aluminium alloy - Strength of aluminium compared to steel - Aluminium Extrusions and their types-hot extrusions,

cold extrusion warm extrusion and micro extrusions etc. - Composition of aluminium alloys used in ship building - Advantages of using aluminium over steel in ship building - Total Life costs of ships with the use of aluminium in shipbuilding.

Unit-4: Composites **8 Hrs**

Difference between thermo-plasts and thermosets. Types of resins, glass and carbon fibers, different types of fabrics and mats such as Chopped Stranded Mats (CSM), Woven Roving(WR) their properties - FRP, GRP materials. Different types of Moulding techniques - Lay-up techniques, and manufacturing requirements - Advantages and Disadvantages of Composites over Steel and Aluminium in shipbuilding.

Unit-5: Testing of Materials & corrosion **20 Hrs**

Material properties such as toughness, hardness, Tensile strength, Yield Strength - Brittle Vs. Ductile Fracture - Creep and Fatigue - Tensile tests-standard test specimens - Impact test-Izod test, Chorpy V-Notch test. Hardness Tests-BHN, VHN - Different types of non-destructive testing for materials - sizes and dimensions of test specimens for the above tests.

Basics of corrosion and the marine environment influence on corrosion. Corrosion Mechanism of steel - Different types of marine corrosion such as Galvanic Corrosion, Inter Granular corrosion, Crevice Corrosion & Pitting, Erosion Corrosion & Stress Corrosion - Basic design for corrosion control - design aspects and prevention techniques - Cathodic Protection, ICCP, MGPS systems.

Text Books

1. ROBERT L. REUBEN, (1994), *Materials in Marine Technology*, Springer-Verlag.
2. WILLIAM F. SMITH & JAVAD HASHEMI, (2009), *Foundations of Materials Science and Engineering*, McGraw-Hill publications.

Reference Books

1. DENNIS F. HASSON, (1988), *Materials for Marine Systems and Structures: Treatise on Materials Science and Technology Volume 28,* Academic Press Inc.
2. SHENOI AND J.F. WELLICOME, (1993), *Composite Materials in Maritime Structures: Volume 1 Fundamental Aspects*, Cambridge University Press.
3. V. RAGHAVAN, (2015), *Materials Science and Engineering*, PHI Learning.
4. H. TUTHILL, C. M. SCHILLMOLLER, (1966), *Guidelines for Selection of Materials*, & Testing of Materials by Arthur.

UG12T2602	Ship Design	L	T	P	C	hrs
		3	1	0	4	72

Objective: To understand the processes involved in designing a ship like - different methods, dimensioning, general arrangement and compliance to statutory rules

Unit – I: Design considerations **20 Hrs**

General aspects of Marine Activities, Transportation of cargoes, Marine services & Operations, Marine Industries - Engineering design - philosophy and definition; Marketing principles in marine environment - Classification of marine vehicles on the basis of mission analysis; Properties of cargo and its handling - Design spiral - concept design - Objective and constraints - preliminary design - Hull form design and development - Engineering Economics in Ship Design – economic criteria and complexities, Initial cost, Operating cost – RFR - Owners requirements - optimal vessel design - Freeboard and load line regulation;

Unit - II: Methods of ship design **10 Hrs**

Design using basic type ships - Design using coefficients - Design using iteration methods - design spiral- design categories (dead-weight carrier, capacity carrier - linear dimension ship). Ship parameters – displacement - displacement coefficient - displacement equation - volume equation - solution of the cubic equation.

Unit - III: Ship dimension **12 Hrs**

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

Unit – IV: General arrangement **15 Hrs**

Subdivision of the ship's hull and erections, arrangement of spaces, arrangement of tanks, superstructure and deckhouses, arrangement of engine plants, Cargo handling capacity Hold capacity and stowage factor Cargo handling equipments, cargo hatches, lifting devices; Anchor installations – types of anchors, anchor handling system, anchor chain & storage; Mooring systems – deck fittings & structural arrangement, mooring machinery, mooring operations.

crew size, accommodation standards, space allocation, habitability, access, materials, standardisation and modular arrangement; Access equipments –hatches, manholes, doors, other closing & opening devices, load line rules, gang ways and ladders design aspects, connections; Mast & riggings; Railings & awnings superstructure and deckhouses-arrangement of engine plant. Safe Return To Port (SRTP).

Unit – V: Statutory & Commercial Considerations **15 Hrs**

Compliance to International and National Rules and Regulations. Building cost estimation. Tender and contract - Introduction to Energy Efficiency Design Index (EEDI) - Introduction to goal based design.

Text Books

1. APOSTOLOS PAPANIKOLAOU, (2014), *Ship Design Methodologies of Preliminary Design*, Springer Publishers.
2. SURESH CHANDRA MISRA, (2015), *Design Principles of Ships and Marine Structures*, CRC Press.

Reference Books

1. THOMAS LAMB, (2003), *Ship Design and Construction*, SNAME Publications.
2. VOLKER BETRAM H. SCHNEEKULTH, (1998), *Ship Design for Efficiency and Economy 2nd Edition*, Elsevier Publishers.

3. D.G.M. WATSON, (1998), *Practical Ship Design*, Elsevier Publisher.
4. ROBERT TAGGART, (1980), *Ship Design and Construction,* SNAME Publications.

UG12T2603	Marine Power Plant	L	T	P	C	hrs
		3	1	0	4	72

Objective: To enable the students to apply systems design approach to Marine power plant for propulsion and generation of electric power.

Unit-1: Energy Conversion & power plant concepts. 12 Hrs

Energy – sources - types. Conversion of energy from source to end use - energy flow diagrams - systems Engineering concepts in Marine Engineering - ship functions - ship systems and components - underlying physical and electrical principles - economic principles - reliability - availability - maintainability and safety - space weight considerations - control and monitoring. Main components of propulsion system - Prime Mover - transmission & propulsors - propulsion support systems. Types of drives- Direct drive - geared drive - Drives involving steam and gas turbines as prime movers - combined drives with single or multiple shaft lines - Diesel Electric Propulsion and all electric ship concepts - electric drive application in submarines - Hybrid drives - redundancy - engine room layout and machinery arrangement.

Unit-II: Electric Power Generation & Distribution 18 Hrs

Main components of electric power plant - Electric power Demand and Load analysis - simulation of electric power demand - Emergency power estimation. Installation rules for electrical power plant-Choices for emergency power plant - Location of emergency power source. Main Components of electrical system on board ships - Merits and demerits of AC and DC on board. Standard voltages - difference between marine and industrial circumstances - comparison of diesel - thermal and Nuclear power plants as prime movers- shaft driven generators - specification of generators and motors-speed based and torque based motors - power electronics and convertors - harmonic distortion - examples of electric propulsion drives. Distribution systems: Ring and radial system. Earthed

or unearthed systems - three or 4 wire systems - DC systems- Components of distribution system. MSB, SSB and DB, Switchgear for electrical system - protection for generators - preferential tripping -single line layout. Rules governing the distribution system - special rules for tankers and fighting crafts. Transformers for power and lighting-. Specification of transformers. Cables-testing of cables –Megger - design and selection of cables. Installation rules.

Unit-III: Diesel engines & Gas turbines 12 HRs

Working principles of Diesel engines - indicator diagram - performance and efficiency - power and torque - fuel consumption - air consumption - pressure charging - operating envelope - methods to broaden the engine characteristics - power density- specific power related to swept volume and bore - Thermodynamic analysis of Diesel engines- Otto - Diesel cycles and comparison between them - heat and work - MEP & efficiency - limitations. Performance of Diesel Engines- effect of ambient conditions on performance. Thermodynamics of Gas turbines- Brayton Cycle - work & heat - power density and efficiency - losses - effect of regeneration - cycle optimization - potential for advanced cycles - Operating envelope- Power-speed curve - fuel consumption - effect of ambient conditions - Installation on board - COGAS and overall plant efficiency.

Unit IV: Engine selection and Propeller Matching 18 Hrs

Basic matching of propeller and engine - Transformation of ship resistance to engine brake power - off design conditions - effect of off design speed and added resistance - effect of change in number of driven shafts or number of engines per shaft - change of gear ratio and pitch - Change in PTO operating condition.

Unit V: Ship Fuel Consumption and emissions 12 Hrs

Energy Balance for a Ship - Fuel Consumption Ton–Mile considerations, Range and Endurance - Health & Environmental Significance of

combustion products - Measurement & quantification of exhaust emissions-NOx Technical code - ISO8718. Exhaust emissions form shipping and their control measures - SOLAS & MARPOL regulations and Energy Efficiency Design Index (EEDI).

Text Books

1. HANS KLEIN WOUD & DOUWE STAPERSMA, (2014), *Design of Propulsion and Electric Power Generation Systems*, IMAREST Publication.
2. JOHN PROUSALIDIS AND CHRISTOS TH KOURTESIS, (2013), *Ship Electric Energy Systems: Design and Operation Principles*, IMAREST Publication.

Reference Books

1. L.R. HARRINGTON, (1980), *Marine Engineering*, SNAME Publishers.
2. ANTHONY F. MOLLAND, (2008), *The Maritime Engineering Reference book*, Butterworth-Heinemann Publishers.
3. G.O.WATSON, (1990), *Marine Electrical Practice*, Butterworth-Heinemann Publishers.
4. DOUG WOODYARD, (2009), Pounder's *Marine Diesel Engines & Gas Turbines*, Butterworth-Heinemann Publishers.
5. BOSE, INDRA NATH, (2012), *Energy Efficiency and Ships*, IMARE, India.

UG12T2604	Ship Motion & Control	L	T	P	C	hrs
		3	1	0	4	72

Objective: To study the behaviour (motions) of ship in seaway, its controllability and other hydrodynamic aspects.

Unit - I: Introduction to Seakeeping **20 Hrs**

Importance of seakeeping analysis - Behaviour of a ship in a seaway. Ship Motions - Surge, sway, heave, roll, pitch and yaw - Characteristics of waves - Sea surface - Regular waves - Sinusoidal and trochoidal wave theories - Analytical and statistical representations - Wave histogram. Standard sea spectra - Average and Significant wave height - Beaufort scale & Sea State code - General Theory of Oscillations - Added Mass - Tuning factor and Magnification factor - Coupled and uncoupled motions - Ship motions in regular waves - Ship motions in irregular waves - Encounter spectrum - Response amplitude operator - Response Spectrum & Motion spectrum - Derived Responses – Local & Relative motions – Added resistance – Powering in waves, Stabilization of ship motions – Control of Roll - Passive (Bilge Keel, Sails, Free Surface Tanks, U-tanks, Moving weight) - Controlled - Passive & Active stabilizers - Control of Pitch.

Unit–II: Sea keeping Performance and Design Aspects **10 Hrs**

Measures of Performance - Sea keeping performance criteria and ship seaways responses - Prescribed Limiting values of the seaway Performance criteria - Speed-Polar Plot - Sea keeping performance - Index- SPI-1 & SPI-2, Design Aspects – Factors affecting pitching, heaving & rolling.

Unit–III: Introduction to Controllability **10 Hrs**

Introduction to Manoeuvrability - Controlled and uncontrolled motions - The Control Loop & Basic Equations of motion - Definition of Motion stability of ocean vehicles and assumptions of Linearity in Equations of

motion - Notation of Force & Moment derivatives -Control forces and moments.

Unit – IV: Coursekeeping, Model tests & trials **20 Hrs**

Analysis of Course keeping and Control - Fixed Stability – Stability Indices – Stability Criterion – Dieudonne's Spiral – Bech Reverse. Definite Manoeuvres – ZigZag Manoeuvre - K & T Course keeping and Turning Indexes - Analysis of Turning Ability – Characteristics of Turning Path - Three phases of Turn - Heel Angle in a Turn, Reduction of speed in a Turn.

Model testing – Free Running Model Tests & Technique, Non-Linear Equations of motion & Captive model tests, Theoretical Prediction of Hydrodynamics coefficients – Semi-Empirical Methods - Regression Analysis & System Identification Methods.

Manoeuvring in restricted waters - Shallow water effects - Bank suction effects- Interaction between ships - Manoeuvring Standards - Special Types of Manoeuvring Devices, Manoeuvring trails - Manoeuvrability & Ship Design.

Unit – V: Control Surfaces **12 Hrs**

Hydrodynamics of Control Surfaces – Geometry, Forces & Moments - Flow around a Ship's Rudder - Design of Rudder - Types and characteristics - number of Rudders - Aspect Ratio - balanced & unbalanced Rudder- Rudder Size - Maximum Rudder Deflection - Rudder Deflection Rate - rudder location - Selection of Section Shape - Calculation of steering gear torque and rudder stock diameter.

Text Books

1. LEWIS E.U., (2010), *Principles of Naval Architecture - Second Revision Volume III*, SNAME Publications.
2. BHATTACHARYA R (1978), *Dynamics of Marine vehicles*, John Wiley & Sons, New York.

References Books

1. LAMB H, (1945), *Hydrodynamics*, Dover Publishers.
2. NEWMAN J.N, (1977), *Marine Hydrodynamics*, MIT Press, USA.
3. PRICE W.G & BISHOP R.E.D, (1974), *Probabilistic theory of Ship Dynamics*, Chapman & Hall, London.
4. CLOYD ARTM, (1989), *Sea Keeping Ship behaviour in Rough weather*, John Wiley & Sons Publishers.

UG12T2605	Business Fundamentals & Economics	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To expose the student about the basics of banking, international transactions, company organization and stock market.

Unit – I: Basics of Economics **24 Hrs**

Definition - scope and subject matter of economics - a few fundamental concepts like utility, wealth, factors of production, demand and supply, elasticity, equilibrium, land and the laws of diminishing returns - Theory of employment — types of unemployment - concepts of full employment and how it can be achieved - National Income — Gross National Product, Net National Product - measurement of national income - economic growth and fluctuations – consumption - savings and investments.

Unit – II: Banking **12 Hrs**

Definition - functions and utility of banking - the principles of commercial banking - multiple credit creation - essentials of a sound banking system. International trade — basic features of import - export.

Unit – III: National & International Financial Institutions 16 Hrs

Industrial Finance Corporation of India (IFCI) - Industrial Credit and Investment Corporation of India (ICICI) - Industrial Development Bank of India (IDBI) - Export-Import Bank (EXIM) - Asian Development Bank - International Monetary Fund - International Bank for Reconstruction and Development (World Bank). Types of Business units — sole proprietorship – partnership - companies - co-operatives - Hindu Undivided Family - Joint Stock companies - public utility services and state enterprises.

Unit – IV: Company organisation and management 14 Hrs

Types of companies - their formation, incorporation and commencement of business - memorandum of association and articles of association – prospectu - shares and debenture - board of directors and general meetings. Business Objectives — concept and rationale of social responsibility - business and its environment - interface with legal, political, economic, social and cultural aspects.

Unit – V: Stock exchange and its workings 6 Hrs

Dealers and brokers' transactions - economic significance - conditions of membership - role of stock exchanges. Business communication and report writing — commercial correspondence and report writing.

Text Books

1. SARAGI S.K, (2011), *Economics Business and Industrial Management*, Himalaya publications.
2. AHUJA H.L., (2016), *Fundamentals of Business Economics*, S.Chand Publications.

Reference books

1. C.B.GUPTA, (2002), *Business Fundamentals*, S.Chand Publications.
2. BHUSAN Y .K., (2000), *Fundamentals of Business Organisation*, S.Chand Publications.
3. GUPTA DN.N.K. & MONIKA CHOPRA, (2016),'' Financial Markets Institutions and Services, Anne Books pvt ltd. Publications.
4. PRASSANNA CHANDER, (2005), *Fundamentals of Financial Management*, Tata Mc Graw hill Publications.

UG12P2601	Marine Power Plant Lab	L	T	P	C	hrs
		1	0	4	3	90

1. Energy balance of a Diesel engine
2. Determination of the characteristics of diesel engine.
3. Determination of the characteristic curves of compressors.
4. Determination of the characteristic curves of pumps.
5. Visit to a Ship / ship in campus
6. Estimation of Electrical Power for a given ship
7. Estimation of Propulsive power and engine selection for a given ship

UG12P2602	Ship Design Lab – II	L	T	P	C	Hrs
		1	0	4	3	90

The Following calculation & arrangements for merchant vessels to be prepared by the students in Auto Cad

1. General Arrangement Drawing for a merchant Vessel
2. Engine room Arrangement for
3. Rudder design
4. Capacity Plan

UG12T2701	Design of Offshore Structures	L	T	P	C	hrs
		3	1	0	4	72

Objective: To develop understanding about the environmental loading, structural components and design process of offshore structures including accidental loading.

Unit - I: Loads on offshore structures **18 Hrs**

Wind Loads- Wave and Current Loads - Calculation based on Maximum base Shear and Overturning Moments - Design Wave heights and Spectral Definition- Hydrodynamic Coefficients and Marine Growth - Fatigue Load Definition and Joint Probability distribution - Seismic Loads.

Unit - II: Steel Tubular Member Design **18 Hrs**

Principles of Working Stress Method (WSD) and Load and Resistance Factor Design (**LRFD**) - Allowable stresses and Partial Safety Factors - Tubular Members - Slenderness effects - Column Buckling - Design for combined axial and bending stresses (API RP 2A guidelines).

Unit–III: Tubular Joint Design for Static and Cyclic Loads 6 Hrs

Simple tubular joints - stress concentration factors - S-N curves and fatigue damage calculations.

Unit–IV: Jack up Rigs **12 Hrs**

Configuration and operation of jack ups - Simplified analysis - Spud can penetration and extraction - Spud can – pile interaction - Design of jack up legs.

Unit -V: Design against Accidental Loads **18 Hrs**

(Fire, Blast and Collision): Behaviour of steel at elevated temperature - Fire Rating for Hydrocarbon fir - Design of structures for high temperature - Blast Mitigation-Blast walls - Collision of Boats and energy absorption - Platform survival capacity and Plastic design methods 8 Example tutorial problems on design of tubular members - Stress concentration factors - fatigue estimation, wave load on structures

Text Books

1. BARL TROP .N.D.P, (2012), *Floating Structures -A Guide For Design & Analysis Vol I & II*, England oil field Publications Pvt Ltd.
2. W.J. GRAFF, (1981), *Introduction to Offshore Structures Design Fabrication & Installation,* Gulf Publications.

Reference Books

1. MOHAMMED AE. REDDY, (2012), *Offshore Structures Design Construction And Maintenance*, gulf Professional.
2. S.K.CHAKRABARTI, (2005), *Handbook of Offshore Engineering (Vol I & II),* Elsevier.
3. GUNTHER CLAUSS EIKE LEKMANN CARSTEN .O, (2011), *Offshore Structures Vol I & II*, Springer Publications.
4. SRINIVASAN CHANDRASEKAR, (2015), *Dynamic Analysis & Design of Off Shore Structures,* Springer Publishers.

UG12P2701	Ship Design Project	L	T	P	C	Hrs
		0	0	12	6	216

Student has to do the preliminary design of an assigned vessel

UG12P2702	Hydrodynamics Lab	L	T	P	C	Hrs
		0	0	4	2	72

1. Introduction to Ship Hydrodynamics Experimental facilities
2. Ship resistance prediction methods using model tests.
3. Model Preparation for resistance.
4. Running Towing Tests to Obtain Resistance.
5. Calculation to get Ship Effective Power and Form Factor.
6. Introduction to Propulsion tests.
7. Calibration of Load Cell and Dynamometer Force Measurement.
8. Self-Propulsion Test for Wake fraction and thrust deduction fraction.
9. Calculations for Wake and Thrust Deduction Fractions.
10. Introduction on Roll Damping and Ship Motion Tests.
11. Propeller Open Water Test.
12. Ship Roll Damping

UG12P2703	Industrial Training	L	T	P	C	Hrs
		0	0	0	2	0

Practical training / internship in a marine industry for 6/8 weeks in the summer vacation after 6th semester. (The student must give Report and Viva-Voce on Practical training attended) in 7th semester

UG12P2704	Comprehensive Viva- Voce	L	T	P	C	Hrs
		0	0	0	2	0

Viva-voce examination will cover all subjects taught till date.

UG12T2801	Ship Vibration & Noise	L	T	P	C	Hrs
		3	1	0	4	72

Objective: To familiarize the student with the ship related noise and vibration, their sources and implications on machinery mounting.

Unit – I: Basics of Vibration: 12 Hrs

Introduction, classification of vibration, analysis of single degree freedom systems - Survey of vibration in Ships and Ship Systems – physics of the problem - Structural parts - vibration levels - Vibration of machinery and equipment.

Unit - II: Major excitation sources 20 Hrs

Propeller induced vibration - machinery induced vibration - wave induced vibration - hull girder vibration - double bottom vibration - local hull structure vibration - superstructure vibration - local structure vibration - shaft vibration – torsional - longitudinal and whirling.

Unit - III: Mounting of machinery and equipment 20 Hrs

Introduction - design considerations - characteristics of elastic mounts - operational effects - loads on elastic mounts due to motion in seaway - inertia properties of supported bodies - source isolation - equipment protection.

Unit - IV: Ship noise 16 Hrs

Introduction - airborne noise criteria - acoustic design practices - noise prediction procedures - structure borne noise source levels - transmission paths - noise treatment prediction procedures.

Unit - V: Noise & Vibration Criteria **6 Hrs**

Measurement instrumentation - conditions - locations. Limits of crew and passengers, machinery, local structures. IMO noise limits in cabins, machinery spaces etc

Text books:

1. NORSKE VERITAS ED, (1985), *Vibration Control in Ships*, Veritec.
2. RAYMOND W. FISCHER, (1985), *Design guide for shipboard airborne noise control,* SNAME Publication.

Reference Books:

1. SHABANA. A.A., (2010), *Theory of vibrations – An introduction 2nd Edition*, Springer Publishers.
2. BALAKUMAR BALACHANDRAN & EDWARD B. MAGRAB, (2009), *vibrations 2nd edition*, Cengage Learning, Canada.
3. VORUS WILLIAM. S, (2010), *Vibration*, SNAME Publishers.
4. GOOD MAN RA, *Wave - Excited Main Hull Vibrations*, LRS Publishers.
5. LEWIS, (2010), *Principles of Naval Architecture Vol – II*, SNAME Publishers.

UG12P2801	Vibration & Noise Lab	L	T	P	C	Hrs
		0	0	4	2	72

Experiments:

1. Measurement of Natural Frequency and Modal Shape of Simply Supported Beam Structure by the Method of Hammer Impact
2. Measurement of Natural Frequency and Modal Shape of Cantilever Beam Structure by the Method of Hammer Impact
3. Measurement of Natural Frequency and Modal Shape of Disc Structure by the Method of Hammer Impact
4. Determination of Damping Ratio (half-power band width method)
5. Determination of Damping Ratio (Attenuation method)
6. A sample Signal Processing and Spectrum Analysis (Software Only)
7. A sample generation of Mechanical Vibration
8. Measurement of Amplitude and Frequency of Simple Harmonic Motion
9. Measurement of Natural Frequency of Vibration System (Lisajours Figure)
10. Measurement of Natural Frequency of Simply Supported Beam (Method of Sine Wave Sweep)
11. Measurement of Natural Frequency of Cantilever Beam (Method of Sine Wave Sweep)
12. Active Vibration Isolation
13. Passive Vibration Isolation
14. Vibration with Single Absorber
15. Vibration with Double Absorber
16. Vibration With Oil Damper
17. Beat Vibration
18. Natural Frequency and Modal Shape of Two or Three Degree of Freedom String
19. Natural Frequency and Modal Shape of Multi Degree of Freedom

String

20. Sound attenuation of materials
21. Noise and vibration measurements to verify within the acceptable limits.

UG12T2802	Project Work	L	T	P	C	Hrs
		0	0	20	10	360

Students have to do a group project in the area related to Naval Architecture and Ocean Engineering

UG12E2601	Finite Elements Method	L	T	P	C	hrs
		3	0	0	3	54

Objective: Familiarize the students with fundamentals of Finite Element Method.

Unit–I: Introduction **8 Hrs**

Brief history of development - General steps in finite element analysis - variation formulations and weighted residual methods - error and accuracy in finite element analysis.

Unit-II: Structural stiffness and network analysis **14 Hrs**

Assembly and analysis of a structure - Finite element analysis of an elastic continuum, displacement approach, minimization of total potential energy - Convergence criteria - Generalization of finite element concepts - Alternative approach to finite element formulation.

Unit-III: Plane stress and plane strain analysis **10 Hrs**

Derivation of stiffness matrix for truss beam, Plane stress, plane strain, axisymmetric elements.

Unit-IV: Element characteristics **12 Hrs**

Triangular, rectangular and iso-parametric elements - Some practical applications - Axisymmetric stress analysis - Some illustrative examples such as ship structures and offshore Jacket structures.

Unit-V: Computer methods and Programs **10 Hrs**

Data input, stiffness generation, assembly and solution of equations and output of results - Application of FEM to structural analysis - FEM software packages - Modelling capabilities - Pre-processors and Post-processors - Modern trends in finite element analysis – Solution methods.

Text Books:

1. RAO .S. S., (2011), *Finite Element Methods in Engineering*, Butterworth Heinemann.
2. TIRUPATHI R, CHANDRUPATLA ASHOK, BELEGUNDU D., (2014), *Introduction to finite Elements in Engineering,* Pearson Education.

Reference books:

1. OLULEKE OLUWOLE, (2011), *Finite Element Modelling for Materials Engineers Using MATLAB*, Springer Publications.
2. IRVING H SHAMES, CLIVE L DYM, (1991), *Energy and Finite Elements in Structural Mechanics*, New age international Publishers.
3. DESAI Y.M., ELDHO T.I., SHAH A.H., (2011), *Finite Element Method with Application in Engineering*, Pearson Education.
4. WAIL N. AL RIFAIE, ASHOK K. GOVIND, (2008), *Finite Element Method for Structural Engineers*, New Age International Publishers.

UG12E2602	Computational Fluid Dynamics	L	T	P	C	hrs
		3	0	0	3	54

***Objective: An introductory course with adequate coverage of mathematical pre-requisites for understanding basics of computational fluid dynamics, the various methods of analysis and applications*.**

Unit-I: Mathematical preliminaries **12 Hrs**

Different types of partial differential equations in fluid dynamics - Finite difference method - Finite volume method - Equations of parabolic type and implicit methods - Equations of hyperbolic type and explicit and implicit schemes - Equations of elliptic type and method to handle them - Equations of mixed elliptic-hyperbolic type.

Unit-II: Basic conservation principles **12 Hrs**

Unsteady Navier-Stokes equation in integral form and differential form - Boundary conditions for N-S equations - RANS equation, boundary layer, thin layer and associated approximations - Euler equations for inviscid fluids and boundary conditions - The full potential equation, inviscid, incompressible and irrotational flow.

Unit-III: Flow simulation schemes **10 Hrs**

Grid generation methods - Inviscid incompressible flow – Potential flow problem and panel methods - Inviscid compressible flow – Numerical solution of full potential equation.

Unit-IV: Simulation of incompressible flow **10 Hrs**

Viscous incompressible flow – Incompressible flow computation - MAC method.

Unit-V: Simulation of compressible flow **10 Hrs**

Viscous compressible flow - Dynamic similarity - RANS equations - Turbulence modelling, boundary conditions - Basic computation methods for compressible flow - Solution procedure.

Text Books:

1. NIYOGI PRADIP, CHAKRABARTY S.K., LAHA M.K., (2006), *Introduction to Computational Fluid Dynamics*, Pearson Education
2. ZIKANOV OLEG, (2010), *Essential Computational Fluid dynamics*, John Wiley & Sons.

Reference books:

1. WESSELING PETER, (2009), *Principles of Computational Fluid dynamics*, Springer Publications.
2. RICHARD H. PLETCHER, JOHN C. TANNEHILL, DALE ANDERSON, (2013), *Computational Fluid Mechanics & Heat Transfer*, CRC Press.
3. CHUNG T.J., (2010), *Computational Fluid dynamics*, Cambridge University Press.
4. VERSTEEG, H.K. MALASEKARA W, (2007), *An introduction to Computational Fluid Dynamics*, Pearson Education.

UG12E2701	Dredging and Harbour Engineering	L	T	P	C	Hrs
		3	1	0	4	54

Objective: To provide basic understanding of Harbour elements, structural details, sedimentation and dredging

Unit – I: Sedimentation and Dredging **10 hrs**

Marine Sediments – source, transportation, deposition and erosion. Littoral transport – effect of harbour structures and channels on littoral transport - Requirement of dredging, Basics of dredging, Types of Dredgers, operational requirement of dredgers, economics of operation, design features - equipment and processes used, capital and maintenance dredging, Production in dredging projects, operational aspects, introduction to dredging costs and contracts, Dredged material management – disposal, beneficial uses, environmental issues.

Unit – II: Dredging Equipment **10 Hrs**

Dregde pumps – centrifugal pumps – pump characteristics – effect of soild-water mixture on pump performance – cavitation – Gas effect and removal – Pipe line Transport – head loss with distance – booster requirement – Instrumentation and Automation – flow and velocity meters – density meters – production meters – Automation in dredging – survey.

Unit – III: Elements of Harbour **10 Hrs**

Port classifications – details and definitions, Navigational and operational parameters, environmental parameters. Layout, breakwater, channel, entrance, basin. Water front facilities – Quay, berths, Jetty, sheet-pile bulkheads, Piled structures. Mooring accessories- Anchors, fender, bollard. Harbour crafts - tugs and supply vessels and their function, equipment and design features: crane vessels, launches for port operation, pilot launches, pollution control vessels; Propulsion requirement of harbour craft.

Unit – IV : Harbour development **10 Hrs**

Port planning - Facilities requirement – general considerations – economic feasibility - evaluation of cost and benefit – evaluation of financial feasibility – influence of ships on port facilities – dimensions – cargo capacity – cargo handling gear – motion and moorings – manoeuvrability at low speeds – Access channels and basin – design of channel – safety criteria – basins – open and closed. Environmental considerations – effect of capital dredging and reclamation - water pollution – noise and vibration pollution – adverse effect on littoral drift due to maintenance dredging – hazardous cargo handling and accidents - environmental impact assessment.

Unit – V: Structural Components **14 hrs**

Breakwaters: types functional requirement – rubble mound breakwaters – design – construction – modes of failure – overtopping – Caisson type breakwater. Berth and terminal design: general cargo berths – berth surface elevations – apron width – transit sheds – pavements – cargo handling systems. container terminals: elevation and width, yard equipment – yard layout and stacking pattern. Roll on/ Roll-off terminals – ferry terminals – liquid bulk terminals – dry bulk terminals.

Text Books

1. *Hans Agerschou, et. al. (2004), Planning and Design of Ports and Marine Terminals, Thomas Telford*
2. *John Herbich, (1992), Handbook of Dredging Engineering, Mc Grow Hill Inc.*

Reference Books

1. *Gregory Tsinker (1996), Handbook of Port and Harbour Engineering, Springer-Science+ Business Media BV.*
2. *Introduction to Naval Architecture – Thomas C. Gillmer*
3. *Basic Ship Theory – E.C. Tupper and K.J. Rawson*
4. *Offshore structures, Volume 1 D. V. Reddy, M. Arockiasamy*

UG12E2702	COMPUTER AIDED DESIGN & COMPUTER AIDED MANUFACTURING	L	T	P	C	hrs
		2	1	0	3	54

- ***Objective: To Impart the knowledge of Computer Aided Design and Manufacturing concepts and its applications.***

UNIT – I: Computer Aided Design (CAD) 10 Hrs

The design process - Application of computers for design - Operating systems - Hardware in CAD: The design work station - I/O Devices - CAD system configuration - Creating database for manufacturing - Benefits of CAD- Interactive Computer Graphics - Graphic display devices- Graphics system- Graphics standards

UNIT – II: Engineering CAD systems 10 Hrs

2-D and 3-D transformations, Scaling, rotation, reflection and homogeneous coordinates - Curve representation, Analytical and parametric representation of curves, Differential geometry of curves, Interpolation of techniques, Control polygon techniques (Beziers, B-spline, NURBs) curve generation.

UNIT – III: Generation of geometry 12 Hrs

Ship curve design, Integration and fairing techniques for curves, Surface representation, Analytical and parametric representation of surfaces, Differential geometry of surfaces, Surface interpolation techniques, Control polygon techniques (Beziers, B-spline, NURBs)

UNIT – IV: Computer Aided Manufacturing (CAM) 10 Hrs

Introduction to CAM, Elements and structure of NC, CNC and DNC machines, Introduction to NC part programming and applications, Manual Part programming, Computer Aided Part programming (APT).

UNIT – V: Case studey **12 Hrs**

An illustrative exercise covering a select portion of CAD application in ship building.

Text Books:

1. NOWACKI, H. BLOOR MIG &OLEKSIEWIG, (1995), *Computation Geometry for ships*, World Scientific Publishing.
2. Michael .W. Mattson, (2009), *CNC Programming, Principles and Applications*, DELMAR Publishers.

Reference Books:

1. SUBU – QUING LIU DING –YUAN, (1989), *Computational Geometry Curve and Surface Modelling*, Academic Press.
2. WARREN S SEAMES, (2002), *Computational Numerical control, Concepts & Programming*, 4th Edition, Delmar Thomson Learning Inc.
3. FRANCO.PPREPARATIONS, (1985), *Computational Geometry*, Springer.
4. GROOVER .MIKELL P, (1984), *Computer Aided Design and Manufacturing*, Prentice -Hall of India (P) Ltd.

UG12E2703	METROLOGY AND MEASURING INSTRUMENTS	L	T	P	C	Hrs
		3	0	0	3	54

Objective: To get an understanding of the principles of measurement and the fundamentals involved in the working of various measuring instruments.

Unit I: Need for Metrology **10 Hrs**

Role in quality control - Factors affecting measurement - SWIPE. Errors in Measurements – Types – Control – Measurement uncertainty – Types - Estimation - Problems on Estimation of Uncertainty - Statistical analysis of measurement data - Calibration of measuring instruments - ISO standards.

Unit II: Linear Measuring Instruments **10 Hrs**

Vernier caliper - Micrometer - Vernier height gauge - Depth Micrometer - Bore gauge - Telescoping gauge. Tolerance – Interchangeability - Selective assembly - Terminology - Limits and Fits - Problems. Design of Limit gauges - Problems - Gauge blocks – Use and precautions - Comparators – Working and advantages. Toolmaker's microscope – Profile projector - Angular measuring instruments – Bevel protractor - Clinometer - Angle gauges - Precision level - Sine bar - Autocollimator - Angle dekkor - Alignment telescope.

Unit III: Geometric Dimensioning and Tolerance **10 Hrs**

Fundamentals of GD & T- Measurement of straightness - flatness and roundness - Simple problems – Measurement of Surface finish – Functionality of surfaces - Parameters - Comparative - Stylus based and Optical Measurement techniques - Filters - Introduction to 3D surface metrology.

Unit IV: Measurement of Screw & Gears **12 Hrs**

Measurement of Screw threads – purpose – Dimensioning – Limit gauging – Size limits – Single element measurements – Pitch Diameter - Lead - Pitch.

Measurement of Gears – purpose – Analytical measurement – Run-out - Pitch variation - Tooth profile - Tooth thickness - Lead – Functional checking – Rolling gear test.

Unit V: **12 Hrs**

Transducers - Measurement of Pressure - Flow measurement - Level measurement - Measurement of temperature and humidity - measurement of rpm - Measurement of Torque - Measurement of Strain - Measurement of Velocity - Measurement of Acceleration - Measurement of Vibrations - Various electrical measurements onboard a ship - Measurement of climatological variables - Principles of Non-Destructive Testing (NDT) - Techniques and methods of testing for health monitoring structures - testing of composites - Gyro-compass - radar - automatic compass - ARPA - Automatic tracking aid - speed and distance log device - echo-sounder - ECDIS - AIS - LRIT - Rudder angle indicator - Rate of turn indicator - VDR - GPS - Onboard testing (watertight compartments - steering gear - lifting devices) - ship trails procedures.

Text Books

1. RAGHAVENDRA N.V. KRISHNA MURTHY L., (2013), *Engineering Metrology & Measurements*, OUP.
2. ANAND K BEWOOR, VINAY A KULKARNI, (2009), *Metrology Measurements*, Tata Mc GrawHill.

Reference Books

1. RAJPUT R.K., (2009), *Mechanical Measurements & Instrumentation*, S.K. Kataria & Sons.

2. BAKSHI U.A., BAKSHI A.V., (2009), *Instrumentation Engineering*, Technical Publications.
3. NORMAN A ANDERSON, (1998), *Instrumentation for Process Measurement & Control*, CRC Press.
4. DIXIT J.B., YADAV AMIT, (2010), *Intelligent Instrumentation for Engineers*, University Science Press.

UG12E2704	Operations Research	L	T	P	C	hrs
		3	0	0	3	54

Objective: Understand the mathematical tools that are needed to solve optimisation problems.

Unit I: Introduction **10 Hrs**

Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available.

Unit II: Single Variable optimization **10 Hrs**

Optimization criteria, bracketing methods – Exhaustivesearch method, bound phase method; Region Elimination methods – Fibonacci search method,Golden search method; Gradient based methods – Newton Raphson method, Bisection method; Root finding using optimization technique.

Unit III: Multi objective optimization **12 Hrs**

Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell" s-conjugate direction method; Gradient based methods – Newton"s method and Variable metricmethod.

Unit IV: Specialized Methods **10 Hrs**

Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method.

Unit V: Algorithms **12 Hrs**

Genetic algorithms and evolutionary approaches-Differences and similarities betweengenetic algorithms and traditional techniques, operators of GA"s, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

Text Books:

1. KALYANMOY DEB, (2005), *Optimization for Engineering design*, Prentice Hall, India.
2. KALYANMOY DEB, (2001), *Multi objective optimization using Evolutionary algorithms*, John Wiley.
3. HAMDY A. TAHA, (2010), *Operations Research: An Introduction*, Pearson Prentic Hall.

Reference Books:

4. FREDERICK S. HILLIER GERALD .J. LIEBERMANN, (2015), *Introduction to Operations Research 10th Edition*, McGraw Hill .
5. R.PANNERSELVAM, (2004) , *Operations Research*, Prentice-Hall, India,
6. S.D. SHARMA, (1994), Operations *Research 11th Edition*, Kedarnath Ramnath & Co.

UG12E2705	Design of Small Crafts	L	T	P	C	hrs
		3	0	0	3	54

Objective: To understand the processes involved in designing a small crafts like – Tugs, Fishing vessels & Yacht.

Unit : I Tugs, towing vessels and Harbour Craft 12 Hrs

Tug design factors – types of harbour tugs – tug capabilities and limitations - stability requirements – Bollard pull required – towing equipment - powering. General arrangement - Special features of pusher tugs Kort-nozzle -Voith-Schneider and Schottel propulsion in tugs.

Harbour Craft - Requirements, Supply vessels, Crane vessels, Pilot Launches - Pollution control vessels, Mooring boats

Unit : II Introduction & Space Allocation Fishing vessels 10 Hrs

Introduction - definitions of fishing vessel - special features of fishing vessels - regulations for the safety of fishing vessels - classification of fishing vessels - fisheries organizations and activities - administrative systems on fishing vessels. Fishery - Characteristics of fish ground - Fishing gear and methods - drift net, long line, drag net, siene net - trawling (side and stern trawlers, single and pair trawling, pelagic & bottom trawling) - Dressing, processing and freezing. Design Procedure - Owner's specifications - Economy, hull form, investment cost operating revenues and costs - Design of Main Dimensions and form - parent vessel data analysi - space requirement (capacity) of the whole ship estimation of main dimensions - estimation of form coefficients - estimation of light ship weight - estimation of dead weight - design of lines. General arrangement engine room, fish holds, erections, deck machinery arrangement crew accommodation, fuel, fresh-water, ballast tanks, bulkhead positions.

Unit – III: Powering & equipment of fishing vessels 10Hrs

Resistance, powering and propeller - other machinery/equipment - selection of equipments/instruments for fish finding, navigation, communication –net monitoring. Seakeeping and maneuvering considerations - Material and construction methods - mechanical properties of materials - comparison of hulls of different material - type of construction - details of steel construction - construction methods in FRP/GRP, Aluminium, Ferro-cement - Fish holds and preservation facilities - insulation materials and properties - methods fish preservation

Unit – IV: Yacht 12 Hrs

Preliminary considerations – Hull Design – Stability – Rudder and keel – Propeller and engine – Hull materials – Layout – Sail and rig

Unit – V: Boat Mechanical Systems 10Hrs

Drive train Installations – Fuel Systems – Exhaust Systems – Rudders and Steering systems – Ventilation & Air-conditioning – Anchoring systems.

Text Books:

1. HENK HENSEN, (2003), *Tugs Use in Port*, The Nautical Institute.
2. FARHAM, (1985), *Design of small fishing Vessel*, Fishing news Books Ltd.
3. DAVE GERR, (2009), *Boat Mechanical systems H*andbook, International Marine/Ragged Mountain Press.
4. LARS LARSSON & ROLF E ELIASSON, (2007), *Principles of yacht design*, International Marine/ McGraw-hill.

Reference Books:

1. MARCHAJ CA , (1996), *Sail Performance theory and Practice*, Adlard Coles Nautical Publishers.
2. VOSSNACK E , (1990), *Fishing vessels*, Rotterdam NE.

3. M .J. GASTON, (1996) , *Tugs Today : Modern Vessels and Towing Techniques*, Patrick Stephens.
4. American society of Civil Engineers, (1994), *Planning and Design guidelines for small crafts Harbour*, American society of civil Engineers.

UG12E2706	High Performance Marine Vehicles	L	T	P	C	hrs
		3	0	0	3	54

Objective: To introduce the students to concepts governing High performing Marine Vehicles and challenges posed to designers.

Unit-I: Classification of high performance vehicles 6 Hrs

Comparison of vehicles on the basis of power - sea keeping and economics - Special design features of high performance vehicles - Materials for high performance marine vehicles; Structural design considerations

Unit - II: High Speed Monohull Crafts 12Hrs

High speed displacement craft: design procedures, estimation of power, systems design considerations; Planning craft: planning phenomena, estimation of power, hull form design,

Unit – III: Hydrofoil craft 10Hrs

Foil types and configurations, design of foils, stability when foil borne; Propulsion considerations;

Unit – IV: Air cushion vehicles types 18Hrs

Air cushion and their effectiveness, cushion sealing arrangements, resistance in calm water and in waves, propulsion and maneuvering arrangements; surface effect ships;

Unit- V: Hybrid Crafts, HPMV market & Future 8Hrs

Novel and Hybrid High speed Craft – Ari Cavity Craft – Foil-Assisted Craft – CAT and HYC Compared – Foil- Assisted SWATH – Semi-SWATH CAT with Bulbous Bow – M Craft. HPMV Market – Market Analysis – HPMV Evolution and Competition – Ferry Routes as Driver for HPMV Development – Naval High-speed Vessel Development – Future Prospects

Text Books

1. LIANG YUN, ALAN BLIAULT, (2012), *High Performance Marine Vessels*, Springer Publishers

2. CHRIS B.MCKESSON, (2014), *The Practical Design Of Advanced Marine Vehicles Hydrodynamics of High Performance Marine Vessels,* Create space.

3. ODD M.FALTINSEN, (2005), *Hydrodynamics of High -Speed Marine Vehicles*, Cambridge University Press.

Reference Books

1. LIANG YUN, ALAN BLIAULT, (2000), *Theory and design of air Cushion Craft*, Arnold Publishers.

2. PROF. LAWRENCE J. DOCTORS, (2015), *Hydrodynamics for High Speed Vessels*, Create space.

3. DONALD L. BLOUNT, (2016), *Performance of Design Hydrodynamics for High Speed Vessels*.

UG12E2707	Port Planning & Infrastructure Facilities	L	T	P	C	Hrs
		3	0	0	3	54

Objective: To expose the student about the basic knowledge of Port Planning and Infra-structure facilities.

Unit – I: Introduction **10 Hrs**

Ports - Major Ports - Role of Ports - Terms related to Port – Harbour - classification of Harbour - Vessel characteristics and Dimensions - Ports and harbours as the interface between the water and land infrastructure - an infrastructure layer between two transport media.

Unit – II: Port Planning **10 Hrs**

Economic and financial feasibility - Traffic projection - Hinterland development - Statutory clearances - Studies required – DPR - EIA clearance - issues of stakeholders.

Unit – III: Basic requirements **14 Hrs**

Tranquility and Maneuverability - Design criteria - site selection and Layout - Environmental conditions - selection of site - Harbour infrastructures - shoreline stability - harbour hydrodynamics. Elements of harbor – navigation channel - turning circle - water front structures - intermodal connectivity - Multipurpose port terminal.

Breakwater: Introduction - Influence of breakwaters on site selection - Relations between breakwater and layout of port - Types of breakwater - Functional requirements – Monitoring – inspection - maintenance and repairs. Material selection - Typical design of Rubble mound breakwater - code provisions.

Unit – IV: Operational and Environmental loads **12 Hrs**

Different types of loads - classification - calculation of loads on the structures - Berthing loads and Fender system Design - Mooring loads and Design principles - Geotechnical Design consideration - Code provisions.

Unit – V: Locks and Gates & Maintenance issues 8 Hrs

Introduction - Types of gates - Dry docks – slipways - erosion and accretion - protective structures - Mechanical handling system in Ports - VTMS. Sedimentation - effect of harbour on shoreline stability - maintenance dredging estimation - considerations for disposal.

Text Books:

1. OZA H.P. & OZA G.H., (1990), *Dock and Harbour Engineering*, Anand Publications
2. KATHIROLI .S & NARASIMHAN .S, *Harbour and coastal Engineering (Indian Scenario) Vol I& II*, NIOT Chennai.

Reference books:

1. T. SINKER GREGORY, (1997), Hand book of Port and Harbour Engineering, Springer Publications.
2. JOHN W. GAYTHWAITE, (2004), *Design of Marine Facilities For Berthing Mooring And Repair Vessels*, ASCE Publications.
3. CARL SORENSEN, (2010), *Port Designer's Hand Book*, ICE Publications.
4. HANS AGERSCHOU IAN DARD, HANNE L. SEVENDSEN et.al, (2004), *Planning and Design of Ports and Marine Terminals*, Thomas Telford Publications.

UG12E2708	Project Management	L	T	P	C	Hrs
		3	0	0	3	54

Unit – I: Concept of Project **6 hrs**

Basic concepts - classification - characteristics of project - Project life cycle - project management tools and techniques of project management - project organisation.

Unit – II: Project Identification **10hrs**

Identification - Generation of Ideas - SWOT analysis - preliminary screening - Project rating index - Market and Demand Analysis - collection of data - market survey - market planning - market environment - project risk analysis - demand forecasting techniques -.

Unit – III: Technical Analysis **15hrs**

Selection of technology - Material inputs and utilities - plant capacity - location and site - machinery and equipment - structures and civil works - environmental aspects - project charts and layouts - PERT - CPM. Linear Programming Formulation of Network Problems - A flow network interpretation for determination of critical paths - Time cost trade off and maximal flow - Chance constrained linear programming for probabilistic durations of activities in PERT network.

Unit – IV: Financial Estimation **20hrs**

Project cost - source of finance - cost of production - financial analysis - characteristics of financial statement - working capital - project income statement - projected profitability - investment evaluation - investment decision rule - techniques of evaluation - payback period. Accounting rate of return - internal rate of return - discounted payback period

Unit - V: Social cost benefit analysis **11 hrs**

Project Scheduling with Limited Resources: Complexity of project scheduling with limited resources - Levelling the demands on key resources - A simple heuristic program for resource allocation. Preparation of project report

Text Books

1. Prasanna Chandra, projects: Planning, Analysis, Implementation and Review, Tata McGraw Hill, 2009
2. Narendra Singh, Project Management and Control, Himalaya Publishing House.

References:

1. Jerome, D. Weist and Ferdinand K. Levy, A Management Guide to PERT/CPM, Prentice Hall of India, New Delhi, 1994.
2. Ravindran, A. Phillips, Don T. and Solberg, Janes J. Second edition, John Wiley & Sons Operations Research: Principles and Practice, 1987.
3. Moder J.V. and Phillips, Project Management with CPM and PERT, C.R.E. Van Nostrand Reinhold Company, 1964.

UG12E2801	Marine Painting & Corrosion Protection	L	T	P	C	Hrs
		3	0	0	3	54

Objective: To develop a Primary knowledge in field of corrosion, surface preparation, paint selection and paint schemes.

Unit – I: Introduction 8 hrs

Corrosion in nature - Corrosion losses - importance of corrosion protection - theories of – corrosion- electrochemical series- types of corrosion - its identification - remedies-factors affecting corrosion – fouling - effect of fouling on ships-factors affecting growth and settlement.

Unit – II: Marine paints & Paint systems 10 hrs

Composition of paints-classification of paints - Primers-mechanism of anticorrosive paint types - selection of paint - paint scheme - antifouling paints-principles of antifouling paints - coating failure. Storage & Application of Paints – Storage - Preparation before application - Application Methods - Application conditions – humidity - temperature-QA & QC-safety & Health. Maintenance of paint systems for ships and offshore structures. Painting contracts and specifications.

Unit – III: Protection of Different parts of Ships under construction. 16 hrs

underwater parts – Boot-top Zone -Topsides and exterior parts on deck & superstructures - Main decks and gangways - cargo holds and tanks - Ballast tanks - Engine rooms - wet & dry accommodation spaces - Requirements for each category and suitable paint systems.

Cathodic protection - Mechanism of cathodic protection - sacrificial anode - design of sacrificial anode system for ship - impressed current system - advantages and disadvantages of cathodic protection. Cathodic protection of offshore structures - control and adjustment of cathodic protection systems - relationship between paits and cathodic proection systems.

Unit – IV: Surface preparation of steel **10 hrs**

Degreasing – weathering - mechanical surface cleaning – pickling - blast cleaning - flame cleaning - rust converters - chemical pretreatment - comparison of pretreatment methods. Surface preparation of galvanized steel - sweep blasting - chemical treatment - mechanical cleaning - surface preparation of Aluminium - Surface preparation grades & roughness. Prefabrication Primers – Requirements - Blast Cleanliness and surface roughness - Dry Film Thickness - types of Primers

Unit – V: Painting of fixed offshore platforms **10 hrs**

Paint systems for submerged zone - tide/splash zone - underdeck area – topsides - working decks and helidecks - high temperature areas - Risers and sea water systems - submerged pipelines.

Text Books:

1. A.M. BERENDSEN, (1989), *Marine Painting Manual*, Graham & Trotman.
2. KENNETH A CHANDLER, (1985), Marine & Offshore Corrosion, Butterworth & Hieneman.

References Books:

1. RAMESH SINGH, (2014), *Corrosion control for Offshore Structures*, Elsevier Publication
2. HARVEY P HACK, (1999), *Designing Cathodic Protection Systems for Marine structures and vehicles*, SNAME.

UG12E2802	Industrial Management	L	T	P	C	Hrs
		3	1	0	4	72

Objective : To equip the student with the knowledge of basic management aspects required in Industrial environment.

Unit – I: Principles & Strategic Management 16hrs

Functional areas of management - production function - marketing function - finance function - Human resource function - and information technology function. Functions of management like planning - organizing - staffing - directing - controlling - decision making and innovation Strategic Management;

Nature of strategic management - Strategic management process - importance - role of operations management in strategic management - elements of production / operation strategy

Unit – II: Quality Management 8hrs

Nature of inspection - quality control - statistical quality control - acceptance sampling techniques - total quality management.- modern quality management - process management - benching marking - business process reengineering - quality circles - quality certification

Unit – III: Materials Management 8hrs

Materials management - objectives of material management - importance of material management - Materials management information systems - materials management organisation - material planning - budgeting - material control - material control cycle

Unit – IV: Enterprise resource planning 6hrs

What is enterprise resource planning - An ERP system - SAP R/3 - ERP implementation life cycle.

Unit - V: Human Resource Management **10hrs**

Employment: job analysis - Human resources planning - recruitment - selection - placement - induction and orientation. Human resources Development: Performance appraisal - training - management development - career planning and development - Organisation development. Compensation - job evaluation - Wage and salary administration - Bonus - Fringe benefits - social security measures. Human relations - Effectiveness of human resources management - organisational health -human resources accounting - audit research.

Text books:

1. K. ASWATHAPPA, K.SRIDHAR BHATT, (2011), *Production and operations research*, Himalaya Publishing house.
2. SARAGI S.K, (2011), *Economics Business and Industrial Management*, Himalaya Publishing house.

Reference Books:

1. O.P.KHANNA,(2003) *Industrial Engineering and Management*, Khanna publishers Ltd
2. JOHN BANK, (1993), *The Essence of Total Quality Management*, PHI.
3. GREG BOUNDS, LYLE YORKS et al, (1994), *Beyond Total Quality Management*, McGrawHill.
4. C. B. MAMORIA, S V GANKAR, (2010), *A Text Book of Human Resource Management*, Himalaya Publishing House.