ANNAMALAI UNIVERSITY

C.A.S. IN MARINE BIOLOGY

FACULTY OF MARINE SCIENCES

M.Sc. FULL TIME INTEGRATED PROGRAM – OCEAN SCIENCE & TECHNOLOGY (2017 – 2018)

SCHEME FOR TEN SEMESTERS

TOTAL CREDITS: 225

First Semester

Code	Subject	Marks	Credits
ITAC 11	Language I	75+25	3
IENC 12	English I	75+25	3
ICEC 13	Civics, Environmental and Health Science	75+25	3
IOST 14	Marine Invertebrates and Prochordates	75+25	7
IOSP 15	Practical I (Covering course IOST 14)	60+40	1
	Total		**17**

Second Semester

Code	Subject	Marks	Credits
ITAC 21	Language II	75+25	3
IENC 22	English II	75+25	3
ICAC 23	Computer Application I	75+25	4
IOST 24	Marine Vertebrates	75+25	7
IANP 25	Ancillary Physics – I	75+25	4
IOSP 26	Practical II (Covering courses IOST 24 & IANP 25)	60+40	2
	Total		**23**

Third Semester

Code	Subject	Marks	Credits
ITAC 31	Language III	75+25	3
IENC 32	English III	75+25	3
ICAC 33	Computer Application II	75+25	4
IOST 34	Ancillary Mathematics – I	75+25	6
IOST 35	Marine Plants	75+25	4
IOST 36	Statistics	75+25	3
IOSP 37	Practical III (Covering courses IOST 35 & 36)	60+40	2
	Total		**25**

Fourth Semester

Code	Subject	Marks	Credits
ITAC 41	Language IV	75+25	3
IENC 42	English IV	75+25	3
IOSA 43	Ancillary Physics – II	75+25	4
IOST 44	Chemistry	75+25	4
IOST 45	Fishery Technology	75+25	7
IOSP 46	Practical IV (Covering courses IOST 43, 44 & 45)	60+40	3
	Total		**24**

Fifth Semester

Code	Subject	Marks	Credits
IOST 51	Physical Oceanography	75+25	3
IOST 52	Chemical Oceanography	75+25	3
IOST 53	Biological Oceanography	75+25	3
IOST 54	Marine Pollution	75+25	3
IOST 55	Ocean & Coastal ecology	75+25	3
IOSP 56	Practical V (Covering courses IOST 51,52,53, 54 & 55)	60+40	5
	Total		**20**

Sixth Semester

Code	Subject	Marks	Credits
IOST 61	Ancillary Mathematics – II	75+25	6
IOST 62	Air – Sea Interaction	75+25	6
IOST 63	Marine instruments for oceanographic Measurements	75+25	6
IOST 64	Fluid Mechanics	75+25	6
IOSP 65	Practical VI (Covering courses IOST 62, 64)	60+40	2
	Total		**26**

Seventh Semester

Code	Subject	Marks	Credits
IOST 71	Marine Geology	75+25	4
IOST 72	Satellite Oceanography	75+25	5
IOST 73	Survey Technology of Coastal Environment	75+25	5
IOST 74	Computer Applications – III	75+25	4
IOSP 75	Practical VII (Covering courses IOST 71, 72, 73 & 74)	60+40	4
	Total		**22**

Eighth Semester

Code	Subject	Marks	Credits
IOST 81	Geographic Information System	75+25	6
IOST 82	Instrumentation and Analytical Methods	75+25	6
IOST 83	Dynamical Oceanography	75+25	6
IOST 84	Ocean Management	75+25	5
IOSP 85	Practical VIII (Covering courses IOST 81& 82)	60+40	2
	Total		**25**

Ninth Semester

Code	Subject	Marks	Credits
IOST 91	Coastal Aquaculture	75+25	6
IOST 92	Coastal and estuarine dynamics	75+25	5
IOST 93	Renewable energy systems	75+25	6
IOSP 94	Practical IX (Covering Courses IOST 91,92 & 93)	60+40	3
	Total		**20**

Tenth Semester

Code	Subject	Marks	Credits
IOST 101	Project Planning Analysis and Management	75+25	6
IOST 102	Underwater Acoustics and Optics	75+25	6
IOSP 103	Practical X (Covering course IOST 102)	60+40	1
IOSP 104	Dissertation and Viva-Voce	120+80	10
	Total		**23**

FIRST SEMESTER

IOST 14 MARINE INVERTEBRATES & PROCHORDATES

Objectives

The marine invertebrates are of ecological and economic significance. Studies pertaining to marine invertebrates are prerequisite. In this regard, the student of ocean science and technology can understand different aspects of invertebrates on classification/systematic, biology , larval development and life history, evolution and paleontology, adaptive radiation and phylogenetic relationship.

UNIT - I

Protozoa and sponges - classification, functional morphology, and life history.
Coelenterate –polymorphism, life history, theories on coral reefs, distribution.

UNIT - II

Endoprocta, Ectoprocta, Phoronida and chaetognatha – Functional morphology and development. Annelida - classification, distribution, morphology and anatomy.

UNIT - III

Crustacean – classification, comparative morphology, crustacean appendages, and larval forms.

UNIT - IV

Mollusca –classification, general characters, torsion and adaptive radiation.

UNIT - V

Echinodermata –classification, water vascular system, reproduction and larval forms.
Prochordates- classification, reproduction and early development.

PRACTICALS

IOST 14 Marine Invertebrates & Prochordates

1. Identification of coastal invertebrate fauna of Parangipettai
2. Mounting of gastropod radulae
3. Mouth parts of *Squilla* and appendages of shrimps
4. Anatomy of shrimp, gastropod and bivalve

Text Books

1. Kaestner, A.1967, Invertebrate zoology, Vols. I to III. Wiley Interscience Publisher, New York.
2. Barnes, R.D., 1980. Invertebrate zoology. 4th Edition. Saunders College Publishers, Philadelphia.
3. Ruppert, E.E and R.D.Barnes, 1994. Invertebrate zoology, 6th edition. Saunders College Publishers, Philadelphia.
4. Hyman, L.H. 1967. The Invertebrate Zoology, McGraw-Hill Book Co. New York.

IOSP 15 PRACTICAL I (Covering course IOST 14)

SECOND SEMESTER

IOST 24 MARINE VERTEBRATES

Objectives :

The objectives of this paper is to impart knowledge on morphology, classification and identification, biology of vertebrates (finfish, reptiles ,birds and mammals) in the marine environment.

UNIT - I Teleost fishes

General characters and classification - Origin of fishes - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance. General morphology,anatomy and outline of classification of fishes- identification of teleost fishes– digestive and reproductive system of fish.

UNIT - II Elasmobranchs

General characters-External morphology of Sharks, skates and Rays. Type study: *Scoliodon, Rhiniodon* and *Dasyatis* - Types of fins and dentition – Respiratory structure - Parental care - Economic importance.

UNIT - III Reptiles

Reptilia: General characters and classification - Type study - sea turtles, crocodiles, sea snakes – Importance of the reptiles - Origin of reptiles and effects of terrestrialisation - Extinct reptiles.

UNIY - IV Birds

Aves: General characters and classification - Type study – Gulls, water fowls, terns, Albatross and raptors Origin of birds -- Flight adaptations – Migration-Polar birds-penguins-General characteristics and biology of marine birds in marine environment.

UNIT - V Marine Mammals

General characters of marine mammals – their taxonomy and classification, adaptations and evolution of Cetacea and Sirenia. Pinnipeds- manatees, dugongs, polar bears and sea otters .Anatomy, physiology, diversity, distribution, habitat loss, degradation, conflict with fisheries, Aquatic adaptations for respiratory and circulatory mechanisms. Changes threat to marine mammals. Endangered marine mammals.

Practical

1. External morphology of fishes teleost and elasmobranch-scales and teeth
2. Dissection of digestive system of a teleost fish
3. Studies on food and feeding habits of finfish
4. Identification of elasmobranchs-sharks, skates and rays
5. Identification of teleost fishes
6. Identification of marine reptiles-sea snakes, turtles and crocodiles
7. Identification of sea birds
8. Anatomy of marine mammals – identification of sea mammals

Text Books

1. Biswas, K.P., 1996. A Text Book of Fish, Fisheries and Technology, II ED. Narendra Publishing House, Delhi, India.
2. Dholakia, A.D., 2004. Fisheries and Aquatic resources of India. Daya Publishing House, Delhi.413 pp.
3. Lagler, K.F., J.E. Bardach and R.R. Miller, 1962. Icthyology. John Wiley & Sons Inc., New York.
4. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata) S.Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
5. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.

Reference Books

1. Carl E. Bond, 1979. Biology of fishes.W.B.Saunders Company, Philadelphia
2. Jones, E.R.H., 1980. Fish migration. Edward Arnold Ltd., London
3. Srivastava , C.B.L., 1999. Fish Biology. Narendra Publishing House, New Delhi (India)
4. Colbert, Edwin, H. 1989. Evolution of the vertebrates. Wiley Eastern Ltd., New Delhi. P. 535.
5. Orr R.T. 1976. Vertebrate Biology. W.B. Sanunders Company, Philadelphia
6. Jefferson, T. A. , Webber, M. A. & Pitman, R. L. 2009. Marine Mammals of the World A Comprehensive Guide to their Identification London ; Burlington, MA: Academic ISBN 978-0-12-383853-7 7-16
7. Whitehead, H., Reeves, R. R. & Tyack, P. L. 1999.Science and the conversation, protection and management of wild cetaceans (eds) J. Mann , R. C. Connor, P.L Tyack & H Whitehead in Cetacean societies : field studies of dolphins and whales. Chicago : University of Chicago Press ISBN 226503402
8. Clapham, P.J., Young, S.B. & Brownel Jr.R.L. 1999. “Baleen whales; conservation issues and the status of the most endangered populations” Mammal Rev. 29(1); 35-60

IANP 25 Ancillary Physics I

Objective:

- Understand the basic concepts of elasticity, Surface tension and viscosity their practical applications.
- Explain the behaviour of thermal expansion of solids, liquids and gases.
- Explain the SHM and Ultrasonics
- Explanation of geometrical and physical optics.
- Explanation of Electromagnetic spectrum, uv radiation, radiation dose effects.

Unit-1 Mechanics and General Properties of Matter:

Elasticity: Strain and stress, elastic limit, Hooke's law; Moduli (Young's, Bulk, Rigidity) and

Poisson's ratio, Surface tension: Surface tension and surface energy, angle of contact, capillary action, Flow of liquids and gases: Streamline and turbulent flow, equation of continuity, Bernoulli's theorem, Torricelli's theorem; Coefficient of viscosity, Reynold's number and critical velocity, Stoke's law; Turbulence and chaos.

Unit-2 Thermal Physics:

Thermodynamics: Laws of thermodynamics and interpretation; derivation from first principles; Entropy and disorder, free-energy and chemical potential. Brownian motion: Elementary ideas of Brownian motion, equipartition energy; Random Walk and Stochastic processes (additive and multiplicative), Diffusion: Mean free path and drift speed.

Unit-3 Sound:

Simple harmonic motions – Progressive Waves – properties – Composition of two S.H.M and beats Stationary Waves – Properties – Melde's experiments for the frequency of electrically maintained tuning fork – transverse and longitudinal modes – Acoustics – Ultrasonics – Properties and application.

Unit-4 Optics:

Light: Fermat's principle of least time, reflection and refraction. Geometrical optics: Focal length of a spherical surface and lens; magnification; compound lenses; resolving power. Interference: Young's double-slit experiment and mathematical formulation . Diffraction: Fraunhoffer and Fresnel diffraction; Grating. Refractive index, dispersion and absorption. Polarization, birefringence and Kerr effect; Polarizers; Optical activity.

Unit-5 Radiation Effects on Biological Systems:

Electromagnetic spectrum, Effects of visible, ultraviolet and high energy radiation on biological systems – Natural and artificial isotopes – alpha, beta and gamma radiation - GM counter and Scintillation counter. Radiation effects of living systems. Medical and biological applications

Practical

1. Vernier microscope -radius of capillary tube
2. Young's modulus - Non-uniform bending - Pin & microscope
3. Young's modulus - Uniform bending - Optic lever
4. Rigidity modulus - Torsional pendulum (without identical masses)
5. Rigidity modulus and moment of inertia - Torsional pendulum (With identical masses)
6. Surface tension and inter facial surface tension drop weight method
7. Coefficient of viscosity of liquid - Graduated burette (radius of capillary tube by
   Mercury pellet method)
8. Sonometer - verification of laws and frequency of tuning fork
9. Meldes string-Transverse and Longitudinal modes.
10. Specific heat capacity of a liquid - Newton's law of cooling
11. Specific heat capacity of liquid - Method of mixtures (Half- time correction)
12. Focal length, Power, R and u of a long focus convex lens
13. Focal length, Power, R and u of a concave lens

Text Books:

1. Mechanics – D.S.Mathur – S.Chand & Co.,
2. Heat and Thermodynamics – Brijlal & N. Subramaniyam – S.Chand & Co.
3. A text book of sound–Brijlal & N. Subramanyam S.Chand & Co.,

Reference Books:

1. University Physics: Sears and Zemansky. Addison-Wesley; 10th edition, 1999. ISBN-10: 0201603225 ISBN-13: 978-0201603224.
2. The Feynman Lectures on Physics (Vols. 1 and 2): R.P. Feynman, R.B. Leighton and M. Sands. Narosa Book Distributors Pvt Ltd. 2008. ISBN-13 9788185015828 ISBN-10 8185015821
3. Fundamentals of Optics: F.A. Jenkins and H.E. White. McGraw-Hill 1957
4. Biological Physics: Nelson. W. H. Freeman, 2003. ISBN1429280751, 9781429280754

IOSP 26 : Practical – II (Covering IOST 24 & IANP 25)

THIRD SEMESTER

IANM 34 – Ancillary MATHEMATICS - I

Objectives:

On completion of the course the students will familiar with Matrices and Determinants, simultaneous linear algebraic equations, numerical differentiation, Numerical solution of Ordinary differential equations and Theory of equations

UNIT I – Theory of Equations

Relation between the roots and coefficients of equations – Transformation of Equations – Diminish and increase the roots – Reciprocal Equations.

UNIT II - Matrices and Determinants

Basic definitions of matrices – Multiplication of matrices – Determinants – Inverse of matrices – Solution of simultaneous linear equations using Cramer's Rule – Solution of simultaneous linear equations using Matrix method.

UNIT III – Solution of Simultaneous Linear Algebraic Equations

Direct Methods – Gaussian Elimination Method – Gauss Jordan Method – Crout's Method – Indirect Methods – Gauss – Seidel iterative method – Relaxation Method – Finding inverse using Gaussian Method.

UNIT IV – Numerical Differentiation

Lagrange's interpolation formula for unequal intervals to find the derivative - Newton – Gregory Forward difference formula to compute the derivatives - Newton – Gregory Backward difference formula to compute the derivatives – Newton – Gregory Central difference formula to compute the derivatives.

UNIT V - Numerical solution of Ordinary differential equations

Taylor's Series Method for first and second order differential equations – Euler's Method – Improved Euler's Method - Modified Euler's Method – Runge – Kutta Method of second order, third order and fourth order.

TEXT BOOKS

1. Narayanan, S. Manikavachagam Pillai, T. K, 2003. Calculus, Volume – I, S. Viswanathan Private Limited, Chennai.
2. Singaravelu, A. 1999. Numerical Methods, Meenakshi Agency, 1999

REFERENCE BOOKS

1. Vittal, P.R, 2006. Allied Mathematics, Margham Publishers, Chennai.
2. Dr.Venkataraman, M. K., Numerical Methods in Science and Engineering, National Publishing House, New Delhi.
3. Sarma S, 2007. Numerical methods, Narosa Publications. Chennai.
4. Sastry, S.S. 1999. Introductory methods of Numerical methods, Prentice Hall of India, New Delhi.
5. Veerarajan, T. 2004. Engineering Mathematics, Tata Mc Graw Hill Publishing House, NewDelhi.

IOST 35 MARINE PLANTS

Objectives

This paper covers the general introduction to the marine microbes, non-flowering and flowering plants of the coastal and marine environs. This also covers the aspects relating to productivity, economic and ecological importance including ecosystem services. Laboratory culture of microbes and field cultivation and transplantation are emphasized in addition to the identification of marine microbes to mangroves.

UNIT - I Marine Microbial Flora

General characteristics of marine microbial flora – viruses, bacteria, actinobacteria and fungi -occurrence and distribution in the oceans,- microbial associations- importance of marine microbial flora.

UNIT - II Marine Phytoplankton

Marine phytoplankton - diatoms, dinoflagellates, coccolithophoids, cyanobacteria - importance as primary producers, harmful algal blooms - red tides – causes and effects - laboratory culture of phytoplankton.

UNIT - III Seaweeds

Seaweeds - Chlorophyceae, Pheophyceae and Rhodophyceae – distribution, economical importance, cultivation and use as biological indicators.

UNIT – IV Seagrasses

Seagrasses - Composition - distribution in tropical and temperate waters – adaptation, ecological and economical importance – threats, conservation and transplantation.

UNIT – V Mangroves

Mangroves – definition- distribution – types of mangrove forests- adaptations - economic and ecological importance.

Practical

1. Isolation of marine microbes (*Vibrio*, *Bacillus, Streptomyces, Penicillium*)
2. Collection, preservation and identification of marine phytoplankton (Bloom formers)
3. Collection, preservation and identification of seaweeds
4. Collection, preservation and identification of seagrasses
5. Collection, preservation and identification of mangroves

Text Books

1. Dawes, C. J., 1997. Marine botany, 2nd edition. John Wiley, USA.
2. Prescott et al., 1999. Microbiology. The McGraw- Hill companies, Inc.
3. Luning, K., 1990. Seaweeds, their environment, biogeography and ecophysiology. Cambridge University Press, USA
4. Kathiresan, K., and S. Z. Qasim, 2005. Biodiversity of Mangrove ecosystems. Hindustan Publishing Corporation, New Delhi, 251pp.
5. Pirog, R. S., 2011. Seagrass: Ecology, uses, and threats. Nova Science Publishers.

Reference Books

1. Alexopoulos *et al.,* 1996. Introductory Mycology. John Wiley and sons, Inc.
2. Hemminga, M. A. and C. M. Duarte, 2000. Seagrass Ecology. Cambridge University Press, UK.
3. Hurd, C. L., P. J. Harrison, K. Bischof, C. S. Lobban, 2014. Seaweed Ecology and Physiology, 2nd edition. Cambridge University Press, Brazil.
4. Kersey, W. T., and S. P. Munger, 2009. Marine Phytoplankton. Nova Science Publishers, Incorporated.
5. Raghukumar, C., 2012. Biology of marine fungi. Springer.

IOST 36 STATISTICS

Objectives:

Students will be able to:

- distinguish between categorical and quantitative variables or data and, within each type, respectively, to distinguish between ordinal and non-ordinal categorical variables and between discrete and continuous quantitative variables.
- define distributions and frequency tables.
- distinguish between bimodal, unimodal, normal, leptokurtic, platykurtic, skewed, and symmetric distributions
- construct histograms from raw data, including setting category boundaries for continuous data (or discrete data with low frequencies within data classes).
- calculate the value of a summation notation expression.
- calculate summary statistics (mean, mode, median, range, interquartile range, standard deviation, and variance) from raw data.

UNIT I

Scope and limitations of Statistics, Type of Data. Concept of a statistical population; qualitative and quantitative data. Presentation of data: construction of tables with one or more factors of classification. Diagrammatic and graphical representation of grouped data. Frequency distribution, cumulative frequency distributions and their graphical representation, histogram. Frequency polygon, ogives.

UNIT II

Basic concepts of sampling – simple random sample, stratified sample and systematic sampling. Sampling distribution and standard error. Measures of averages – mean median and mode – their use in biological studies. Dispersion for biological characters – quartile deviation, mean deviation and standard deviation and coefficient of variation. Measures of skewness and Kurtosis.

UNIT III

Small sample tests – Student ‘t’ test for mean, difference of two means, Paired ‘t’ test, test, test for correlation and regression coefficients. Chi-square test for goodness of fit and independence of attributes. ‘F’ test for equality of variances.

UNIT IV

Correlation and Regression – Rank correlation – regression equations. Simple problems based on biological data.

UNIT V

Fundamentals of computer-computer hardware - computer software and operating systems-classification of computers-fundamentals of Windows, Excel, Word & Power Point-Applications of computer in general-data analysis using packages (SPSS)-Editing, Data tabulation, graph plotting.

PRACTICALS

1. Methods of sampling and collection of biological data.
2. Calculation of mean, median, mode, standard deviation, standard error and coefficient of variation, kurtosis, skewness, t and χ^2
3. Calculation of correlation coefficient values and finding out the probability values.
4. Calculation of b and a values and plotting of regression lines.
5. Calculation of F value and finding out the probability value for F value.

TEXT BOOKS

1. Simpson,G.F.Katka, 1965. Basic statistics
2. Siegel,S., 1956.Nonparametric statistics for the behavioral sciences. McGraw-Hill book company, Inc., New York.
3. Pearce, S.C. 1965. Biological statistics.
4. Lindgren,B.W. and G.W.McElrath, 1966. Introduction to probability and statistics.
5. Beyer, W.H., 1974. Hand book of tables for probability and statistics.

SUGGESTED BOOKS

1. Avely,N. and K.R.Buch, 1966. Introduction to the theory of probability and statistics.
2. Sankaranarayanan,G. 1969. Elementary theory of mathematical statistics and its application.
3. Kenny, J.F. and F.S. Keeping. 1963. Mathematics of statistics.
4. Mood,A.M. et al. 1973. Introduction to the theory of statistics.

IOSP 37: Practical – III (Covering IOST 35 & 36)

FOURTH SEMESTER

IANP43 Ancillary Physics II

Objective:

- To understand the basic concepts of elasticity, ballistic Galvanometer, Potentiometer and their practical applications.

- Explanation of the basic concepts of magnetic materials, electric and magnetic circuits, Ferrites.

- Explanation of the Photo electric effect, Wave mechanics

- To understand characteristics of nuclear forces, particle accelerators and elementary particles

- Explanation of laser actions, applications of lasers and Laser Raman Spectrometer

Unit-1

Electricity: Conversion of Galvanometer into Ammeter and Voltmeter – figure of merit of a galvanometer – Ballistic Galvanometer – theory and charge of sensitiveness – measurement of capacitance – measurement of Themo EMF and resistance by potentiometer – applications of electromagnetic induction – Transformers – theory, energy loss and applications.

Unit-2

Magnetism : Basic concepts of magnetic materials – magnetic properties of Dia, Para and Ferro magnetic materials – Area of (B-H) loop – electric and magnetic circuits – Curie temperature – applications of Ferrites in computer memory.

Unit-3

Modern Physics: Photo electric effect – Einstein's photo electric equation – verification of Einstein's photo electric equation by Millican's experiment – photo electric cells – applications.

Wave mechanics: De Broglie matter waves – characteristics and calculation of De Broglie wave length – experimental study of De Broglie matter wave by G.P.Thomson experiment

Unit-4

Nuclear Physics: characteristics of nuclear forces – nucelar structure by liquid drop model – binding energy – mass defect – particle accelerators – cyclotron and betatron – artificial transmutations by α - particles – nuclear fission and nuclear fusion – elementary particles – Leptons, Measons and Baryons.

Unit-5

Laser physics: Purity of spectral lines – Coherence length and time – spontaneous and induced emissions – population inversion – meta stable state – conditions for laser actions – Ruby laser - Helium – neon laser – applications of lasers – Raman effect – Raman Shift – stokes and anti stokes lines – Laser Raman Spectrometer

Practical

1. Potentiometer – Ammeter calibration

2. Potentiometer – Low range voltmeter

3. Potentiometer – emf of a thermocouple

4. M and H – absolute determination using deflection and vibration magnetometer

5. Field along the axis of the coil – Determination of M

6. Moment of magnet – Tan C position

Text Books:

1. Murugesan R., 2008. Electricity and magnetism. S.Chand & Co, New Delhi

2. Brijlal and subramanian, 2005. Electricity and magnetism – Ratan Praksshan Mandhir, Delhi

3. Murugesan R., 2004. Modern Physics S.Chand & Co, New Delhi

4. Gaur, R.K. and S.L.Gupta, 2013. Engineering Physics, Dhanpat Raj Publications.

Reference Books:

1. Vasudeva, D.N., 2005. Electricity and Magnetism. S.Chand & Co, New Delhi

2. Thygarajan, K and Ajoy Ghatak, 2011. Lasers: Fundamentals and Applications. Springer

3. Arumugam, M. 2008, Engineering Physics, Anuradha Publications

IOST 44 CHEMISTRY

Objectives:

To get a good exposure to the basic concepts of chemistry to enable them to pursue careers related to chemistry.

UNIT-1: Metallurgy

Mineral wealth of India - Important minerals in India - Minerals exported and imported to India. Basic principles of metallurgy - Extraction of the following metals: Fe, Cr, Pb and Zn. Manufacture of steel and stainless steel, heat treatment of steel - General methods of preparation and properties of alloys of the following metals: Zn, Cu, Pb, Ni, Fe and Cr.

UNIT- 2: ORGANIC CHEMISTRY

Electronic displacement effects: Inductive, resonance and steric effects. Their effect on Ka and Kb on organic acids and bases - Organic reaction mechanisms: SN1 Vs. SN2 reaction of alkyl halides : mechanism only - Aromatic electrophilic substitution; nitration, halogenation, Friedel - Craft's alkylation and acylation

UNIT- 3: PHYSICAL CHEMISTRY

Solutions: Types and examples of solutions: gas in liquid and liquid in liquid (totally miscible, partially miscible and immiscible liquid pairs) - Henry's and Raoult's laws, ideal and real solutions, deviation from ideal behaviour-Vapour-Pressure composition diagram for a totally miscible binary liquid system obeying Raoult's laws- Partially miscible liquid system (Phenol-water) - Phase Rule: Definition of phase, component and degree of freedom, Phase rule (statement only) - Application of phase rule to a one-component system (water)

UNIT-4: KINETICS AND CATALYSIS

Rate expression for I and II order, methods of determining order of a reaction, order and molecularity - Catalysis : homogeneous and heterogeneous, catalyst used in Contact and Haber's processes - Concept of energy of activation and Arrhenius equation – technologically important catalysis.

UNIT- 5: INDUSTRIAL CHEMISTRY

Natural rubber: Composition, cis-structure, elasticity, manufacture and uses of synthetic rubber (neoprene, Buna-S), Vulcanization of rubber-Plastic: Manufacture and uses of PVC, Bakelite, acrylates, PET, PUF, and Polystyrene

Corrosion: Causes of corrosion of metals, Prevention: Galvanization, electroplating and cathodic protection.

Practical

a) Identification of acidic, basic, phenolic and neutral organic substances

b) Detection of N, S and halogens

c) Test for aliphatic and aromatic nature of substances.

d) Test for saturation and unsaturation.

e) Identification of functional groups

i) Carboxylic acid
ii) Phenols
iii) Aldehydes
iv) Ketones
v) Esters
vi) Carbohydrates
vii) Primary amines
viii) Amides

Text Books :

1. C.N.R. Rao, University General Chemistry, Macmillan Co., India Ltd, 1973.

2. M.J. Sienko and R.A. Plane, Chemistry – Principles and properties, International Student Edition. 1995.

3. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons (1995).

4. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.

5. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry(Organic), S. Chand and Co., 1987.

Reference Books :

1. G.C. Hill, J.S. Holman, Chemistry in Context, ELBS, 1998

2. W.R. Kneen, M.J.W. Rogers, P. Simpson, Chemistry – Facts, patterns and principles, ELBS., 1999.

3. Bruce H. Mahan, University Chemistry, 3rd edition, Addition-Wesley Publishing Company,1977.

IOST 45 FISHERY TECHNOLOGY

Objectives:

The objective of this paper is to make the students familiarize the major and minor fishery resources of the world and our country apart from imparting knowledge about the common crafts and gears used for fishing. Further this paper also deals with the preservation and processing of the catch

UNIT I : Introduction to Marine Fisheries

Major and Minor marine fisheries of the world and India. Present status of world and Indian capture fisheries. Fishery resources of EEZ of India,

UNIT II : Methods of fishery survey

Methods of surveying the fishery resources – acoustic method, aerial method, survey of fish eggs and larvae.

UNIT III : Fishery population assessment

Population dynamics, theory of fishing, mortality, natality, recruitment, fishing pressure, Analysis fish population : assessment of growth – direct and indirect methods, fecundity, fish tagging & marking and recapturing.

UNIT VI : Fishing crafts and gears

Principle methods of exploitation of sea fishes – indigenous and modern crafts and gears – catamarans, country boats, trawlers, modern vessels with refrigeration facility, types of nets - cast net, gill net, trawl nets, purse seine, hook and line etc., mesh size regulation.

UNIT V : Preservation and processing

Principles of preservation and processing. Types of fish spoilage and causative factors. Principle methods of fish preservation and processing in India and other countries.

Practical

1. Identification of fish eggs and larvae
2. Local crafts and gears used
3. Estimation of fecundity and Ova diameter studies
4. Methods of fish preservation and processing techniques
5. Different fish tags
6. Field visit to seafood processing industries and fishing harbours

Text books

1. Biswas, K.P., 1996. A Text book of Fish, Fisheries and Technology, H ED. Narendra Publishing House, Delhi, India, 396 p.
2. Dholakia, A.D., 2004. Fisheries and Aquatic resources of India. Daya Publishing House, Delhi, 413 pp.
3. Lagler,K.F., J.E. Bardach and R.R. Miller, 1962. Ichthyology, John Wiley & Sons Inc., New York, 545 p.
4. Bal, D.V. and K.V. Rao, 1990. Marine Fisheries of India. Tata McGraw Hill Publishing Company Limited, New York, 472p.
5. Mohan Joseph,M. and A.A.Jayaprakash, 2003. Status of exploited marine fishery resources of India, 308 p.

Reference Books

1. Carl E. Bond, 1979. Biology of Fishes, W.B. Saunders Company, Philadelphia, 514 p.
2. King, M., 1995. Fisheries Biology, Assessment and Management, Fishing News Books, 341 p.
3. Shanmugam, K., 1990. Fishery Biology and Aquaculture, Leo Pathipagam, Madras, India.
4. Nelson, J.S., 2006. Fishes of the world, 4th edition, John Wiley and sons inc., New Jersy USA, 601 p.
5. Bore, Q. and R.H. Moore, 2008. Biology of fishes, 3rd edition, Taylor and Francis group, NY, 478 p.

IOSP 46: PRACTICAL- IV (covering IANP 43, IOST 44 & IOST 45)

Fifth semester

IOST 51 PHYSICAL OCEANOGRAPHY

Objectives:

The main emphasis of the course will be on physical forces in the ocean, especially those forces that drive ocean waves and tides. The student will be expected to understand concepts relating to formation, classification and theories of waves and tides. Coastal processes including estuaries and tidal influences will also be covered.

UNIT – I: Physical Properties of seawater

Physical properties of sea water- distribution of temperature, salinity and density-surface tension and viscosity -Water masses: formation and classification, TSdiagram-Heat budget of ocean –acoustical and optical characteristics of seawater – SOFAR channel –shadow zone – colour of the sea.

UNIT – II: Waves

Formation and characteristics of wind waves and swells-significant wave height and period-wave spectrum. Wave generation – Fetch limited, duration limited and wind speed limited conditions. Theories of wave generation. Wave prediction – SMB and PNJ methods.

UNIT – III: Small amplitude waves

Small amplitude waves –Phase speed, particle velocity, particle displacement, wave pressure, standing waves- Group velocity-Wave energy-Shallow water wave transformation, Internal waves. Coastal sediment transport -limits for littoral drift, suspended and bed load movement, long shore sediment transport rate.

UNIT – IV: Finite amplitude waves

Finite amplitude waves: Girstner's wave – phase speed, vorticity, surface profile correct to third order. Stokes wave – Surface profile correct to third order, phase speed, Stoke's drift. Crapper's wave, Cnoidal wave, Solitary wave. Phase speed of a long wave. Kelvin waves, Rossbywaves, Tsunamis, Storm surges and Seiches.

UNIT – V: Tides

Ocean Tides: Tide generating forces, theories of tide, tide analysis and prediction,

Harmonic analysis and Fourier spectrum analysis. Tides in estuaries and ocean regions.

Amphidromic points – Tidal bores and tidal currents.

Practicals

1. Water sampling devices – Mayer's water sampler, Knudsen water sampler, Nansen water sampler, Universal water sampler, Horizontal water sampler, Bacteriological water sampler.
2. Light measuring devices – Secchi disc, Luxmeter, Turbidity meter.
3. Temperature and pressure measuring devices – towing surface thermometer, Six's maximum and minimum thermometer, Reversing thermometer, Bathythermograph, Fortin's barometer
4. Current measuring devices – Watt's current meter, direct reading current meter.
5. Bottom sampling devices – Ekman's dredge, Petersen grab, Vertical gravity corer, Ooze sucker, and Mud snapper.
6. Depth measuring devices – Echosounder.
7. Measurement of density and specific gravity
8. Surface tension and inter facial surface tension - drop weight method.
9. Coefficient of viscosity of liquid - Graduated burette (radius of capillary tube by Mercury pellet method).

Text Books

1. Duxbury, A.C., A.B.Duxbury&K.A.Sverdrup, 2000. An Introduction to the World's oceans. Wm.C.Brown Publishers.
2. McCormick,J.M. and J.V.Thiruvathakal, 1976. Elements of Oceanography. W.B.Saunders, Philadelphia.
3. Pickar,G.L. and W.J.Emergy, 1995. Descriptive Physical Oceanography – an Introduction, Pergammon Press, London.
4. Svedrup, H.U., M.W. Johnson and R.H.Flemming, 1958. The Oceans –their Physics, Chemistry and General Biology. Prentice –Hall Inc., New Jersey.
5. Kinsman. B., 1965, Wind waves, their generation and propagation of ocean waves, Dover Phoenix edition Englewood cliffs publisher, N.J: prentice- hall.

Reference Books

1. Parker, S.H. 1985. Exploring the Oceans, Prentice Hall, New Jersey
2. McIlveen, R. 1995. Fundamentals of weather and climate. Chapman and Hall.
3. Bigg,G.R. 1996. The oceans and climate, Cambridge University Press.
4. Qasim, S.Z., 1999. The Indian Ocean, Images and Realities, Oxford and IBH.
5. Neshyba, S. 1987. Oceanography: Perspectives on the fluid earth. John Wiley & Sons, New York.

IOST 52 CHEMICAL OCEANOGRAPHY

Objectives:

Students should be able to:

Describe the important processes controlling the distribution of chemical species in seawater and sediments. Calculate the average duration of different elements in the ocean. Describe the interaction between marine chemical processes and the biological, geological, and physical processes in the oceans Explain the impact of chemistry of the oceans on the future of planet Earth.

UNIT I

Distribution of water on the earth, hydrological cycle - Ocean as a chemical system, structure of water molecules, differences between freshwater and seawater.

UNIT II

Chemical composition of seawater - concept of chlorinity and constancy of composition of seawater. Major and minor constituents, trace element, their distribution and importance.

UNIT III

Dissolved gases – carbon dioxide, oxygen, nitrogen, hydrogen sulfide, noble gases, methane, origin, distribution and importance in the marine environment. Ozone depletion and global warming.

UNIT IV

Organic matter – dissolved and particulate, source classification, distribution and seasonal variation. Ecological significance – growth promoting and growth inhibiting effect, humic substances.

UNIT V

Nutrients – inorganic nutrients, origin, role in productivity. Significance of Redfield ratio. Speciation of nutrients and their distribution and cycling. Analytical methods.

Practicals

1. Salinity
2. Alkalinity
3. Dissolved oxygen
4. Calcium and magnesium
5. Nitrite and nitrate
6. Reactive phosphate
7. Silicate

Text Books

1. Riley,J.P. and R.Chester, 1971. Introduction to Marine Chemistry, Academic Press, London.
2. Riley, J.P. and G.Skirrow, 1975-1984. Chemical Oceanography. Vol.1-8. Academic Press, London.
3. Strickland,J.D.H. and T.R.Parsons, 1972. A practical handbook of seawater analysis. Fisheries Research Board of Canada, Bulletin, 167, Ottawa.

Suggested Books

1. Baretta-Bekker, J.G., E.K.Duursma and B.R.Kuipers (Eds.), 1992. Encyclopedia of Marine Sciences, Springer-Verlag, Berlin.
2. Pilson, M.E.Q. 1998. An Introduction to the Chemistry of the Sea, Prentice hall, New Jersey.
3. Duxbury, A.C., A.B.Duxbury & K.A.Sverdrup, 2000. An Introduction to the World"s oceans. Wm.C.Brown Publishers.
4. Anikochine, W.A. and R.W.Sternberg, 1973. The world oceans: Introduction to oceanography, Prentice-Hall.

IOST 53 BIOLOGICAL OCEANOGRAPHY

Objectives:

This paper will help students of Ocean Science & Technology to gain a basic knowledge about different groups of marine organisms, their occurrence and distribution with regard to space and time, in addition to biological oceanographic processes, current attempts and methodologies to address them.

Unit 1

Sea as a biological environment- classification and characteristics of marine environment – light, temperature, salinity, pressure and water movement. Comparison of marine and terrestrial environment.

Unit 2

Plankton: Phytoplankton and zooplankton - their inter relationships, primary and secondary production, vertical migration. Phyto- and zooplankton - methods of collection, preservation, estimation of standing crop.

Unit 3

Nekton: Environmental characteristics, composition, adaptations, body shape, defence, camouflage, sense organs, echolocation, reproduction, life cycle and migration.

Unit 4

Characteristics of the benthic environment – classification of benthos, intertidal, interstitial and deep-sea-adaptations of benthic organisms. Distribution and zonation patterns in the intertidal zone, biotic and abiotic regulation of zonation. Adaptation to deep sea environment, Bioluminescence.

Unit 5

Biological processes: marine primary production - carbon sequestration - detritivory and herbivory - predation, parasitism and pathogenesis - fouling and boring-competition and succession - dispersal and settlement-marine food chains.

Practical

1. Identification of phytoplankton and zooplankton (diatoms, dinoflagellates, hydromedusae copepods, pterpods, chaetognatha, thaliaceae and planktonic larvae). Identification of locally available macroalgae, seagrass and halophytes including mangrove plants.

2. Determination of primary production using light and dark bottle technique.

3. Benthic fauna of marine and estuarine environment-collection and identification.

4. Field trips to study animal communities in different biotopes- mud flat, sandy and rocky shores, mangroves, oyster beds, fouling and boring organisms, symbionts, parasites, commensals and phytal fauna.

Text Books

1. Kathiresan, K., 2014. Ocean and coastal ecology. Scientific Publishers, India. 384pp.
2. Nybakken, J.W., 1997. Marine Biology – an ecological approach. Addison Wesley Edu. Pub. Inc.
3. Raymont, J.E.G., 1973. Plankton and Productivity in the oceans, Pergamon Press, London.
4. Boney, A.D., 1975. Phytoplankton, Edward Arnold, London.
5. Lalli, C.M. and T.R. Parson, 1993. Biological oceanography: an introduction. Pergamon Press Ltd.

Reference books

1. Barnes, R.S.K. and R.N. Hughes, 1999. An introduction to marine ecology. Blackwell Sciences.
2. Castro, P., and M. Huber, 2012. Marine Biology: 9th Edition. McGraw-Hill Higher Education.
3. Garrison, T., 2011. Essentials of Oceanography: 6th edition. Cengage Learning.
4. Garrison, T., 2012. Oceanography: An Invitation to Marine Science – 8th edition. Cengage Learning.
5. Karleskint, G., R. Turner, and J. Small, 2012. Introduction to Marine Biology: 4th edition. Cengage Learning.

IOST 54 - MARINE POLLUTION

Objectives:

The objective of this course is to provide students with an understanding of the sources, links and biological effects of major classes of pollutants in the marine environment. The course will help prepare students for careers in academic programs, research centers and consulting firms by providing them with an in-depth understanding of causes, consequences and methods of assessment of marine pollution.

UNIT I

Definition, major pollutants, sources, transport pathways, monitoring methods, biological indicators, bioaccumulation and biomagnification.

UNIT II

Sewage, industrial, agricultural and domestic discharges. Composition of sewage, impacts on marine environment, treatment methods (primary, secondary and tertiary). Detergents – composition –eutrophication and ecological significance.

UNIT III

Heavy metal pollution – sources, distribution, fate, toxicity and diseases. Pesticide pollution –classification and composition, sources, transport, distribution, fate and ecological impact in the marine environment.Radioactive pollution – sources (natural and artificial), distribution, biological effects of radiation. Plastics and litter – impact of mining and dredging.

UNIT IV

Oil pollution – composition, sources, and fate of spilled oil, biodegradation and biological impact of oil on marine life.

Thermal pollution – sources, waste heat disposal, uses of waste heat and ecological impacts.

UNIT V

Environmental Impact Assessment (EIA) – Environmental Impact Statement (EIS) – Environmental Risk Assessment (ERA) – Legal and Regulatory aspects.

Methods for Impact Identification — Public participation in environmental decision making – Decision Methods for Evaluation of Alternatives – Mitigation measures – Environmental Monitoring Plan.

Case studies of EIA of developmental projects and projects on coastal areas

Practical

Analysis and estimation of critical pollutants.

1. Estimation of Ammonia (NH_3)
2. Estimation of hydrogen sulfide (H_2S)
3. Estimation of BOD
4. Estimation of COD
5. Pesticide residue in seawater
6. Petroleum hydrocarbon in seawater
7. Heavy metals (Cu, Cd, Pb, Hg) in seawater, sediments & animal tissues,

Text Books

1. Carl J. Sindermann, 1995. Ocean Pollution: Effects on Living Resources and Humans (275 pp) 7/176 – CRC press, Baca Raten Tokyo.
2. Clark, R.B., 2000. Marine Pollution. Clavendon Press, Oxford.
3. Michael J. Kennish, 1998. Pollution impacts on marine biotic communities-CRC Press, New York.
4. Kathiresan, K., 2014. Ocean and coastal ecology. Scientific Publishers, India, pp.271
5. Calow, P., Handbook of Environmental Impact Assessment, Blackwell Science, 1999. Science, London,1999.

Reference books

6. David J. Hoffman, Barnett A. Rattner, G. Allen Burton, Jr. Johan Caims, Jr,.1997. Hand book of Ecotoxicology (755 pp)- 7/018. LEWIS publishers, Tokyo.
7. Johnson, R. (ed.), 1976. Marine Pollution. Academic Press, London.
8. Michael C. Newman, Morris H. Roberts, Jr. Robert C. Hale, 2001. Coastal and Estuarine Risk Assessment (347 pp) 07/125 LEWIS PUBLISHER, New York.
9. Michael J. Kennish, 1997. Pollution Impacts on Marine Biotic Communities (310 pp) 7/77, CRC press New York.
10. Michael J. Kennish., 1996. Estuarine and Marine Pollution. (524 pp) 07/002 CRC press, New York.
11. Muhammad Sadiq., 1992 – Toxic Metal Chemistry in Marine Environments (390 pp) 7/154 -Marcel Rekker, inc Newyork , basel, Hnog kong.
12. Pantin, S.A. 1982. Pollution and the Biological resources of the oceans. Butterworth Scientific Co., London.
13. Trivedy R.K,. 2001 Aquatic Toxicology and Toxicology (239 pp) 7/157 – ABD pulishers, Jaipur.
14. Petts, J., Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London,1999.

IOST 55 OCEAN AND COASTAL ECOLOGY

Objectives:

The paper is aimed at teaching the students on varied aspects of coastal and marine ecology. This paper includes the knowledge about the Ocean and coastal Ecology apart from Coral, estuary and mangrove ecology. Upon completion of this course, the student will be able to understand the nature of different ecosystems, distribution of living organisms and their adaptations in the respective ecosystems.

Unit -1 Introduction to Marine Ecology

Marine Ecology- definition- importance of marine ecology – uniqueness of marine environment - major groups of marine organisms- Uniqueness of marine organisms. Hydrothermal vents and cold seep communities

Unit – II Ocean ecology

Pelagic zone of ocean - Epipelagic zone, Mesopelagic zone, Bathypelagic zone, Abyssalpelagic zone, Hadalpelagic zone- adaptations of the organisms associated with the zones. Benthic zone of ocean - Bathyal zone, Abyssal zone, Hadal zone –adaptations of the organisms associated with the zones.

Unit - III Coastal Ecology

Pelagic zone of coastal environment – adaptations of organisms in the pelagic zone.

Benthic zone of coast - Intertidal zone, Rocky shores, Sandy shores, Muddy shores - Continental shelf or sub-tidal zone of coast – Adaptations of organisms

Unit - IV Ecology of Coral Reef Ecosystem

Importance of coral, Coral distribution, Types of coral reefs, Ecology of Coral Reefs, Organisms associated with reefs, Species interactions and ecology of reefs, Ecology of Reef fishes

Unit - V Ecology of Estuary

Estuarine environment –definition- types of estuaries- estuarine organisms - adaptation of estuarine organisms - estuarine productivity - estuarine food webs.

Practical

1. Field visits to landing centers, sandy shore, rocky shore and muddy shores
2. Identification of marine organisms in different environments
3. Observation of various adaptations of marine organisms to their respective environments
4. Preparation of reports for the field visits

Text books

1. Kathiresan, K., 2014. Ocean and coastal ecology. Scientific Publishers, India. 384pp.

2. Kinne O. (Ed), Marine Ecology Vol. I to V.John Wiley & Sons, 1980-1985

3. Nair, N.B. and D.M. Thampy, 1980. A Text Book of Marine Ecology. The Macmillan Co. India Ltd., New Delhi, 352 pp.

4. Odum, E.P. 1987. Basic Ecology. Saunders College Publication, Philadelphia, 895 pp.

5. Nybakken, J.W. 2001. Marine Biology – An ecological approach (Fourth edition) Addison Wesley Edu. Pub. Inc, 516 pp.

Reference books

6. Kathiresan, K., and S. Z. Qasim, 2005. Biodiversity of Mangrove ecosystems. Hindustan Publishing Corporation, New Delhi, 251pp.
7. Barnes, R.S.K. and R.N. Hughes. 1999. An Introduction to Marine Ecology (Third edition), Blackwell Science, 286 pp.

8. Townsend C.R., J.L. Harper and M. Begon. 2000. Essentials of Ecology. Blackwell Science, 552 pp.

9. Jeffrey S. Levinton, 2008. Marine Biology: Function, Biodiversity, ecology, 3rd edition 640 pp.

IOSP 56 : PRACTICAL –V (covering IOST 51,52,53, 54 & 55)

SIXTH SEMESTER

IANM 61 ANCILLARY MATHEMATICS II

OBJECTIVIES:

On completion of the course the students will be familiar with Solving the algebraic and transcendental equations, ordinary differential equations, numerical integration, empirical laws and curve fitting and assignment problem.

UNIT – I: Solution of Algebraic and Transcendental Equations

Iteration Method – Bisection Method – Newton's Method – Regula Falsi Method – Horner's Method

UNIT – II: Numerical Integration

Trapezoidal Rule – Truncation error in Trapezoidal Rule - Simpson's $1/3^{rd}$ rule - Simpson's $3/8^{th}$ rule - Truncation error in Simpson's $1/3^{rd}$ rule – Romberg's Method.

UNIT – III: Numerical solution of Ordinary differential equations

Milne's Predictor Corrector Method – Adam's – Bashforth Predictor Corrector Method – Picard's Method.

UNIT – IV: Empirical Laws and Curve Fitting

Laws reducible to the linear law – Method of Group averages – Method of Least Squares – Method of Moments.

UNIT – V: Assignment Problem

Mathematical model in Assignment Problem – Cases of Assignment Problem – Finding the Optimal Solution – Travelling Salesman problem.

TEXT BOOKS

1. Singaravelu, A. 1999. Numerical Methods, Meenakshi Agency, Chennai.
2. Kandasamy, P and Thilagavathy, 2003. K. Resource Management Technique, S. Chand & Co., New Delhi.

REFERENCE BOOKS

1. Dr.Venkataraman, M. K., Numerical Methods in Science and Engineering, National Publishing House, New Delhi.
2. Sarma S, 2007. Numerical methods, Narosa Publications. Chennai.
3. Sastry, S.S. 1999. Introductory methods of Numerical methods, Prentice Hall of India, New Delhi.
4. Hamdy A Taha, 1998. Operations Research, Prentice hall of India, 1998.
5. Kapoor, V.K, 2002. Problems and Solutions of Operations Research, Sultan Chand & sons, New Delhi.

IOST 62. AIR - SEA INTERACTION

Objective:

The student's undergoing this course will get a sufficient knowledge about the various meteorological events in the atmosphere and its impact on sea surface. Significant attention is also focused on weather forecasting technique and satellite in forecasting technique.

Unit I: Introduction to Atmosphere –Meteorology-weather and climate-composition, extent, thermal and vertical structure of the atmosphere-heat and temperature, mechanism of heat transfer-incoming solar radiation-heat budget-latitudinal heat balance.

Unit II: Moisture, Atmospheric stability and Precipitation – Hydrological cycle-changes of state-humidity and its measurement-condensation-adiabatic process-atmospheric stability-lapse rate-lifting process-convection lifting-orographic lifting-condensation and cloud formation-cloud-fog-formation of precipitation and its types-measurement.

Unit III: Air pressure, Wind and circulation of Atmosphere– Factors affecting air pressure-measurement-wind pressure-coriolis effect-friction-surface wind-vertical air motion-wind measurement-scale of atmospheric motion-local winds-land and sea breezes-distribution of surface pressure and winds-monsoon circulation-global wind and ocean currents.

Unit IV: Upper ocean dynamics – Oceanic heat budget, factors influencing heat budget terms, radiative and turbulent fluxes, bulk method for computation of fluxes, dominant forces for ocean dynamics, and equation of motion.

Unit V: Cyclone and thunderstorms, weather forecasting - Inter Tropical Convergence Zone (ITCZ), Tropical cyclones- formation, classification and structure, Strom surges, EL-Nino Southern Oscillation (ENSO),cyclone tracking- thunderstorms- forecasting technique-standard tool in weather forecasting-satellite in weather forecasting.

Practical

1. Illustrating the concept of atmospheric pressure-construction of graph to measure how Pressure changes with height above earth surface.
2. Illustrating the temperature profile for various class of stability
    i. Stable
    ii. Unstable
    iii. Inversion
3. Determination of Relative Humidity and Dew point temperature at a place.
4. Illustrating the effect of terrain roughness on the wind velocity profile for various Surface conditions.
5. Construction of wind rose diagram at a given location over a period
6. Rainfall measurement.
7. Analysis of rainfall (i.e.) determination of mean, monthly and annual rainfall etc.

Text Books:

1. Csanady, G. T., 2001. Air-Sea Interaction (Laws and Mechanisms) Cambridge University Press
2. Geernaert, G.L., 1999. Air-Sea Exchange: Physics, Chemistry and Dynamics, Springer
3. Gill A.E., 1982. Atmosphere- Ocean Dynamics, Academic Press.
4. Menon P.A., 1989. Our Weather, National Book Trust, India.
5. Patrick Santurette, Christo G. Georgiev, 2005. Weather analysis and forecasting, Academic Press,
6. Pickard G.L. and W.J.Emery, 1990. Descriptive Physical Oceanography, Pergamon Press, Newyork.
7. Roll H.U., 1965. Physics of the Marine Atmosphere, Academic Press, Newyork.

IOST 63 MARINE INSTRUMENTS FOR OCEANOGRAPHIC MEASUREMENTS

Objectives:

The main objectives of this paper are to expose the students to state of the art instrumentation, to introduce them to the methods of various instruments used in the marine environment and to prepare them to use these techniques in their own research.

The students also learn the facilities available are research vessels and the navigational techniques. Instruments in each category are provided to work with and conduct field and laboratory trails.

UNIT I – Introduction

Marine Instrumentation; In-situ and Remote Sensing Instruments, Operating platforms-fixed, ship, Platform and Buoy based; Output Formats; Telemetry

Parameters to be measured/user Requirements – Temperature, salinity, sound velocity, wave Height, Wave Period, Tidal Height, Tidal Period and Ocean Depth etc.,

UNIT II – Fixed platform Based Instruments

Different types of Tide Gauges – Pressure sensor based, Acoustic based; Principle, operation and application; Benchmark and Datum fixing

Wave Radars, Rain Gauge, Temperature Sensors, Bottom Observations

UNIT III – Buoy Based Instruments

Different types of buoys; Principles, application and operations of Wind, Temperature, Currents, Wave Height and Direction and Environmental Sensors

Satellite Telemetry Systems

UNIT IV – Ship Based and submersible Based Instruments

Basics of Surveying; Principle, operation and applications of Surveying Equipment – Echosounder, Multibeam Sonar, Sub-bottom Profiler, Side Scan Sonar, Boomers, Sparkers, Magneto meters, Positioning and Tracking Equipment

UNIT V – Marine Sensors

Acoustic transducers – Piezo electric type, magnetostrictive type; Sonar transducers for Echosounder, Acoustic Sub-bottom Profiler, Multibeam Sonar; Non-acoustic Sensors – Biosensors, Chemical Sensors.

General Methods of Test and Calibration

Text Books

1. R.J. Urick (1975): Principles of Underwater Sound
2. D. Srinivasan (1989) : Indigenous Instruments for Ocanographic Measurements
3. D. Srinivasan & Dhilsha Rajappan (2001) : Principles of Electro Acoustic Transducer Technology

IOST 64: FLUID MECHANICS

Objectives:

By studying this subject Fluid mechanics, a student will understand that the study of fluid flow assuming the fluid as ideal frictionless is quite useful. The mathematical analysis becomes simple. It gives a through study of the influences of inertial force (equal to the product of mass and acceleration of the fluid particles), normal surface force and body force. It also solves a number of practical problems.

Unit – I: Basic concepts and properties

Fluid-definition, distinction between solid and fluid- units and dimensions- properties of fluids- density, specific gravity, specific weight, specific volume, temperature, viscosity, compressibility, vapour pressure, ideal and real fluid, capillary and surface tension.

Unit – II: Fluid statics

State of rest- Pascal's law-hydrostatic law- hydrostatic force on a submerged plane surface- location-concepts of fluid static pressure, absolute and gauge pressure – total and center of pressure – pressure measurements by manometers- buoyancy–equilibrium of floating bodies- metacenter-determination of metacentric height.

Unit – III: Fluid kinematics

Description of fluid flow- velocity of fluid particles-types: steady & unsteady-uniform & uniform- laminar & turbulent flow –rotational and irrotational flow-one, two and three dimensional flow –flow pattern: stream line, stream tube and path line-basic principles of fluid flow-continuity equation- rotational and irrotational motion.

Unit – IV: Fluid dynamics

Introduction- forces acting on fluid in motion-Euler's equation of motion-Bernoulli's equation –pressure velocity relationship- application of Bernoulli's equation- flow measurement in open cannel, estuary: pitot tube, weir, notches- rectangular& triangular – Hot wire anemometry- LASER anemometry- flow visualization techniques.

Unit – V: Fluid machines

Classification on the basis of general features- specific speed –impulse and reaction principles.

Pumps: definition and classifications - Centrifugal pump: classifications, working principle, work done - Reciprocating pump: classification, working principle, Basic principles of indicator diagram.

IOST 64 Fluid Mechanics

1. Determination of coefficient of discharge of a Rectangular Notch.
2. Determination of coefficient of discharge of a Triangular Notch.
3. Determination of coefficient of discharge of a Mouth piece.
4. Determination of coefficient of discharge of an Orifice.
5. Determination of coefficient of discharge of an Orifice meter.
6. Determination of coefficient of discharge of a Venturimeter.
7. Determination of Metacentric height of a ship model
8. Verification of Bernoullli's theorem.
9. Determination of Reynold's number for the fluid flow.
10. Determination of efficiency by using centrifugal pump.
11. Determination of efficiency by using Kaplan turbine

Text Books:

1. White, F.M. "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
2. Kumar, K.L. "Engineering Fluid Mechanics". Eurasia publishing house, New Delhi. 2007.
3. Bansal, R.K. "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd, New Delhi.1995.

References Books:

1. Modi, P.N and Seth, S.M. "Hydraulics and Fluid mechanics". Standard Book House. New Delhi. 2005.
2. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition. New Delhi. 2004.

IOSP 65 PRACTICAL VI (Covering Courses IOST 62 and 64)

SEVENTH SEMESTER

Objectives

This course will provide an introduction and overview of this critical portion of our planet. Emphasis will be from a geological perspective of the systems that operate within, over, and adjacent to the World oceans and seas. The students are exposed to the fundamental concepts in Marine Geology, tectonic process and morphology of the near shore and ocean basin, weathering and sedimentary cycle and transport mechanism, major coastal deposits and land forms, plate tectonics, continental drift, earth quakes and marine mineral resources and concepts of exploration.

Unit–I: Introductory concepts in Earth Science

Origin of the universe and earth; earth's interior – crust, mantle and core; Geological time scale, division of geological time. Pangaea – continental drift and paleomagnetism, crustal movement plate tectonics, isostacy sea floor spreading. Emergent and submergent margins, convergent and divergent boundaries, changing sea level.Crustal deformation- folds, faults.

Unit–II: Products of Earth process

Materials of earth's crust – igneous rock, metamorphic rock and sedimentary rock,. Weathering and erosion – mechanical and chemical weathering, rates of weathering.Erosion by wind, water and glaciers.

Unit–III: Introduction and Concepts in Marine Geology

Introduction to marine geosciences.morphology of the near shore environment: beach, estuaries, continental shelf. Continental slope, rise, submarine canyons morphology and characteristics. Morphology of the ocean basins, ocean floor, abyssal plains, hills plateau, mid oceanic ridges. Sediment transport by waves and currents: long shore currents. General coastal geomorphology of India.

Unit–IV: Depositional environment and features

Major coastal deposits and land forms: marine deltas, estuaries, spits and related features, beach ridges, barrier islands organic reefs and atolls. sedimentary structures, texture and their depositional significance. Physical properties of particles: size, mass properties - shape, sphericity and roundness, mineral stability and significance. Porosity and permeability.Turbidites.Sea floor sediments, geochronology.relative dating, absolute dating. Analysis of sediments -graphical representation and determination of depositional environment.

Unit–V: Marine mineral resources

Beach placers, hydrocarbon resources, manganese nodules, phosphotites, sulphur, dissolved salts, limestone deposits, evaporates; their mechanism of origin and global distribution pattern. Methods of deep sea exploration of mineral resources - gravity, magnetic and seismic methods –principle and techniques.

Practical

1. Grain size analysis of sediments- sieving. Graphical representation and statistical parameters. Determination of depositional environment.
2. Determination of particle morphology. Determination of grain size-sphericity, roundness calculation. Identification of texture
3. Mineral separation techniques. Provenance interpretation
4. Identification of important sedimentary minerals
5. Interpretation of seismic data (travel time and intercept)

Text Books

1) *Sverdrup,* H. U., *Johnson,M.,* Richard H. *Fleming*., 1942 *The Oceans, Their Physics, Chemistry, and General Biology*. Prentice-Hall, New York.
2) Blatt, H., and Tracy, R.J., 1996, Petrology: Igneous, sedimentary, and metamorphic, 2nd ed: New York, W.H. Freeman.
3) Bolt, B.A.,1993. Earthquakes, 3rd ed: New York, W.H. Freeman.
4) Cox, A., and Hart, R.B., 1986, Plate tectonics: How it works:Palo Alto, CA. Blackwell.
5) Carter, R.W.G., and Woodroffe, C.D.., Eds 1994. Coastal evolution: Cambridge UnIVersity Press.
6) Craig, J.R., Vaughan, D.J., and Skinner, B.J., 1988, Resources of the Earth: Englewiid Cliffs, NJ, Prentice-Hall.
7) Davis, G.H. and Reynolds, S.J., 1996, Structural geology of rocks and regions: New york, John Wiley and Sons.
8) Duxbury, A.C., and Duxbury, A.B., 1994, An introduction to the world's oceans, 4the ed: Dubuue, Iowa, Wm. C. Brown.
9) Dyer, K.R. 1986. Coastal and Estuarine sediment dynamics, New York, Wiley-Intersciences.
10) Hardisty,J., 1990, Beaches, form and process: New York, Karper Collins Academic.
11) Sharma, P.V., 1986., Geophysical Methods in Geology, (2nd edition) New York, Elsevier.
12) Benn, D.I., and Evans, D.J.A., 1998. Glaciers and Glaciation, London, Arnold.
13) Chorley, R.J., Schumm, A.A., and Sugden, D.E., 1995, Geomorphology: New York, Methuen.
14) Johnston, A.C., and Kanter, L.R.., 1990. Earthquakes in stable continental crust: Scientific American, V.262, no.3,p.68-75.
15) Kearey, P., and Vine, F.J., 1990 Global Tectonics: Oxford, Blackwell Scientific.

IOST 72 SATELLITE OCEANOGRAPHY

Objectives:

The main objectives of this course are to expose students to remote sensing instruments, to introduce them to the methods of satellite oceanography, and to prepare them to use these techniques in their own research.

Satellite instruments have become critical tools to monitor global climate changes, ocean circulation, SST, waves, upwelling, mixed layer, coastal and estuarine dynamics. Satellites can provide global continuous temporal coverage of the earth. However, interpreting these remote measurements is delicate, because the relationships with traditional in-situ properties of the ocean are generally complex. Introducing students to these new tools has become a necessity.

Unit – 1: Introduction to Remote Sensing

Introduction to Remote Sensing: Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology - advantages of RS over conventional methods of survey. Evaluation of remote sensing with special reference to Indian Scenario, NNRMS, MARSIS, NRSA, IIRS, SAC, INCOIS. Kepler's laws of planetary motion, Basic principles of aerial photography, scale, ground coverage, fundamentals photogrammetry-measurements of height.

Unit – II: Spectral Signature

Solar and terrestrial radiation, Electromagnetic spectrum: Characteristics of electro-magnetic radiation; spectral reflectance of earth surface features in different wavelength regions of electromagnetic spectrum; concept of signature. Atmospheric effects, Mie scattering, rayleigh scattering spectral response of some natural earth surface and coastal features.

Unit – III: Space Platforms

Basic principles of optical, thermal, hyperspectral and microwave remote sensing, satellite altimetry, synthetic aperture radar, characteristics of space platforms – LANDSAT, SPOT, IRS series (IRS-P6, oceansat I and II), SEASAT, ERS, JERS, RADARSAT. Characteristics of sensors – MSS, TM, LISS I – IV, VHRR, AVHRR, CZCS, MOS, SeaWiFS, OCM & MODIS. High resolution sensors – IKONOS, Quickbird, CASI.

Unit – IV: Image Processing and Analysis

Acquisition of data, image processing: sub setting, geometric, radiometric and water column corrections, data generation, data analysis: visual analysis, digital techniques, supervised and unsupervised classifications. Retrieval of ocean colour properties, chlorophyll and SSC. Sea surface Temperature mapping.

Unit – V: Applications of Remote Sensing

Application in oceanography and meteorology: Ocean circulation, waves, upwelling, mixed layer, coastal and estuarine dynamics, potential fishing zone identification, coastal resource

mapping. Identification of weather systems and their tracks, estimation of atmosphere temperature and humidity profiles, estimation of cloud height precipitation and wind.

Practical

1. Identifying different regions of the electromagnetic spectrum
2. Spectroradiometer usage
3. Spectral differences of different natural earth surfaces
4. Selection and retrieval of data
5. Differentiating various sensors products (OCM, PAN, WiFS and LISS)
6. Band Combinations
7. Image sub setting / mosciking / image enhancement
8. Geometric correction
9. Radiometric correction
10. On screen visual interpretation of digital data (water, vegetation, mangrove, corals etc.)
11. Supervised Classification
12. Unsupervised Classification
13. Chlorophyll retrieval
14. SSC retrieval
15. SST retrieval
16. Map composer

Text Books

1. Ramachandran, S., 2000. Marine remote sensing applications. Institute for Ocean Management, Anna University, 374 pp.
2. Sabins, F.F., 1997. Remote sensing: Principles and interpretation 3rd edition. W.H. Freeman and Company, New York.
3. Lillesand, T.M. and R.W. Kefer, 2000. Remote Sensing and image interpretation. John Wiley & Sons. Inc.
4. Anji Reddy, M., 2000. Remote sensing and Geographical Information System. The Book Syndicate, Hydrabad.
5. Edmund P. Green, Peter J. Mumby, Aladair J. Edwards and Christopher D. Clark, 2000. Remote Sensing Handbook for tropical coastal management. Coastal Management sourcebooks 3, UNESCO Publication, 316 pp.
6. Lucas, L.F. Janseen, Wim H. Bakker, Ben G.H. Gorte, John A. Horn, Christine Pohl, Anupma Prakash, Colin V. Reeves, Michael J.C. Weir, Tsehaie Woldai, 2001. Principals of Remote Sensing An Introductory Text Box, 2nd edition, ITC Educational Textbook Series.
7. Miller, Richard L., Del Castillo, Carlos E. and McKee, Brent A., 2005. Remote Sensing of Coastal Aquatic Environments. Technologies, Techniques and Applications Series: Remote Sensing and Digital Image Processing, Vol.7, Springer, 347pp.
8. Yeqiao Wang, 2009. Remote sensing of coastal environments. Taylor & Francis, CRC press, 457pp.
9. James B. Campbell and Randoiph H. Wynne, 2011. Introduction to Remote Sensing . Guilford press, 667pp
10. Sebnem Duzgun and Nuray Demirel, 2011. Remote Sensing of the Mine Environment. CRC press, 220pp.

IOST 73 SURVEY TECHNOLOGY OF COASTAL ENVIRONMENT

Objectives:

The students undergoing this course will have a wide knowledge about different kinds of surveying and control techniques both in land and sea. Various techniques adopted for sounding, theory of tides and establishing mean sea level were thoroughly dealt in hydrographic surveying. The positioning system both satellite and acoustics and the function of various sensors provides the broad exposure about the survey techniques used in the marine environment.

Unit – I: Introduction, Chain & Compass surveying

Introduction –units of measurement-scales- chain surveying: measuring distance-ranging –compass survey: prismatic compass-bearing –meridians-included angle- traverse.

Unit – II: Level & Theodolite surveying

Levelling: definitions- instruments types-classification –principles of levelling-reduction of levels -contours-Theodolite survey: measurement of horizontal and vertical angles –traversing- tachometer- stadia hair-determination of constants-measuring distance and elevation.

Unit – III: Hydrographic surveying

Introduction-horizontal and vertical control-shore line survey- theory of tides -tide gauge -tidal datum- sounding- methods- locating sounding stations-current meter: determination of velocity and discharge-theory of errors and adjustment.

Unit – IV: Basics of Geodetic surveying

Geodesy: definition and classification – geometry of ellipsoid – various co-ordinate systems –orthometric and ellipsoidal heights- properties of spherical triangle- Napier's rule - methods of map projection - geodetic computation.

Unit – V: Advanced methods of surveying

Electro magnetic distance measurement (EDM): introduction-electromagnetic waves-modulation- types of EDM measurements –distomat- total station- Satellite systems: GPS, Differential GPS, GLONASS –GPS surveys – software modules – applications of GPS. Horizontal and Vertical controls – methods.

Practical

1. Ranging a line.
2. Determination of area of an extent by cross-staff survey.
3. Traversing with compass and chain (open- river or estuary).
4. Traversing with compass and chain (closed- pond or lake).
5. Levelling – simple and differential (determination of R.L of various stations by a).Height of collimation method. b) Rise and fall method.
6. Inverted levels
7. Contours- Block contouring
8. Theodolite- Measurement of Horizontal angles by repetition method.
9. Determination of width of a river or distance between two inaccessible points by using a theodolite
10. Determination of height of a building or a structure like light house by measuring vertical angle.
11. Determination of shortest distance between two places on the earth surface (Measuring latitude and longitude by using a GPS).

Text Books:

1. Agor, R. "A text book on Advanced Surveying". Khanna publishers, 4th edition, New Delhi. 2007.

2. Arora, K.R. "A text book on Surveying Volume I and II" – Standard publishers-New Delhi. 1990.

Reference Books:

1. Punmia, B.C., Ashok K.Jain and Arun K.Jain. " Higher Surveying"- Lakshmi publications, 15th edition, NewDelhi. 2005.

2. Punmia, B.C., Ashok K.Jain and Arun K.Jain. "Surveying Volume I and II"- Lakshmi publications, 15th edition, NewDelhi. 2005.

3. Hofmann -Wellenhof, B.H. Lichtendger and J.collins, "GPS- Theory and practice"

Springer wein, New York. 1997.

IOST 74 COMPUTER APPLICATIONS – III

Objectives:

The important objective of this course is to provide academic training in programming and application of computer languages. The students learn adequate information about the different structures, functions, operation and applications of these programs in different areas of coastal and marine environment.

UNIT – I : C

Introduction to C – Alphabets – Identifiers - Keywords- Constants - Basic Data types-Enumerated data types-Comments in C - Input & output statements -Type definitions-Variable declarations - Expressions – Operator –Control structures – Functions -Arrays – String manipulation- Structures and Unions- Pointers-File I/O.

UNIT – II : C++

Principles of Object – Oriented programming Software Crisis – Basic concepts of OOP-Benefits of OOP – Application of OOP – Applications of C++ - An Example with Class – Structure of C++ Program – Creating the Source File – Compiling and Linking. Tokens, Expression and Control Structures – Introduction - Tokens – Keywords – Identifiers – Basic Data Types – User Defined Data Types – Derived Data Types – Symbolic Constants – Types Compatibility – Declaration and Dynamic Initialization of Variables – Operators in C++ - Scope Resolution operator – Memory Management Operators – Manipulators – Type cast operator – Expressions and Implicit Conversions – Operator overloading – Control structures.

Functions in C++ : Introduction - The Main Function - Function Prototyping – Call by Reference – Return by Reference – Return by Reference – Inline Functions – Default Arguments – Function Overloading – friend and Virtual Functions.

Class and Objects : Specifying a Class – Defining Member Functions – A C++ Program with Class – Making an Outside Function Inline – Nesting of Member Functions – Private Member Functions – Arrays within a Class – Arrays of Objects.

UNIT – III : C++

Constructors and Destructors : Introduction – Constructors – Parameterized Constructors-Multiple Constructors in a Class – Dynamic Initialization of Objects – Copy Constructor – Dynamic Constructors – Constructing Two – Dimensional Arrays – Destructors.

Operator Overloading and Type Conversion – Introduction – Defining Operator Overloading – overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators using Friends – Rules of Overloading Operators.

Inheritance : Introduction – Defining Derived Classes – Single Inheritance – Making a private member Inheritable – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance- Virtual Base Classes – Abstract Classes – Constructors in derived Classes – Member classes : Nesting of Classes. Pointers, Virtual Functions and Polymorphism Introduction – Pointers to Objects – this pointer – Pointers to Derived Classes – Virtual Functions – Pure virtual Functions.

UNIT – IV : MATLAB

Introduction to MATLAB – Menus and toolbar – Computing with Matlab - Script files and the editor debugger – Programming in MATLAB – Variables - Programming Techniques – Relational Operators – Logical Operators – Logical Expressions – Input and Ouput - Loops - For Loops- While Loops - Conditional Statements – If Statement- Switch Statement - String Matrices – Arrays – Multidimensional Arrays – Structure Arrays – Functions – Matrix Functions - Elementary Mathematical Functions – User Defined Functions- Working with Data Files - Plotting – XY Plotting functions - Subplots and Overlay plots – Special Plot types – 2-Dimensional and 3-Dimensional Plots.

UNIT – V : MATLAB

MATLAB Introduction – Notation – Neuron model – single – input neuron, transfer functions, multiple – input neurons – network architecture – layers of neurons – MATLAB scripts: Introduction concepts and functions – simple problems using scripts – single layer perceptron for pattern recognition – simple problems – perceptron learning rule – Training multiple – neuron perceptrons – Simple problems using MATLAB scripts.

Practical

I. C LANGUAGE

1. To find Area of Circle and Rectangle
2. To find the Result of four function calculator using Switch Case
3. Fibonacci Numbers
4. Given number is PALINDROM or not
5. To Print Book no, name and author using Array of Structure
6. Factorial using Function

II. C++ LANGUAGE

1. Class and Object
2. Bubble Sort
3. Grade marks using Switch Case
4. Matrix addition
5. Function overloading
6. Operator overloading
7. Mark list preparation of using Multiple Inheritance

III. MATLAB

1. Matrix Function
2. Mathematical Function
3. Circle plotting
4. 2-D and 3-Dimensional plot
5. Switch case
6. For and while Loops
7. Function Visualization

Text Books

1. Balagurusamy, E., 2003. Object Oriented Programming with C++, Second edition, Tata McGraw Hill
2. Balagurusamy, E., 2006. Object-oriented programming with C++, 3rd Edition,Tata McGraw Hill
3. Balagurusamy, E., 2007. Programming in Ansi C, 4th Edition, Tata Mc Graw Hill
4. Bjarne Stroustrup, 2000. The C++ Programming Language, Third Edition, Pearson Education
5. Brian R.Hunt, Ronald L.Lipsman, Jonathan M.Rosenberg, 2000. A Guide to MATLAB for Beginners and Experienced users, John Wiley,
6. Delores M. Etter, David C. Kuncicky, Holly Moore, 2005. Introduction to MATLAB 7, Pearson Education
7. MATLAB Manuals
8. Rudra Pratap, 2006. Getting started with MATLAB 7: a quick introduction for scientists and engineers,
9. William John Palm III, 2004. Introduction to Matlab 7 for Engineers, Second edition, McGraw Hill Professional
10. Yashavant P. Kanetkar, 2008. LET US C, 8th Edition, Infinity science,

IOSP 75 - PRACTICAL VII (Covering Courses IOST 71, 72, 73 & 74)

EIGHTH SEMESTER

IOST 81 GEOGRAPHIC INFORMATION SYSTEMS

Objectives:
By completing this course, students will:

- Gain a basic, practical understanding of GIS concepts, technical issues, and applications.
- Learn where GIS fits in the world of Information Systems and maps, how it is unique and why it is important.
- Know the issues involved in choosing a GIS package, obtaining and evaluating data, and implementing and managing a GIS project.
- Be able to explain the benefits and costs of GIS.
- Understand the technical language of GIS.
- Gain practical experience using Arc View, a powerful and popular desktop GIS package.

Understand GIS career options and how to pursue them.

Unit -1

Introduction to GIS: Definitions, Basic Concepts, history and evolution, Components, Need, Scope, interdisciplinary relations, and overview of GIS.

Map: Types of map, map scale, classes of maps. Map projection: fundamentals and types; precision and errors; Base Maps & Thematic Maps; Map Legend, Symbols & Border Information; label placement

Unit – II

Data- Types and Models: Spatial/Geometrical Data- Raster data, Vector data, its advantages and disadvantages. Non-spatial / Attribute Data. Models of data- Basic Data Models –raster and vector, Spaghetti model and Topology model; Advanced data models- Grid model, TIN model, network model, other models, combination of models.

Unit – III

Data Sources: Data collection, modes of data acquisition- Primary and secondary methods of acquisition of spatial and non-spatial data - GPS data. Map scanning and digitizing, topology building, editing and cleaning, linking of spatial and non-spatial data. Data Processing: Updation, corrections, modifications, scale changes, geometric transformations and map projection transformations, conflation sliver removal, edge matching, interactive graphic editing, rubber sheeting.

Unit – IV

Spatial Analysis, Integration and Modelling: Logic operations, general arithmetic operations, general statistical operations, geometric operations, query and report generation from attribute data, geometric data search and retrieval, classification reclassification,

integrated geometry and attributes, overlay, buffer zones, raster data overlay, integrated data analysis. GIS- Packages-Arc GIS, Definition and concept of Web GIS-advantages and limitations of web GIS, overview of Web GIS.

Unit V

Applications in Marine sciences: Marine resources exploration, Mapping and Marine Resources Information System; GIS in Marine and Coastal Zone Management. Mapping and monitoring of pollution, changes in coastal zones. Applications in Disaster Management: Tsunami- types, causes, RS and GIS applications for post Tsunami damage assessment and rehabilitation. Creating custom GIS software applications and user interface.

Practical

1. DATA Encoding

    a. Raster Encoding
    b. Run — Length coding
    c. Quad tree coding
    d. Scanning and conversion of images

2. Digital mapping

    a. Overview of Arc View and Arc GIS tools.
    b. Digitizing / Creating new shape files and area estimation
    c. Edited coverage: – Clipping , merging , Intersect , Union, Dissolve and Assign data by location (Spatial Join).
    d. Buffering
    e. Projection and Transformation
    f. Downloading GPS data and other XY coordinates data for GIS use
    g. Preparation of contour maps using different Softwares :
        i) Surfer
        ii) Arc GIS
    h. Chart preparation
    i. Lay out preparation / Labeling and Annotation
    j. DEM – Demo

Text Books

1. Burrough, P.A. and R. A. McDonnell, 1998. *Principles of Geographic Information Systems*. New York: Oxford University Press, 333 p.
2. Chrisman, N. R., 2001. *Exploring Geographic Information Systems*. John Wiley & Sons, New York.

3. Heywood, I,. S. Cornelius, and S. Carver, 1998. *An Introduction to Geographical Information Systems*. Prentice Hall, New Jersey, 279p.
4. Lo, C. P. and A. K. W. Yeung, 2002. *Concepts and Techniques of Geographic Information Systems* Prentice Hall, New Jersey, 492p.
5. Michael N. Demers. 2000. Fundamentals of Geographic Information Systems. 2nd edition. John Wiley & Sons, Inc.
6. O'Sullivan, D. and D. J. Unwin, 2003. *Geographic Information Analysis*. John Wiley & Sons, New Jersey, 436p.
7. Paul A. Longley, Michael F. Goodchild, David J. Maguire and David W. Rhind. 2001. Geographic Information Systems and Science. John Wiley & Sons, Inc.
8. Michael Kennedy , 2009. Introducing Geograophic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, 2nd Edition, Wiley Publication, 624pp.
9. Pinde Fu and Jiulin Sun, 2010. Web GIS: Principles and Applications. ESRI, 312pp.
10. Cheiarian Harder, 2011. Understanding GIS: An ArcGIS Project workbook. ESRI, 378pp.
11. Vasilis D. Valavanis, 2011. Marine Geographical Information Systems: Theory and Applications (Advances in Geographic Information Science). Springer, 500pp.
12. Rolf A de By, Martin C. Wllis, Yola Georgiadou, Wolfgang Kainz, Richard, A. Knippers, Menno-Jan Kraak, Mostafa M. Radwan, Edmund J. Sides, Yuxian Sun, Michael J.C. Weir and Cees J. van Westen, 2001. Principals of Geographic Information Systems: An introductory textbook. 2nd edition. , ITC Educational Textbook Series
13. Kang Tsung Chang, 2006. Introduction to Geographic Information Systems, TATA McGraw Hill, 3rd edition, 431 pp.

IOST 82 INSTRUMENTATION AND ANALYTICAL METHODS

Objectives:

The main objectives of this paper are to expose students to state-of-the-art instrumentation, to introduce them to the methods of various instruments used in the marine environment, and to prepare them to use these techniques in their own research.

The course is a combination of lectures and demonstrations on the principles and functioning of these instruments. Instruments in each category are provided to work with and conduct field and laboratory trials.

Unit – I: Minor Equipments

Introduction, working principle and use of Hygrometer – Flow meter – Conductivity meter – Refractometer – Salinometer – pH meter – Oxygen analyzer – Lux meter – Turbidity meter

Unit – II: Microscopy

Principle, design and function of Light microscope, Phase contrast microscope – Epifluorescent microscope – Electron microscope

Unit – III: Spectroscopy

Absorption and emission principles – Colorimeters – Spectrophotometers – UV-Visible, Fluorescence Spectrophotometer, Flame photometer, Atomic Absorption Spectrophotometer, Inductively Coupled Plasma Spectrometer (ICP).

Unit – IV: Centrifugation & Electrophoresis

Centrifugation: Centrifugal force and principle of sedimentation – sedimentation coefficient – types of centrifuges and rotors – Types of centrifugation – Differential centrifugation, density gradient centrifugation, zonal centrifugation, isopycnic centrifugation

Electrophoresis: General principle, factors affecting mobility of charged molecules – (i) electric field strength (ii) sample (iii) buffer (iv) supporting medium. Principle and use of electrophoresis using paper, cellulose acetate and thin layer of gels – PAGE

Unit – V: Chromatography

Principle, working procedures and use of paper, thin layer, gas, ion-exchange and High performance liquid chromatograph.

Practical

1. Polyacrylamide gel electrophoresis of proteins
2. Paper chromatography of amino acids
3. Estimation of nutrients using Spectrophotometer
4. Estimation of dissolve petroleum hydrocarbon in seawater using Spectrofluorometer
5. Estimation of Na, K and Ca using Flame photometer
6. Estimation of heavy and trace metals using ICP spectrometer

Text Books

1. Skoog. D.A. and J.J. Leary, 1992. Principles of Instrument analysis. Fourth edition. Saunders College Publishers, Philadelphia.
2. Wilson and Walker, 2000. Practical Biochemistry. Principles and Techniques. Cambridge University Press.
3. Galan, W.Ewing, 1988. Instrumental Methods of Chemical Analysis. McGraw-Hill Book company.
4. Richard w. Von Norman, 1963. Experimental Biology. Prentice-Hall, New York.

IOST 83 DYNAMICAL OCEANOGRAPHY

Objectives:

To introduce and describe mathematically a number of commonly occurring flows in the ocean. The objective is for the students to gain an appreciation of how to use mathematics to model simple aspects of these flows and to provide the student with an understanding of the physical processes that controls the distribution of water properties and the movement of those properties in the ocean. A theme of the course will be the range of time and space scales that exist from small scale mixing processes, to the grand global circulation.

UNIT – I Statics and Kinematics

Statics of the ocean: fields of gravity, pressure and mass, barotropic and baroclinic fields, sigma-t surfaces, static stability, double diffusion, representation of field of motion in the sea, equation of continuity.

UNIT – II Equations of Motion-Nonlinear and Magnetic terms

Equation of motion, non-linear terms in the equation of motion, equation of mean flow, Reynold's stress and eddy viscosity, scaling equation of motion, dynamic stability.

UNIT – III Currents without Friction

Currents without friction, inertial motion, Geo potential, Geo potential surface and isobaric surface, Margules's equation for a two layer ocean, geostrophic current, relative current and slope current, Hellan-Hansen's formula, thermal wind equations, level of no motion and absolute currents.

UNIT – IV Currents with Friction

Currents with friction, Ekman's solution to the equation of motion with friction present, Ekman transport and upwelling, bottom friction and shallow water effect, Swerdrup's equation and its application, equatorial undercurrent, stream line and path line, Stommel's theory of western boundary currents, vorticity, Munk's theory, equitorial under current.

UNIT – V Ocean circulation

Major currents of the world oceans - boundary currents, equatorial currents, turbidity currents, Langmuir circulation, gyres, thermohaline circulation, conveyor belt, Antarctic circumpolar current, Topographic steering, *El Nino* and *La-Nina*.

Text Books

1. Dijkstra, Henk A, 2008. Dynamical Oceanography, Springer Science
2. Pickard, G.L. and J.W. Emery, 1992. Descriptive Physical Oceanography, An Introduction (5th Edition), Butterworth-Heinemann
3. Thurman, H.V. and E.A. Burton, 2001. Introductory Oceanography, Prentice Hall
4. Albert Defant, 1961. Physical oceanography 2 volumes. Pergamon press inc
5. Stephen Pond, George L. Pickard, 1983. Introductory dynamical oceanography 2nd edition. Pergamon Press.

Reference Books

1. Dijkstra, Henk A, 2005. Non-linear Physical oceanography, Springer Science
2. Hell, M.N., 1962. Sea ideas & Observation Progress Vol.1. Willey, John & sons.
3. Von Arx, W.S., 1962. Introduction to Physical oceanography. Addison – Wesley
4. Fomin, L.M., 1964. Dynamic method in oceanography. Elsevier publication co.
5. Neumann, G., 1968. Ocean currents oceanography series vol.4. Elsevier Science Publishing co.

IOST 84 OCEAN MANAGEMENT

Objectives:

Students will gain an understanding of the interrelationships between the marine sciences (including the issues, research areas and the scientists) and public policy through exploration of the concepts and implementation processes of integrated coastal and ocean management. Through this effort, students will learn how the needs of the science and the understanding of marine science principles compare with the needs of policy development, resource use and regulation/management. The paper will allow the student to synthesize information from a variety of sources and explore some aspect of public policy from the perspective of a marine scientist. The students can also learn about different aspects of disaster management, as the marine environment is high vulnerable to disasters.

UNIT – I Developmental Activities and Impacts

Seas and Ocean – Coastal zone importance – coastal developmental activities such as mariculture, tourism, shorefront construction and their impacts – global and national coastal problems such as loss of habitat, sea level change, degradation of water quality and fisheries resource depletion.

UNIT – II Coastal zone management issues

Coastal zone management issues – major ecological, social and economic trend and their importance – coastal zone regulations, aquaculture authority bill - CZM programs – Integrated coastal zone management – environmental economics – comparison between developed and developing countries, temperate and tropical countries and their CZM – Marine Fisheries management policies.

UNIT – III Ocean management

Biodiversity from a global and national view – current status of marine biodiversity – biodiversity conservation - marine protected areas- marine biosphere reserves – marine parks.

Role of international, national agencies and organizations in ocean management – Law of the sea, CBD, IOC-UNESCO, WTO,UNEP, FAO, IUCN, WWF, IMO, CMS, CITES, ICES, IOI (Malta), SCAR, SCOR, LOICZ.

UNIT – IV Management of coral reefs and mangroves

Management of coral reefs – protection, monitoring, research capacity building and coral restoration and rehabilitation.

Management of coral reef for resilience and resistance to climate change- resilience factors, resistance factors and strategies for enhancing resilience.

Management of mangroves- silviculture, legal protection, marine protected areas, international protection, restoration and afforestation.

Management of mangroves for resilience to climate change- impact of climate change on mangroves and strategies for mitigating climate change effects.

UNIT – V Disaster management

Introduction-definition-types of disaster management-factors affecting disaster-phases of disaster-Disaster prevention and mitigation-disaster preparedness-relief-recovery-action plan-disaster management in Indian Scenario.

Text Books

1. Borgese, E.M. and N. Ginsburg, 1979 – 1986. Ocean Year Book 1-6. The University of Chicago Press, Chicago.
2. Hickling, C.F. and Peter Lancaster Brown, 1973. The Seas and Oceans. Blandford Press, London.
3. Ross, D.A., 1980. OpportUNITies and Uses of the Ocean. Springer Verlag, New York.
4. Brahtz, J.F.P. (Ed.) 1972. Coastal Zone Management. U.N. International Economic and Social Affairs, New York.
5. Kathiresan, K., 2014. Ocean and coastal ecology. Scientific Publishers, India, pp.271

Reference books

1. Coastal area management and Development, 1982. UN. Department of International Economic and Social Affairs.
2. Sharma, R.C. and P.C. Sinha, 1994. India's Ocean Policy, Khama Publishers, New Delhi.
3. Duxbury, A.C., A.B. Duxbury and K.A. Sverdrup, 2000. An Introduction to the World's Oceans. 6th Edition. McGraw Hill Companies.
4. Rajagopalan, R. (Ed.), 1996. Voices for the Oceans – A Report to the Independent World Commission on the Oceans. International Ocean Institute, Operation Centre, Madras, India.
5. Qasim, S.Z., 1999. The Indian Ocean – Images and Realities. Oxford & IBH Publishing Company, India.

PRACTICAL – VIII (Covering IOST 81& 82)

NINTH SEMESTER

IOST 91 COASTAL AQUACULTURE

Objectives

The objective of the paper is to teach the students of Ocean Science and Technology to understand the biology and culture techniques of finfish and shell fish for employability of the students in aquaculture activities in coastal environment.

UNIT- I Introduction

Importance of coastal aquaculture, present status in India, prospects and scope-role of MPEDA, BFDA, CMFRI, CAA (Coastal Aquaculture Authority) - subsidy schemes of central government and state fisheries department.

UNIT - II Biology of important cultivable species

Criteria for choosing cultivable species- fish, crustaceans, molluscs and seaweeds-biological criteria-environmental adaptability. Role of genetics in aquaculture. Endocrine glands.

UNIT - III Shrimp culture techniques

Selection of site - topography, designing and layout. Farm structure and construction - .aerator, pumps, aquaculture equipment. Pond preparation - water culture, probiotic-feed management- sampling, health management- disease diagnosis-PCR. Hatchery and management.

UNIT - IV Finfish culture

Culture techniques: grow out and hatchery. Ornamental fish culture methods- aquarium keeping. Live feed and Formulated feeds.

UNIT - V Other culture systems and techniques

Cage culture, pen culture, seaweed culture, race-way culture, raft and rack cultures. Recycling aquaculture systems (RAS). Integrated farming.

Practical

1. Identifications of cultivable fin fishes, shell fishes and seaweeds
2. Collection of seeds using different gears
3. Field trips to commercial shrimp farms and hatcheries.
4. Disease diagnosis by PCR
5. Types of diseases – observation
6. Aquarium keeping – demonstration
7. Cost benefit analysis of aquafarms

Text books

1. Pillay, T.V.R., 1990. Aquaculture – principles and Practices. Fishing News Books. 575 pp.
2. MPEDA, 1998. A Manual on Shrimp Farming. The Marine Products Export Development Authority, Kochi.P.171.
3. ICAR,2006. Handbook of Fisheries and Aquaculture. 45 pp
4. Samuel Paulraj, 1994. Shrimp farming techniques : Problems and Solutions, Palani Pub.
5. Joachim W. Hertrampft and Felicitas Piedad - Pascal, 2000. Hand book on ingredients for Aquaculture Feeds. Kluwer Academic Publishers, London.

References books

1. Gopinath,K., A.D. Diwan. 2010. Coastal Fisheries and Aquaculture Management. Narendara Publishing House. Delhi. 447 pp.
2. Jhingran,V.G.,1991. Fish and Fisheries of India. Hindustan Publishing Corporation, Delhi. 23pp.
3. Felicity Huntingford, Malcolm Jobling and Sunil Kadri, 2012. Aquaculture and Behavior, Wiley - Blackwell, UK, 340 pp.
4. Felix,S. 2010. Marine and Aquaculture Biotechnology, Agrobios (India), Jodhpur, 471 pp.
5. Nayar, K.N.,1987. Technology of oyster farming. In: Oyster culture – status and prospects. (Ed. Nayar.K.N. and S. Mahadevan). Bull. Mar.Fish.Res.Inst. 38:59-62.

IOST 92 COASTAL AND ESTUARINE DYNAMICS

Objectives:

This course will explore the circulation of the coastal ocean including continental shelf circulation, upwelling, coastal jets, undercurrents, coastal-trapped waves. Fundamentals of surface waves and tides; tsunamis, wind generation, breaking waves. Estuary classification and circulation patterns; shallow-water processes and beach morphology.

Unit – I: Beach features

Beach cycles – beach profiles – erosion and accretion – beach stability – artificial nourishment – coastal defense structures – planning and design of coastal protection structures – tidal inlet and stability – coastline changes – case study.

Unit – II: Sediment transport

Coastal processes – transformation of waves in shallow water – refraction, reflection and shoaling – long shore currents – littoral currents – sediment transport rate – onshore and offshore transport – coastal features – LEO observation

Unit – III: Sea level changes

Periodic sea level changes – meteorological and oceanographic contribution – atmospheric pressure, wind, water density, effect of currents, evaporation and precipitation – seasonal variation – long term changes – sea level records – practical aspects of sea level: coast protection, storm surge forecasts, tsunami warning system.

Unit IV: Estuarine dynamics

General characteristics of estuaries, classification and nomenclature, estuarine circulation and mixing – gravity driven freshwater flow – saline intrusion – stratification and entrainment – tides and tidal currents in estuaries

Unit – V: Estuarine sedimentation

Factors affecting sedimentation – sources of sediment – sediment budget - dispersion and settlement of sediments – desilting and its impact – embank features and stability – estuary mouths and tidal inlets.

Practical

1. Beach profile
2. Estimation of longshore sediment transport

Text Books

1. Estuary and coastal Hydrodynamics	:	A. Tippen
2. Estuaries : A physical Introduction	:	K.R. Dyer
3. Beaches and Coasts	:	C.A.M. King
4. Waves and coasts	:	R.E.Mayer
5. Stability of Coastal Inlets	:	P. Brunn and Gerritsen
6. Shelf sediment transport processes and Pattern	:	D.J.P.Swift

IOST 93 RENEWABLE ENERGY SYSTEMS

Objectives: Aim of this course is to introduce various renewable energy sources like solar energy, biomass energy and hydropower energy and their applications. Introduction to wind, geo thermal energy, and their uses in generation of heat and electricity are explained. Various schemes and devices for getting power from Tidal and wave energy are discussed.

Unit – I: Solar energy

Introduction – types of energy – resources and importance- environmental aspects of energy utilization – types of renewable energy.-extraterrestrial solar radiation - radiation at ground level-collectors-solar cells-applications of solar energy

Unit – II : Biomass energy and Hydropower energy

Biomass Energy : Introduction-Biomass Conversion-Biogas Production-Ethanol Production - Pyrolysis and Gasification-Direct Combustion-Applications.

Hydropower Energy : Introduction-basic concepts- site selection-types of turbines-small scale hydropower.

Unit – III: Wind and geo thermal

Wind Energy : Introduction-basic theory-types of turbines-applications.

Geothermal Energy : Introduction-geothermal resource types applications for heating and electricity generation

Unit – IV: Tidal and wave energy

Tidal Energy: Introduction-origin of tides-power generation schemes

Wave Energy: Introduction-basic theory-wave power devices

Unit – V: Other renewable energy sources

OTEC : Introduction-Open and Closed OTEC cycles- biophotolysis - Salinity Gradient Devices- Environmental Aspects.

Practical

1. Solar still
2. Flat plate Solar Water heating system
3. Solar Air Heater
4. Solar Cooker
5. Bio-Mass Gasifier

REFERENCES :

1. Non Conventional energy resources – G.D. Rai, Khanna Publishers
2. Energy Technology – S. Rao & Dr. B. Parulkar, Khanna Publishers

IOSP 94 PRACTICAL - IX (Covering Courses IOST 91, 92 & 93)

TENTH SEMESTER

IOST 101- PROJECT PLANNING, ANALYSIS AND MANAGEMENT

Objectives:

This course will aim to train the students to under take their own project work by way of planning and survey methods. Proper selection procedures, their feasibility and cost estimation for the project work is dealt with. Project monitoring and evaluation process also dealt with.

UNIT-I: PROJECT PLANNING AND SURVEY

Project identification and Development in industry and for national development - Project ideas and Innovation - planning and Implementation of R & D projects. Resource survey, Need analysis, Market research, Market Planning.

UNIT-II: PROJECT SELECTION FACTORS

Analysis of infrastructure – Elements of economic geography location – Manpower – Inputs – Transport – Site selection – Industrial policy – Government incentives and regulation – Techno – economic analysis – Choice of technology – choice of process – appropriate Technology.

UNIT-III: FEASIBILITY STUDY

Technical Feasibility – Technology assessment – technology transfer, Cost benefit analysis – Financial analysis – Economic Analysis Social – Cost benefit analysis – UNIDO, World Bank and OECD methodologies.

UNIT-IV: PROJECT FINANCE

Cost estimating – Project financing – sources of finance – Cost of capital structure – International finance & Foreign exchange regulations.

UNIT-V: PROJECT MONITORING & EVALUATION

Projects Scheduling and Monitoring tools and Techniques – Project management – Information system and Documentation – Project Evaluation.

Text Books:

1. Divdan P.: Project Management, New Delhi, Deep & Deep Publishers (P) Ltd., 1997.

2. Goel B.B.: Project Management; Principles and Techniques, New Delhi, Deep & Deep Publishers (P) Ltd., 2000.

3. Harvey Maylor, Project Management, New Delhi, Pearson Education Pvt. Ltd., 2004.

4. Prasana Chandra: Projects; Preparation appraisal, budgeting and implementation, New Delhi, Tata McGraw Hill Pub. Co., Ltd.,3rd ed., 1992.

Reference Books:

1. Harold Kerzner: Project Management; A System approach to planning, Scheduling and controlling, New Delhi, CBS Publishers and Distributors, 2nd ed., 2000.

2. Joy P.K.: Total Project Management: The Indian Context, New Delhi, Macmillan India Ltd., Updated, 1996.

3. Rao PCK: Project Management Control, New Delhi, Sultan Chand & Sons, 1997.

IOST102 : UNDERWATER ACOUSTICS AND OPTICS

Objectives

To provide students with an understanding of the physics of underwater sound, including propagation in deep and shallow water, the interaction of sound with the seabed and sea surface, making of transducers for generating and receiving underwater sound.Able to understand the concept of light in water, apparent optical properties and ocean colour applications.

Ocean Acoustics

Unit–I: Fundamentals of sound transmission

Introduction – sound speed, propagation equation, sound reflection, refraction and transmission, source intensity, directivity, transmission loss, target strength, noise: variability of ambient noise with time and depth, angular distribution of ambient noise field, ship generated noise, reverberation and scattering, spectrum analysers

Unit–II: Transducers

Principle of acoustic transduction, Piezo electric transduction, Langevin projector, resonance behaviour of transducers, multiple matching layer transducers, polar response measurements, hydrophones

Unit–III: Arrays

Transducer array, Linear hydrophone array, polar response, Fourier transform approach to pattern synthesis, array beam steering, directivity index, parametric source, synthetic aperture sonar

Unit–IV: Ocean Optics

Characterisation of light field in water, radiance, irradiance, diffuse attenuation coefficient, water leaving radiance – Inherent and Apparent optical properties of sea water – Light scattering by water molecules –Absorption characteristics of water constituents.

Unit–V

Optical properties of Case I and Case II waters. Refractive index of sea water -Remote sensing reflectance, reflectance albedo, Photosynthetically Active Radiation– Ocean colour sensors, Algorithms for Ocean colour data processing, Ocean colour application studies.

Practical

1. Measurement of velocity of sound in air using Resonance column methods
2. Determination of velocity of sound waves in water and sea water using Ultrasonic Interferometer
3. Determination of velocity of sound waves in various organic liquids using Ultrasonic Interferometer
4. Low frequency noise measurement in ocean water using Hydrophone-Demonstration.
5. Transmission and reflectance study of water constituents using UV-Spectrophotometer.
6. Hyper spectral Radiometer-Demonstration

Text books

1. Underwater acoustic systems: R.F.W. Coates. Macmillan new electronics series, 1990ISBN-10: 0333425421 ISBN-13: 978-0333425428
2. Acoustical Oceanography:C.S. Clay and H. Medwin. Wiley, 1977.ISBN-100471160415, ISBN-13: 9780471160410
3. Sound propagation in the sea:R. Urick.United States. Defence Advanced Research Projects Agency DARPA, 1979
4. Fundamentals of ocean acoustics :L. Brekhovskikh and Y. Lysanov.Springer 1982ISBN-13: 9783540113058.ISBN-10: 3540113053
5. Marine Optics: N.G.Jerlov. Elsevier.,1976. ISBN0080870503, 9780080870502

Reference books

1. Physical Optics of Ocean waters: K.S.Shifrin. Springer 1988 ISBN 0883185296, 9780883185292
2. Ocean Optics: Web Book-By Curtis Mobley, Emmanuel Boss and Collin Roesler.

IOSP 104 : PRACTICAL X (COVERING IOST 102)