

**ANNAMALAI UNIVERSITY  
ANNAMALAINAGAR**

**HAND BOOK**

**DEGREE OF MASTER OF SCIENCE  
OCEAN SCIENCE AND TECHNOLOGY  
(5 YEAR INTEGRATED)**

**2018 - 2019**

**ANNAMALAI UNIVERSITY  
ANNAMALAI NAGAR**

**DEGREE OF MASTER OF SCIENCE**

**OCEAN SCIENCE AND TECHNOLOGY**

**(5 YEAR INTEGRATED)**

**2018 – 2019**

**FACULTY OF MARINE SCIENCES**

**REGULATIONS**

**MASTER'S PROGRAMME**

A Master's Programme consists of a number of courses. Master's Programme consists of a set of Core Courses.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the faculty.

A course is divided into five units to enable the students to achieve modular and progressive learning.

**SEMESTERS**

An academic year is divided into two semesters, Odd Semester and Even Semester. The normal semester periods are:

Odd Semester: July to November (90 Working days)

Even Semester: December to April (90 Working days)

## **CREDITS**

The term credit is used to describe the quantum of syllabus for various programmes and hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.

The minimum credit requirement for a five year Master's Programme shall be 225.

## **ELIGIBILITY**

A pass in H.Sc. (10 + 2 level) OR an Equivalent thereto under academic stream in the following subjects viz. Mathematics, Physics, Chemistry and Biology.

## **COURSES**

Each course may consist of lectures / laboratory work / seminar / project work / practical training / report / viva voce etc.

## **COURSE WEIGHT**

Core courses may carry different weightage. For example, a course carrying one credit for lectures, will have instruction of one period per week during the semester, if three hours of lecture is necessary in each week for that course then 3 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lectures / laboratory work and other form of learning in a 15 week schedule:

- (i) One credit for each lecture period per week.
- (ii) One credit for every three periods of laboratory or practical work per week.
- (iii) One credit for 3 contact hours of project work in a week.
- (iv) One credit for every two periods of seminar.

## **GRADING SYSTEM**

The term Grading System indicates a 10-point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

## **DURATION**

The duration for completion of a five year Master's Programme is ten semesters.

## **STRUCTURE OF THE PROGRAMME**

The Master's Programme will consist of:

- (i) Two Language Courses in Part I (Tamil/Hindi/French) and Part II (English) in each semester up to II year (4<sup>th</sup> Semester)
- (ii) One course on Civics, Environmental and Health Science in the First semester
- (iii) Two Ancillary courses (two papers each in I and II year).
- (iv) Core courses which are compulsory for all students.

Dissertation / Project work / Practical training / Field work can be done in an organization (Government, Industry, Firm, Public Enterprise etc.) approved by the concerned department.

## **ATTENDANCE**

Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least Seven Calendar days before the last instruction day in the semester about the attendance particulars of all students.

Each student should fulfil the attendance requirement of 75% as prescribed by the University, to be eligible to appear for the University Examinations.

## **EXAMINATIONS**

The internal assessment for each course carries 25% marks and is based on two sessional tests. The pattern of question paper will be decided by the faculty. The tests are compulsory.

There will be one End Semester Examination (75% marks) of 3 hours duration for each course. The pattern of question paper will be decided by the faculty.

The Internal assessment for each practical course carries 40% of marks while the end semester practical examination of 3 hours duration carries 60% of marks.

## **EVALUATION**

The performance of a student in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The total performance in each semester will be rated by Grade Point Average (GPA); while the continuous performance from the 2<sup>nd</sup> Semester onwards will be marked by Overall Grade Point Average (OGPA).

## **MARKS AND GRADING**

A student cannot repeat the assessment of Sessional Test I and Sessional Test II. However, if for any compulsive reason, the student could not attend the test, the prerogative

of arranging a special test lies with the teacher in consultation with the Head of the Department.

A student has to secure 50% minimum in the End Semester Examination.

The student who has not secured a minimum of 50% of marks (sessional plus end semester examination) in a course shall be deemed to have failed in that course.

A candidate who has secured a minimum of 50% marks in all the papers prescribed in the programme and earned a minimum of 225 credits will be considered to have passed the Master's Programme.

## **GRADING**

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme.

<b>Marks</b>	<b>Grade</b>	<b>Letter grade</b>	<b>Class</b>
90 and Above	10	S	Exemplary
85 – 89	9.0	D	Distinction
80 – 84	8.5	D	Distinction
75 – 79	8.0	D	Distinction
70 – 74	7.5	A	First Class
65 – 69	7.0	A	First Class
60 – 64	6.5	A	First Class
55 – 59	6.0	B	Second Class
50 – 54	5.5	C	Second Class
49 or Less	-	F	Fail

The successful candidates are classified as follows:

I Class – 60% Marks and above in overall percentage of Marks (OPM).

II Class – 50-59% Marks in overall percentage of marks.

Candidates who obtain 75% and above but below 90% of marks (OPM) shall be deemed to have passed the examination in FIRST CLASS (Distinction) provided he / she passes all the papers prescribed for the programme at the first appearance.

For the Internal Assessment Evaluation, the details shall be as follows:

Test (2 tests)	-	15
Assignment	-	5
Seminar	-	5
		-----
Total	-	25 Marks
		-----

## **COURSE – WISE LETTER GRADES**

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

A student is considered to have completed a course successfully and earned the credits if he / she secures an overall letter grade other than F. A letter grade F in any course implies a failure in that course. A course successfully completed cannot be repeated for the purpose of improving the Grade point.

The F grade once awarded in the grade card of the student is not deleted even when he / she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the odd / even semester in which the candidate has appeared for clearance of the arrears.

A student who secures F grade in any course which is listed as a core course has to repeat it compulsorily when the examination is held next. If it is an Elective course, the student has the option to repeat it when it is offered next or to choose a new elective if he / she so desires in order to get a successful grade. When new elective is chosen in the place of failed elective, the failed elective will be indicated as dropped in the subsequent grade card.

If a student secures F grade in the Project Work / Field Work / Practical Work / Dissertation, he / she shall improve it and resubmit it if it involves only rewriting incorporating the clarifications of the evaluators or he / she can re-register and carry out the same in the subsequent semesters for evaluation.

## **M.Sc. OCEAN SCIENCE AND TECHNOLOGY**

### **5 YEAR INTEGRATED PROGRAMME**

<b>Course Code</b>	<b>Course</b>
<b>I Semester</b>	
ITAC 11	Language I
IENC 12	English I
ICEC 13	Civics, Environmental and Health Science
IANM 14	Ancillary Mathematics-I
IOST 15	Marine Invertebrates and Prochordates
IOST 16	Marine Vertebrates
IOSP 17	Practical I (IOST 15)
IOSP 18	Practical II (IOST 16)
<b>II Semester</b>	
ITAC 21	Language II
IENC 22	English II
ICAC 23	Computer Application I
IANM24	Ancillary Mathematics - II
IOST 25	Chemistry
IOST 26	Marine Plants
IOSP 27	Practical III (IOST 25)
IOSP 28	Practical IV (IOST 26)
<b>III Semester</b>	
ITAC 31	Language III
IENC 32	English III
ICAC 33	Computer Application II
IANP 34	Ancillary Physics – I
IOST 35	Ocean and Coastal Ecology
IOST 36	Statistics
IOSP 37	Practical V (IOST 34)
IOSP 38	Practical VI (IOST 35)
IOSP 39	Practical VII (IOST 36)
<b>IV Semester</b>	
ITAC 41	Language IV
IENC 42	English IV
IANP43	Ancillary Physics – II
IOST 44	Physical Oceanography
IOST 45	Chemical Oceanography
IOSP 46	Practical VIII (IANP 43)
IOSP 47	Practical IX (IOST 44)
IOSP 48	Practical X (IOST 45)
<b>V Semester</b>	
IOST 51	Biological Oceanography
IOST 52	Atmospheric Science and Meteorology
IOST 53	Marine Geology
IOST 54	Marine Pollution

<b>Course Code</b>	<b>Course</b>
IOST 55	Computer Application – III
IOSP 56	Practical XI (IOST 51 )
IOSP 57	Practical XII (IOST 53)
IOSP 58	Practical XIII (IOST 54)
IOSP 59	Practical XIV (IOST 55)
<b>VI Semester</b>	
IOST 61	Air – Sea Interaction
IOST 62	Fluid Mechanics
IOST 63	Waves and Tides
IOST 64	Instrumentation and Analytical Methods
IOSP 65	Practical XV (IOST 61)
IOSP 66	Practical XVI (IOST 62)
IOSP 67	Practical XVII (IOST 63)
IOSP 68	Practical XVIII (IOST 64)
<b>VII Semester</b>	
IOST 71	Coastal and Marine Resources
IOST 72	Survey Technology of Coastal Environment
IOST 73	Satellite Oceanography
IOST 74	Marine instrument for oceanographic Measurements
IOST 75	Ocean management
IOSP 76	Practical XIX (IOST 72)
IOSP 77	Practical XX (IOST 73)
IOSP 78	Practical XXI (IOST 74)
<b>VIII Semester</b>	
IOST 81	Geographic Information System
IOST 82	Renewable energy systems
IOST 83	Dynamical Oceanography
IOST 84	Disaster Management
IOST 85	Fishery Technology
IOSP 86	Practical XXII (IOST 81)
IOSP 87	Practical XXIII (IOST 82)
IOSP 88	Practical XXIV (IOST 85)
<b>IX Semester</b>	
IOST 91	Underwater Acoustics and Optics
IOST 92	Coastal and estuarine dynamics
IOST 93	Numerical modeling for coastal processes
IOST 94	Environmental Impact Assessment
IOST 95	Marine Recreation
IOSP 96	Practical XXV (IOST 91)
IOSP 97	Practical XXVI (IOST 92)
<b>X Semester</b>	
IOST 101	Project Planning Analysis and Management
IOST 102	Dissertation and Viva-Voce



## M.Sc. OCEAN SCIENCE & TECHNOLOGY

(Five Year Integrated CBCS Course)  
(For the students admitted during the year 2018 – 2019 onwards)

### SEMESTER WISE SCHEME OF COURSES AND CREDITS

Course Code	Course	L	P	Marks	Credits
<b>I Semester</b>					
ITAC 11	Language I	3		25+75	3
IENC 12	English I	3		25+75	3
ICEC 13	Civics, Environmental and Health Science	3		25+75	3
IANM 14	Ancillary Mathematics-I	4		25+75	4
IOST 15	Marine Invertebrates and Prochordates	4		25+75	4
IOST 16	Marine Vertebrates	4		25+75	4
IOSP 17	Practical I (IOST 15)		3	40+60	1
IOSP 18	Practical II (IOST 16)		3	40+60	1
<b>Total</b>					<b>23</b>
<b>II Semester</b>					
ITAC 21	Language II	3		25+75	3
IENC 22	English II	3		25+75	3
ICAC 23	Computer Application I	3		25+75	3
IANM24	Ancillary Mathematics - II	4		25+75	4
IOST 25	Chemistry	4		25+75	4
IOST 26	Marine Plants	4		25+75	4
IOSP 27	Practical III (IOST 25)		3	40+60	1
IOSP 28	Practical IV (IOST 26)		3	40+60	1
<b>Total</b>					<b>23</b>
<b>III Semester</b>					
ITAC 31	Language III	3		25+75	3
IENC 32	English III	3		25+75	3
ICAC 33	Computer Application - II	3		25+75	3
IANP 34	Ancillary Physics – I	4		25+75	4
IOST 35	Ocean and Coastal Ecology	4		25+75	4
IOST 36	Statistics	4		25+75	4
IOSP 37	Practical V (IOST 34)		3	40+60	1
IOSP 38	Practical VI (IOST 35)		3	40+60	1
IOSP 39	Practical VII (IOST 36)		3	40+60	1
<b>Total</b>					<b>24</b>
<b>IV Semester</b>					
ITAC 41	Language IV	3		25+75	3
IENC 42	English IV	3		25+75	3
IANP 43	Ancillary Physics – II	4		25+75	4
IOST 44	Physical Oceanography	4		25+75	4
IOST 45	Chemical Oceanography	4		25+75	4
IOSP 46	Practical VIII (IANP 43)		3	40+60	1

Course Code	Course	L	P	Marks	Credits
IOSP 47	Practical IX (IOST 44)		3	40+60	1
IOSP 48	Practical X (IOST 45)		3	40+60	1
	<b>Total</b>				<b>21</b>
	<b>V Semester</b>				
IOST 51	Biological Oceanography	4		25+75	4
IOST 52	Atmospheric Science and Meteorology	4		25+75	4
IOST 53	Marine Geology	4		25+75	4
IOST 54	Marine Pollution	4		25+75	4
IOST 55	Computer Application – III	4		25+75	4
IOSP 56	Practical XI (IOST 51 )		3	40+60	1
IOSP 57	Practical XII (IOST 53)		3	40+60	1
IOSP 58	Practical XIII (IOST 54)		3	40+60	1
IOSP 59	Practical XIV (IOST 55)		3	40+60	1
	<b>Total</b>				<b>24</b>
	<b>VI Semester</b>				
IOST 61	Air – Sea Interaction	4		25+75	4
IOST 62	Fluid Mechanics	4		25+75	4
IOST 63	Waves and Tides	4		25+75	4
IOST 64	Instrumentation and Analytical Methods	4		25+75	4
IOSP 65	Practical XV (IOST 61)		3	40+60	1
IOSP 66	Practical XVI (IOST 62)		3	40+60	1
IOSP 67	Practical XVII (IOST 63)		3	40+60	1
IOSP 68	Practical XVIII (IOST 64)		3	40+60	1
	<b>Total</b>				<b>20</b>
	<b>VII Semester</b>				
IOST 71	Coastal and Marine Resources	4		25+75	4
IOST 72	Survey Technology of Coastal Environment	4		25+75	4
IOST 73	Satellite Oceanography	4		25+75	4
IOST 74	Marine instrument for oceanographic Measurements	4		25+75	4
IOST 75	Ocean management	4		25+75	4
IOSP 76	Practical XIX (IOST 72)		3	40+60	1
IOSP 77	Practical XX (IOST 73)		3	40+60	1
IOSP 78	Practical XXI (IOST 74)		3	40+60	1
	<b>Total</b>				<b>23</b>
	<b>VIII Semester</b>				
IOST 81	Geographic Information System	4		25+75	4
IOST 82	Renewable energy systems	4		25+75	4
IOST 83	Dynamical Oceanography	4		25+75	4
IOST 84	Disaster Management	4		25+75	4
IOST 85	Fishery Technology	4		25+75	4
IOSP 86	Practical XXII (IOST 81)		3	40+60	1
IOSP 87	Practical XXIII (IOST 82)		3	40+60	1
IOSP 88	Practical XXIV (IOST 85)		3	40+60	1
	<b>Total</b>				<b>23</b>

<b>Course Code</b>	<b>Course</b>	<b>L</b>	<b>P</b>	<b>Marks</b>	<b>Credits</b>
<b>IX Semester</b>					
IOST 91	Underwater Acoustics and Optics	4		25+75	4
IOST 92	Coastal and estuarine dynamics	4		25+75	4
IOST 93	Numerical modeling for coastal processes	4		25+75	4
IOST 94	Environmental Impact Assessment	4		25+75	4
IOST 95	Marine Recreation	2		25+75	2
IOSP 96	Practical XXV (IOST 91)		3	40+60	1
IOSP 97	Practical XXVI (IOST 92)		3	40+60	1
<b>Total</b>					<b>20</b>
<b>X Semester</b>					
IOST 101	Project Planning Analysis and Management	4		25+75	4
IOST 102	Dissertation and Viva-Voce	20		25+75	20
<b>Total</b>					<b>24</b>

(L – Lecture Hours P – Practical Hours C – Credits)

**Overall credits - 225**

## I SEMESTER

### IANM 14 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.

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

## **IOST15 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.

### **PRACTICAL I : IOSP 17 : 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

### **REFERENCE BOOKS**

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

## IOST 16 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 II : IOSP 18 - MARINE VERTEBRATES

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

### REFERENCE BOOKS

1. Ayyar, E.K. and T.N. Ananthkrishnan, 1992. Manual of Zoology Vol. II (Chordata) S.Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
2. Biswas, K.P., 1996. A Text Book of Fish, Fisheries and Technology, II ED. Narendra Publishing House, Delhi, India.
3. Carl E. Bond, 1979. Biology of fishes. W.B. Saunders Company, Philadelphia
4. Clapham, P.J., Young, S.B. & Brownell Jr. R.L. 1999. "Baleen whales; conservation issues and the status of the most endangered populations" Mammal Rev. 29(1); 35-60
5. Colbert, Edwin, H. 1989. Evolution of the vertebrates. Wiley Eastern Ltd., New Delhi. P. 535.
6. Dholakia, A.D., 2004. Fisheries and Aquatic resources of India. Daya Publishing House, Delhi. 413 pp.
7. 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
8. Jones, E.R.H., 1980. Fish migration. Edward Arnold Ltd., London
9. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10<sup>th</sup> edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
10. Lagler, K.F., J.E. Bardach and R.R. Miller, 1962. Ichthyology. John Wiley & Sons Inc., New York.
11. Orr R.T. 1976. Vertebrate Biology. W.B. Saunders Company, Philadelphia
12. Srivastava , C.B.L., 1999. Fish Biology. Narendra Publishing House, New Delhi (India)
13. Whitehead, H., Reeves, R. R. & Tyack, P. L. 1999. Science and the conservation, 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

## II SEMESTER

### IANM 24 ANCILLARY MATHEMATICS - II

#### Objectives:

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  $1/3^{\text{rd}}$  rule - Simpson’s  $3/8^{\text{th}}$  rule - Truncation error in Simpson’s  $1/3^{\text{rd}}$  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.

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



## IOST 25 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  $K_a$  and  $K_b$  on organic acids and bases - Organic reaction mechanisms:  $S_N1$  Vs.  $S_N2$  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 III : IOSP 27 : CHEMISTRY**

- 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

### **REFERENCE 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.G.C. Hill, J.S. Holman, Chemistry in Context, ELBS, 1998
6. W.R. Kneen, M.J.W. Rogers, P. Simpson, Chemistry – Facts, patterns and principles, ELBS., 1999.
7. Bruce H. Mahan, University Chemistry, 3rd edition, Addition-Wesley Publishing Company,1977.

## **IOST 26 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 IV : IOSP 28 : MARINE PLANTS**

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

## REFERENCE BOOKS

1. Dawes, C. J., 1997. Marine botany, 2<sup>nd</sup> 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.
6. Alexopoulos *et al.*, 1996. Introductory Mycology. John Wiley and sons, Inc.
7. Hemminga, M. A. and C. M. Duarte, 2000. Seagrass Ecology. Cambridge University Press, UK.
8. Hurd, C. L., P. J. Harrison, K. Bischof, C. S. Lobban, 2014. Seaweed Ecology and Physiology, 2<sup>nd</sup> edition. Cambridge University Press, Brazil.
9. Kersey, W. T., and S. P. Munger, 2009. Marine Phytoplankton. Nova Science Publishers, Incorporated.
10. Raghukumar, C., 2012. Biology of marine fungi. Springer.

### III SEMESTER

#### IANP 34 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: Fraunhofer 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 V : IOSP 37 : ANCILLARY PHYSICS - I

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

### REFERENCE BOOKS

1. Mechanics – D.S.Mathur – S.Chand & Co.,
2. Heat and Thermodynamics – Brijlal & N. Subramaniam – S.Chand & Co.
3. A text book of sound–Brijlal & N. Subramanyam S.Chand & Co.,
4. University Physics: Sears and Zemansky. Addison-Wesley; 10th edition, 1999.ISBN-10: 0201603225 ISBN-13: 978-0201603224.
5. 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 185015821
6. Fundamentals of Optics: F.A. Jenkins and H.E. White. McGraw-Hill 1957
7. Biological Physics: Nelson. W. H. Freeman, 2003. ISBN1429280751, 9781429280754

## **IOST 35 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 VI : IOSP 38 OCEAN AND COASTAL ECOLOGY**

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

## REFERENCE 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.
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, 3<sup>rd</sup> edition 640 pp.



## 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.

### 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 for correlation and regression coefficients. Chi-square test for goodness of fit and independence of attributes. ‘F’ test for equality of variances.

### UNIT IV

Unbiased Estimators – Methods of Moments – Maximum Likelihood Estimation – Curves fitting by Principle of least squares - Correlation and Regression – Rank correlation – regression equations. Simple problems based on biological data.

### UNIT V

Covariance matrix – Correlation Matrix – Multivariate Normal density function – Principal components – Sample variation by principal components – Principal components by graphing.

Statistical and graphing software: Excel, SPSS Sigma plot, SYSSTAT

## PRACTICAL VII : IOSP 39 STATISTICS

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  $\chi^2$
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

### REFERENCE 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.
6. Avely,N. and K.R.Buch, 1966. Introduction to the theory of probability and statistics.
7. Sankaranarayanan,G. 1969. Elementary theory of mathematical statistics and its application.
8. Kenny, J.F. and F.S. Keeping. 1963. Mathematics of statistics.
9. Mood,A.M. et al. 1973. Introduction to the theory of statistics.

## IV SEMESTER

### IANP 43 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- I Electricity**

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 Thermo EMF and resistance by potentiometer – applications of electromagnetic induction – Transformers – theory, energy loss and applications.

#### **Unit – II Magnetism**

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 – III Modern Physics and Wave mechanics**

Modern Physics: Photo electric effect – Einstein's photo electric equation – verification of Einstein's photo electric equation by Millikan'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 – IV Nuclear Physics**

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

## **Unit – Laser Physics**

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 VIII : IOSP 46 : ANCILLARY PHYSICS - II**

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

### **REFERENCE 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.
5. Vasudeva, D.N., 2005. Electricity and Magnetism. S.Chand & Co, New Delhi
6. Thygarajan, K and Ajoy Ghatak, 2011. Lasers: Fundamentals and Applications. Springer
7. Arumugam, M. 2008, Engineering Physics, Anuradha Publications

## **IOST 44 PHYSICAL OCEANOGRAPHY**

### **Objectives:**

To introduce students to physical oceanographic concepts and principles. The main emphasis of the course will be on physical forces in the ocean, especially those forces that drive ocean currents. The student will be expected to understand concepts relating to atmospheric-oceanic coupling, planetary forces and thermohaline circulation.

### **UNIT – I Geographical features**

History of oceanography, origin of ocean basins and seawater, bottom topography, abyssal hills and plains, submarine canyons, trenches and ridges. Classification of the marine environment.

### **UNIT – II Physical properties of seawater**

Physical properties of seawater – temperature, dissolve oxygen, density, viscosity, surface tension and conductivity of seawater - their distribution in space and time - Formation and classification TS diagram -acoustical and optical characteristics of seawater – SOFAR channel – shadow zone

### **UNIT – III Heat Budget**

Insolation – long wave radiation – effect of clouds – sensible and latent heat transfer Bowen's ratio – ocean heat transport – spatio temporal variability of heat budget terms and net heat balance.

### **UNIT – IV Circulation**

Currents – forces causing surface and deep currents - trade winds - major currents of the world oceans - boundary currents - equatorial currents - turbidity currents - geostrophic currents - gyres Langmuir circulation - upwelling - *El Nino* and *La-Nina*

### **Unit – V Indian Ocean**

Major expeditions – wind pattern – Northeast and Southwest monsoon winds – ocean surface circulation – equatorial current systems – Under currents – circulation in Arabian Sea and Bay of Bengal – Somali Current – Upwelling areas in Indian ocean – mixed layer variability – eddies – winter cooling – Indian ocean warm pool

## **PRACTICAL IX : IOSP 47 : PHYSICAL OCEANOGRAPHY**

### **Sampling Devices**

1. Water sampling devices –Horizontal water sampler, Niskin water sampler, Bacteriological water sampler.
2. Light measuring devices – Secchi disc, Lux meter, Turbidity meter.
3. Temperature and pressure measuring devices – towing surface thermometer, Six's maximum and minimum thermometer, Reversing thermometer, Bathythermograph, Fortin's barometer
4. Bottom sampling devices – Ekman's dredge, Petersen grab, Vertical gravity corer, Ooze sucker, and Mud snapper.

### **Estimation of physical properties of seawater**

1. Determination of density and salinity of seawater and its interrelationship
2. Determination of Surface tension of seawater and its correlation with salinity
3. Determination of viscosity of seawater and its correlation with salinity
4. Computation of Density using temperature and salinity (TS diagram)
5. Determination of turbidity using turbidity meter

### **REFERENCE BOOKS**

1. Duxbury, A.C., A.B.Duxbury & K.A.Sverdrup, 2000. An Introduction to the World's oceans. Wm.C.Brown Publishers.
2. Stowe, K., 1996. Exploring Ocean Science. John Wiley Sons Inc.
3. McCormick, J.M. and J.V.Thiruvathakal, 1976. Elements of Oceanography. W.B.Saunders, Philadelphia.
4. Pickar, G.L. and W.J.Emergy, 1995. Descriptive Physical Oceanography – an Introduction, Pergammon Press, London.
5. Svedrup, H.U., M.W. Johnson and R.H.Flemming, 1958. The Oceans –their Physics, Chemistry and General Biology. Prentice –Hall Inc., New Jersey.
6. Parker, S.H. 1985. Exploring the Oceans, Prentice Hall, New Jersey
7. Soares, M. 1998. The Ocean our future. Cambridge University Press.
8. McIlveen, R. 1995. Fundamentals of weather and climate. Chapman and Hall.
9. Bigg, G.R. 1996. The oceans and climate, Cambridge University Press.
10. Qasim, S.Z., 1999. The Indian Ocean, Images and Realities, Oxford and IBH.
11. Neshyba, S. 1987. Oceanography: Perspectives on the fluid earth. John Wiley & Sons, New York.
12. Gross, G., 1993. Oceanography: A view of the earth, Prentice-Hall Inc., New Jersey.
13. Readings in Earth Sciences (Vol. I to III) 1975. Scientific American Resource Library. W.H.Freeman & Co.

## **IOST 45 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**

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**

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**

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**

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

### **UNIT – V Nutrients**

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

## **PRACTICAL X : IOSP 48 : CHEMICAL OCEANOGRAPHY**

### **Titrimetric Procedures**

1. Chlorinity
2. Salinity
3. Alkalinity
4. Dissolved oxygen
5. Calcium and magnesium

### **Colorimetric Procedures to pollutants**

6. Bromide, fluoride and iodide
7. Nitrite
8. Nitrate
9. Phosphate
10. Total Phosphorus
11. Particulate organic carbon
12. Hydrogen Sulphide
13. Ammonia
14. Organic nitrogen
15. Reactive Silicate

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



## V SEMESTER

### IOST 51 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 – I**

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 – II**

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 – III**

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

#### **Unit – IV**

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 – V**

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 XI : IOSP 56 BIOLOGICAL OCEANOGRAPHY**

1. Identification of phytoplankton and zooplankton (diatoms, dinoflagellates, hydromedusae copepods, pteropods, chaetognaths, thaliaceae and planktonic larvae).
2. Identification of locally available macroalgae, seagrass and halophytes including mangrove plants.
3. Determination of primary production using light and dark bottle technique.
4. Benthic fauna of marine and estuarine environment-collection and identification.
5. 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.

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

## **IOST 52 ATMOSPHERIC SCIENCE AND METEOROLOGY**

**Objective:** To know and understand the atmospheric process and fundamentals and concepts of Meteorology.

### **Unit – I Fundamentals of Meteorology**

Principles of Meteorology, Thermal Structure of the Atmosphere and its Composition. Radiation: Basic Laws - Rayleigh and Mie scattering, Multiple scattering, Radiation from the Sun, Solar Constant, Effect of Clouds, Surface and Planetary Albedo. Emission and Absorption of Terrestrial Radiation, Radiation windows, Radiative Transfer, Greenhouse effect, Net radiation budget; Thermodynamics of dry and moist air: Specific gas constant, Adiabatic and Isoentropic processes, entropy and enthalpy, Moisture variables, Virtual temperature; Vertical stability of the atmosphere: Dry and moist air parcel and slice methods. Tropical convection.

### **UNIT – II Cloud Physics and Dynamic Meteorology:**

Cloud classification, Condensation Nuclei, Growth of Cloud drops and ice-crystals, Precipitation Mechanisms: Recipitation of warm and mixed clouds, Artificial precipitation, Hail suppression, Fog and Cloud – Dissipation, Radar observation of Clouds and Precipitation, Radar echoes of hail storm and Tornadoes, Radar observation of Hurricanes. Basic equations and fundamental forces: Pressure, Gravity, Centripetal and Coriolis forces, Continuity equation in Cartesian and Isobaric coordinates. Divergence and Vertical motion Rossby, Richardson, Reynolds and Froude numbers. Circulation, Vorticity and Divergence; Atmospheric Turbulence: Atmospheric Energetics:

### **UNIT – III General Circulation and Climate Modelling:**

Observed zonally symmetric Circulations, Meridional circulation models, Mean Meridional and Eddy transport of momentum and Energy, Angular momentum and Energy budgets; Zonally asymmetric features of general circulation; Standing eddies; East-West circulations in Tropics: Climate variability and Forcings; Feedback processes, Low frequency variability, MJO (Madden-Julian oscillation), ENSO, QBO (quasi-biennial oscillation) and Sunspot cycles. Basic principles of general circulation modelling; Grid-point and Spectral GCMs; Role of the ocean in climate Modeling; Internal variability of ocean fields (SST, winds, circulation, etc.) and its Relationship with Monsoon, Concepts of Ocean – Atmosphere coupled Models.

### **UNIT – IV Synoptic Meteorology:**

Tropical Meteorology: Trade wind inversion, ITCZ; Monsoon trough tropical cyclones, Their structure and Development theory; Monsoon depressions;; Western disturbances; SW and NE monsoons; Synoptic features associated with onset, Withdrawal, Break active and Weak monsoons and their prediction. Air masses and fronts: Sources, Origin and Classification of Air masses; and Fronts, Frontogenesis and Frontolysis; Structure of Cold and Warm fronts; Weather systems associated with fronts. Extra-Tropical synoptic scale features: Extratropical Cyclones and Anticyclones.

## **UNIT – V Satellite Meteorology**

Meteorological Satellites – Polar orbiting and Geostationary Satellites, Visible and Infrared radiometers, Multiscanner radiometers; Identification of Synoptic systems, Fog and Sandstorms, Detection of Cyclones, Estimation of SST, Cloud top Temperatures, Winds and Rainfall: Temperature and Humidity soundings.

### **REFERENCE BOOKS**

1. Donald Ahrens, C. (2008) Meteorology Today.
2. Frederick K. Lutgens, Edward J. Tarbuck, Dennis Tasa , (2009) The Atmosphere: An Introduction to Meteorology (11th Edition).
3. Steven A. Ackerman, Meteorology, John A. Knox, (2011) Third Edition.
4. Frederick K. Lutgens, Edward J. Tarbuck, Dennis Tasa, (2006) The Atmosphere: An Introduction to Meteorology (10th Edition) .
5. C. Donald Ahrens, (2011) Essentials of Meteorology: An Invitation to the Atmosphere.
6. Donald Ahrens. C. (2008) Essentials of Meteorology.
7. Sverre Petterssen, (2008) Introduction To Meteorology.
8. BarCharts, (2012). Meteorology (Quick Study: Academic).
9. James R. Holton, (2004). An Introduction to Dynamic Meteorology (International Geophysics).
10. Storm Dunlop , (2008). Guide to Weather Forecasting: All the Information You'll Need to Make Your Own Weather Forecast (Firefly Pocket series).
11. C. Donald Ahrens , (2008), Meteorology Today: An Introduction to Weather, Climate, and the Environment. Study Guide/Workbook .
12. Frank R. Spellman , (2012). The Handbook of Meteorology.
13. Roland B. Stull, (1988). An Introduction to Boundary Layer Meteorology (Atmospheric Sciences Library).
14. Storm Dunlop, (2003). The Weather Identification Handbook: The Ultimate Guide for Weather Watchers.
15. Frederick K. Lutgens,, Edward J. Tarbuck, Dennis Tasa, (2012) The Atmosphere: An Introduction to Meteorology (12th Edition).
16. Roland B. Stull, (1999). Meteorology for Scientists and Engineers

## **IOST 53 MARINE GEOLOGY**

### **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, isostasy 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 XII : IOSP 57 : MARINE GEOLOGY

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)

### REFERENCE 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*: Englewood 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*, 4th ed: Dubuque, 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 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.

### **UNIT - V**

Thermal pollution – sources, waste heat disposal, uses of waste heat, role of biocides (Chlorine), ecological impacts.

## **PRACTICAL XIII : IOSP 58 : MARINE POLLUTION**

Analysis and estimation of critical pollutants in seawater.

1. Estimation of Ammonia (NH<sub>3</sub>) in seawater
2. Estimation of hydrogen sulfide (H<sub>2</sub>S) in seawater
3. Estimation of BOD in seawater
4. Estimation of COD in seawater
5. Pesticide residue in seawater
6. Petroleum hydrocarbon in seawater
7. Heavy metals (Cu, Cd, Pb, Hg) in seawater, sediments & animal tissues

## REFERENCE 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., 1999. Handbook of Environmental Impact Assessment, Blackwell Science, , London,1999.
6. David J. Hoffman, Barnett A. Rattner, G. Allen Burton, Jr. Johan Cairns, 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 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 Output - 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 XIV : IOSP 59 COMPUTER APPLICATION - III**

#### **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

### REFERENCE BOOKS

1. Balagurusamy, E., 2003. Object Oriented Programming with C++, Second edition, Tata McGraw Hill
2. Balagurusamy, E., 2006. Object-oriented programming with C++, 3<sup>rd</sup> Edition, Tata McGraw Hill
3. Balagurusamy, E., 2007. Programming in Ansi C, 4<sup>th</sup> 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, 8<sup>th</sup> Edition, Infinity science,

## VI SEMESTER

### IOST 61 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, Storm surges, EL-Nino Southern Oscillation (ENSO), cyclone tracking-thunderstorms- forecasting technique-standard tool in weather forecasting-satellite in weather forecasting.

## **PRACTICAL XV : IOSP 65 : AIR – SEA INTERACTION**

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.

### **REFERENCE 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 62 : 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 thorough 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 & non-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 channel, 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.

## **PRACTICAL XV : IOSP 66 : 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 Bernoulli'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

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

## IOST 63 WAVES AND TIDES

### Objectives:

This course will aim to learn the following

- Wave Motion and Speed, Wave height
- Deep Water and Shallow Water Waves
- Refraction / Reflection / Diffraction
- The Surf Zone
- Tsunami, Internal Waves, Standing Waves
- Tide Patterns and Levels
- Tidal Currents and Tidal Bores
- Equilibrium Tidal Theory
- Dynamic Tidal Analysis
- Predicting Tides and Tidal Currents

### Unit – I Introduction to wave motion

General characteristics of waves, small amplitude waves – phase speed, group speed, orbital motion of water particles, wave energy and momentum, internal waves

### Unit – II Finite amplitude waves

Gestner's wave – vorticity, Stoke's third order wave – phase velocity and wave profile, Stoke's drift, Crappers, Cnoidal and solitary waves

### Unit – III Long Waves

Introduction to long waves, phase speed of long wave, Kelvin waves and Rossby waves, seiches, Co-tidal oscillation

### Unit – IV Wind waves

Generation of wave by wind, their growth, propagation and decay, theories of wave generation, significant wave height and period, wave spectrum, principles of wave forecasting, SMB and PNJ methods

### Unit – V Tides

Tide generating forces, tidal theories, tidal analysis and prediction - Harmonic analysis, response method, tides at the coast, in estuaries, in bays and in open ocean, tidal currents.



## **PRACTICAL XVII : IOSP 67 : WAVES AND TIDES**

1. Deployment and retrieval procedure for the Directional wave Recorder
2. Study of wave characteristics from wave recorder data
3. Computation of wave energy using significant wave height, density and gravity
4. Study of Tide characteristics from tide gauge data
5. Deployment and retrieval procedure for the Current meter
6. Study of Current characteristics from current meter data

### **REFERENCE BOOKS**

1. Blair Kinsman, 2012. Wind Waves: Their Generation and Propagation on the Ocean Surface, Dover Publications, 704pp.
2. Albert Defant, 1961. Physical oceanography 2 volumes. Pergamon press inc
3. Dijkstra, Henk A, 2008. Dynamical Oceanography, Springer Science
4. John Wright, Angela Colling, Dave Park, 1999. Waves, Tides, and Shallow-water Processes, Gulf Professional Publishing, 227pp.
5. G. I. Marchuk, B. A. Kagan, 2014. Ocean Tides: Mathematical Models and Numerical Experiments, Elsevier, 304pp.

## **IOST 64 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 XVIII : IOSP 68 : INSTRUMENTATION AND ANALYTICAL METHODS**

1. Separation of Proteins using Polyacrylamide gel electrophoresis
2. Separation of amino acids using Paper chromatographic technique
3. Spectrophotometer : Estimation of nutrients in seawater
4. Spectrofluorometer: Estimation of dissolved petroleum hydrocarbon in seawater
5. Flame Photometer: Estimation of Na, K and Ca in seawater
6. ICP Spectrometer: Estimation of heavy metals in seawater

### **REFERENCE 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.

## VII SEMESTER

### IOST 71 COASTAL MARINE RESOURCES

#### **Objective:**

- To assess the various living and non-living resources, resource exploration and exploitation and strategies for sustainable management of coastal and marine resources.
- To link marine ecology and environmental policies for effective management of coastal resources

#### **UNIT- I Coastal and marine resources**

Types and functions of coastal and marine resources – Coastal zone as an integrated resource area – Marine resources: biotic, mineral and energy resources

#### **UNIT - II Non-living marine resources**

Renewable vs. Non-Renewable Resources – Marine minerals – Placer deposits hydrocarbon deposits – Polymetallic nodules – Exploration and exploitation of natural minerals – Methyl/ Gas Hydrates – Sea Salt – Potential energy in the ocean – Salinity – Wave – Tides – Currents – OTEC

#### **UNIT - III Living marine resources**

Environmental variability on marine fisheries resources – Interactions between fisheries and the ecosystem – Marine Protected Areas (MPA) – Large marine Ecosystems (LMEs) – Climate effects on living marine resources – Biological monitoring of marine ecosystems

#### **UNIT – IV Resource exploration and exploitation**

Marine geophysical methods – Sea floor resource exploitation – Exploitation of the oceans by human activities – overfishing – mining – ocean dumping – oil spills – coral reef bleaching – Marine archaeology

#### **UNIT - V Coastal and marine resource management**

Resources as common property – Defining resource management – Conflicting interests with other Marine Resources: Food and Recreation/Tourism – Management tools – Ecosystem health and protection of biological diversity – Ecotourism – Future uses of the oceans

## REFERENCE BOOKS

1. Beer, T., Environmental Oceanography: Second Edition (Marine Science Series), CRC Press, 1997.
2. Kennish, M.J., Pollution Impacts on Marine Biotic Communities, CRC Press, New York, 1998.
3. Alongi, D.M., Coastal Ecosystem Processes, CRC Press, New York, 1998.
4. Eisma, D., Intertidal deposits, River Mouths, Tidal flats and Coastal Lagoons, CRC Press, New York, 1998.
5. Newman, M.C., Roberts Jr. M.H. and Male, R.C. (Eds.), Coastal and Estuarine Risk Assessment, Lewis Publishers, Washington D.C. 2002.

## **IOST 72 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 XIX : IOSP 72 SURVEY TECHNOLOGY

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).

### REFERENCE BOOKS

1. Agor, R. “A text book on Advanced Surveying”. Khanna publishers, 4<sup>th</sup> edition, New Delhi. 2007.
2. Arora, K.R. “A text book on Surveying Volume I and II” – Standard publishers-New Delhi. 1990.
1. Punmia, B.C., Ashok K.Jain and Arun K.Jain. “ Higher Surveying”- Lakshmi publications, 15<sup>th</sup> edition, NewDelhi. 2005.
2. Punmia, B.C., Ashok K.Jain and Arun K.Jain. “Surveying Volume I and II”- Lakshmi publications, 15<sup>th</sup> edition, NewDelhi. 2005.
3. Hofmann -Wellenhof, B.H. Lichtendger and J.collins, “GPS- Theory and practice” Springer wein, New York. 1997.

## IOST 73 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 XX : IOSP 77 SATELITE OCEANOGRAPHY**

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 / mosaic / 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

### **REFERENCE 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 3<sup>rd</sup> 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, 2<sup>nd</sup> 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 74 MARINE INSTRUMENT 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

## **PRACTICAL XXI : IOSP 78 : MARINE INSTRUMENT FOR OCEANOGRAPHIC MEASUREMENTS**

### **Demonstration**

1. GPS
2. Wave recorder
3. Electromagnetic Current meter
4. Echo Sounder
5. CTD

### **Data processing**

1. Sea bed mapping using single beam Echo sounder data
2. Vertical profile of conductivity and temperature from CTD data
3. Vertical profile of sound velocity
4. Vertical profile of Argo data set
5. Meteorological data analysis from Buoy data
6. Oceanographic data analysis from Buoy data

### **REFERENCE BOOKS**

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

## **IOST 75 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 Land sea interactions**

Multiple uses of the coastal zones and conflicts. Coastal settlements - human impacts on the coastal zones with special emphasis on artisanal fishing, coastal aquaculture and coastal tourism. Coastal vulnerability - mangroves, wetlands, sand dunes, sea-grasses, lagoons and enclosed seas, islands, coral reefs and other protected areas.

## **UNIT – V Coastal ecosystem monitoring**

Coastal and marine ecosystem monitoring –Estuaries, mangroves, lagoons, backwater, reef etc. Effect of port activities and coastal pollution on mangroves, corals and beaches. Role of national and international agencies for coastal and Ocean management.

### **REFERENCE 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
6. Coastal area management and Development, 1982. UN. Department of International Economic and Social Affairs.
7. Sharma, R.C. and P.C. Sinha, 1994. India's Ocean Policy, Khama Publishers, New Delhi.
8. Duxbury, A.C., A.B. Duxbury and K.A. Sverdrup, 2000. An Introduction to the World's Oceans. 6<sup>th</sup> Edition. McGraw Hill Companies.
9. 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.
10. Qasim, S.Z., 1999. The Indian Ocean – Images and Realities. Oxford & IBH Publishing Company, India.
11. John R. Clark. 1995. Coastal zone management handbook. Lewis publishers, Washington, D.C. 694pp.
12. Kay, R. and J. Aider, 2005., Coastal planning and management, 2/e. Taylor and Francis, 380pp.

## VIII 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 – I**

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 XXII : IOSP 86 GEOGRAPHIC INFORMATION SYSTEM**

#### **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



## REFERENCE 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*. 2<sup>nd</sup> 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*, 2<sup>nd</sup> 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. Willis, 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*. 2<sup>nd</sup> edition. , ITC Educational Textbook Series
13. Kang Tsung Chang, 2006. *Introduction to Geographic Information Systems*, TATA McGraw Hill, 3<sup>rd</sup> edition, 431 pp.

## IOST 82 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 XXIII : IOSP 87 RENEWABLE ENERGY SYSTEM**

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

### **REFERENCE BOOKS**

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

## **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, equatorial under current.

### **UNIT – V Thermohaline Effects**

Thermohaline circulation, thermodynamic and salinity circulation, Antarctic circumpolar current, topographic steering, equations for salt and temperature conservation, Reynold's fluxes and eddy diffusivity, mixed layer of the ocean.

## REFERENCE 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 2<sup>nd</sup> edition. Pergamon Press.
6. Dijkstra, Henk A, 2005. Non-linear Physical oceanography, Springer Science
7. Hell, M.N., 1962. Sea ideas & Observation Progress Vol.1. Willey, John & sons.
8. Von Arx, W.S., 1962. Introduction to Physical oceanography. Addison – Wesley
9. Fomin, L.M., 1964. Dynamic method in oceanography. Elsevier publication co.
10. Neumann, G., 1968. Ocean currents oceanography series vol.4. Elsevier Science Publishing co.

## **IOST 84 DISASTER MANAGEMENT**

### **Objectives:**

The main objectives of this paper are to expose students about the coastal natural disasters, technological hazards and its characteristics. The course is a combination of lectures on the state-of-the-art disaster preparedness and management strategies and to prepare them to use these techniques whenever needed.

### **UNIT - I Coastal natural disasters**

Hazards and Disasters - Description and distinction – Atmospheric (Flood, Drought and Cyclone and dust storms) Geologic (Landslide, Earthquake, Tsunami, Volcanoes) Hydrologic (coastal, riverine flooding and saltwater intrusion), meteor impact – Sea level rise and its effects

### **UNIT - II Technological hazards**

Manufacturing (with hazardous substances & processes) Storage (of hazardous substances) Transport (of large numbers of people and/or hazardous substances) Waste & Contamination (due to hazardous substances) – oil spills

### **UNIT - III Characteristics of disasters/ hazards**

Suddenness – uncertainty – potential risk- dynamism – rarity – disruption of communication, power supply and transportation – People's unusual behaviour – theft and robbery – derailed law and order

### **UNIT - IV Disaster preparedness**

Creation of awareness on disasters - Preparedness in the event of disasters – developing shelter facilities – stocking food and other essential items – mobile health facilities – self regulation during emergency – vulnerability and risk analysis – bioshields and/ or artificial structures for protection, control and redirection

### **UNIT - V Managerial components**

Rehabilitation and reconstruction - strengthening livelihoods, improving nutrition & health – ensuring safe house and site, proper protection - good governance - preparedness assessment and planning - electrical malfunction - internal flood - bomb threat - civil disturbance - six principles of resilience: homeostasis, omnivory, high flux, buffering, flatness, redundancy

## REFERENCE BOOKS

1. Harsh K. Gupta ,2003. Disater Managemnet, University press, 152pp.
2. Damon P. Coppola, 2015. Introduction to International Disaster Management, Butterworth-Heinemann, 760pp.
3. I.Sundar T.Sezhiyan,2007. Disaster Management, Sarup & Sons, 182pp.
4. Jack Pinkowski, 2008. Disaster Management Handbook, CRC Press, 624pp.
5. Rajiv Sinha, Rasik Ravindra, 2012. Earth System Processes and Disaster Management, Springer Science & Business Media, 244pp.

## **IOST 85 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 XXIV : IOSP 88 FISHERY TECHNOLOGY**

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



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

## IX SEMESTER

### IOST 91 : 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.

#### 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

Characterization 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 XXV : IOSP 96 UNDERWATER ACOUSTICS AND OPTICS**

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

### **REFERENCE BOOKS**

1. Underwater acoustic systems: R.F.W. Coates. Macmillan new electronics series, 1990 ISBN-10: 0333425421 ISBN-13: 978-0333425428
2. Acoustical Oceanography: C.S. Clay and H. Medwin. Wiley, 1977. ISBN-10: 0471160415, 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 1982 ISBN-13: 9783540113058. ISBN-10: 3540113053
5. Marine Optics: N.G. Jerlov. Elsevier., 1976. ISBN 0080870503, 9780080870502
6. Physical Optics of Ocean waters: K.S. Shifrin. Springer 1988 ISBN 0883185296, 9780883185292
7. Ocean Optics: Web Book-By Curtis Mobley, Emmanuel Boss and Collin Roesler.

## **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 XXVI : IOSEP 96 COASTAL AND ESTUARINE DYNAMICS**

1. Measurement and plot of Beach profile.
2. Estimation of longshore sediment transport
3. Preparation and interpretation of Bathymetric charts
4. Preparation of wave refraction diagrams
5. Analysis of wave records
6. Hind casting of ocean waves.

## REFERENCE BOOKS

1. Dyer, K.R. 1986. Coastal and Estuarine sediment dynamics, New York, Wiley-Intersciences
2. Peter Nielsen, 2009. Coastal and Estuarine Processes Volume 29 of Advanced Series on Ocean Engineering, World Scientific Publishing Company, 360 pp
3. Dronkers Job, 2005. Dynamics Of Coastal Systems Volume 25 of Advanced Series On Ocean Engineering, World Scientific Publishing Company, 540 pp
4. J. van de Kreeke, R. L. Brouwer, 2017. Tidal Inlets: Hydrodynamics and Morphodynamics, Cambridge University Press, 220 pp.
5. Andrew D. Short, 2009. Handbook of beach and shoreface morphodynamics, John Wiley, 379 pp.

## **IOST 93 NUMERICAL MODELING FOR COASTAL PROCESSES**

### **OBJECTIVE:**

- To introduce the usefulness and versatility of numerical, ecological, and water quality modeling in the context of environmental problem solving
- The course will have a theoretical and a practical component which will be closely interconnected.
- On the theoretical component, the basic modeling concepts will be presented as well as the implications related to the implementation and application of numerical models.
- In terms of the practical component, the objective is to develop the skills on using numerical models to study physical and biogeochemical processes in coastal systems.

### **UNIT - I INTRODUCTION**

Role of mathematical models - Modeling of coastal processes - Water Quality Modeling - Introduction to Ecology & Ecological Models– Model development and validation - Basic numerical tools used in mathematical models

### **UNIT - II MODELING OF COASTAL PROCESSES**

Equations governing processes in coastal environment: Inviscid & viscous flows, waves, coastal flow fields & estuarine flows, beach processes - Case studies of numerical solutions of equations governing coastal processes: Systems of linear algebraic equations; over-, even- and under- determined system of linear equations – Review of matrix algebra – Numerical solutions of matrix equations - Matrix Eigen value problem.

### **UNIT - III EQUATIONS INVOLVED IN MODELING**

Interpolation & Curve-fitting - Quadratic splines & Cubic splines – System of ordinary differential equations: Initial value - Boundary-value, Eigen value Problems - Numerical Solution to Systems of Equations

### **UNIT - IV WATER QUALITY MODELS**

Mass Balance for a well mixed system - Steady State & Time dependent solution to a well mixed system - Modeling Feed-forward & Feedback systems

### **UNIT - V WATER QUALITY MODELING AND FEEDBACK**

Incompletely Mixed Systems – Advection and Diffusion – estuarine transport – dispersion coefficient – water quality response to inputs

## REFERENCE BOOKS

1. Chapra, S.C. and Canale, R.P. Numerical Methods for Engineers, Tata McGraw Hill Publishing Co. Ltd., 2006.
2. Smith, G.D. Numerical solution of Partial Differential equations, Clarendon Press, 1985.
3. Chapra, S.C. Surface Water Quality Modeling, McGraw Hill Companies, Inc. 1997.
4. Reeves, D., Chadwick, A. and Fleming, C. Coastal Engineering, Spon Press, 2004.
5. Dean, R.G. and Dalrymple, R.A. Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.
6. Ippen, A.T. Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc. New York, 1978.

## **IOST 94 - ENVIRONMENTAL IMPACT ASSESSMENT**

### **OBJECTIVE:**

- To provide a description of the existing natural and socio-economic environment within the area of influence of the project
- To identify the project components which might have a significant impact on the existing natural and socio-economic environment and the potential impacts of these project components on a local and regional scale
- To analyze the net environmental impacts of the project and suggest mitigating measures or alternatives which might alleviate negative impacts.

### **UNIT – I INTRODUCTION**

Environmental Impact Assessment (EIA) – Environmental Impact Statement (EIS) – Environmental Risk Assessment (ERA) – Legal and Regulatory aspects in India – Types and limitations of EIA – Terms of Reference in EIA – Issues in EIA – National – Cross-sectoral – Social and cultural

### **UNIT – II COMPONENTS AND METHODS**

Methods for Impact Identification – Matrices, Networks and Checklists – Prediction and assessment of Impacts on Air, Noise, Water, Soil, Biological and Cultural environments – Public participation in environmental decision making – Decision Methods for Evaluation of Alternatives – Mitigation measures – Environmental Monitoring Plan

### **UNIT – III QUALITY CONTROL AND INSTITUTIONAL ARRANGEMENTS**

Trends in EIA practice and evaluation criteria – Capacity building for quality assurance – Expert system in EIA – use of regulations and AQM – QAQC -Roles, scope and contributions of public involvement – Indigenous involvement in decision making processes – NGO's roles and responsibilities in EIA – Constitution and law

### **UNIT – IV EIA ESSENTIAL SECTORS AND ISSUES**

Sewage/ Industrial outfall, Coolant water intake/outfall, Desalinisation, Dredging – composition, limit values, disposal options and pre-treatment – Thermal Impact on marine ecosystem – Biofouling and entrainment – Hazardous waste incineration: set up of plants, rotary kiln and liquid wastes



## **UNIT – V CASE STUDIES**

Case studies of EIA of developmental projects and projects on coastal areas – Comparative Review of EIA systems: EIA in the USA, EIA in the European Countries, EIA in developing countries

### **REFERENCE BOOKS**

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York,1996.
2. Petts, J., Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London,1999.
3. The World Bank Group, Environmental Assessment Source Book, Vol. I, II and III, The World Bank, Washington,1991.
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley Interscience, New Jersey,2003.
5. Wood, C., Environmental Impact Assessment/ A Comparative Review, Prentice Hall, Pearson Education Limited, 1995.
6. Glasson, J., Introduction to Environmental Impact Assessment: Principles and Procedures, Process, Practice and Prospects, UCL Press, 1999.
7. Calow, P., Handbook of Environmental Impact Assessment, Blackwell Science, 1999.

## **IOST 95 MARINE RECREATION**

### **UNIT – I COASTAL WORLD**

Types of beaches - importance of beaches - aesthetic value of beaches - Need for protecting beaches – world important beaches

### **UNIT – II SCOPE OF MARINE RECREATION**

Types of marine recreation - Beach games - Marine tourism - beach visitation, swimming, snorkeling, scuba diving, surfing, wind surfing, fishing, motor boating, sailing, personal watercraft use, rowing, canoeing, kayaking, hunting for waterfowl, beachcombing and nature viewing and photographing -boat races

### **UNIT – III MARINE RECREATION MANAGEMENT**

Marine recreation regulations -Recreational activities: permitted and not-permitted - Recreational marine insurance - Conservation - Coastal zone management with special reference to marine recreation - territorial waters and exclusive economic zone - fishing holiday

### **UNIT – IV SAFETY IN MARINE RECREATION**

Caution and warnings - standardization of recreational appliances and transportation units - Safety of Life at Sea (SOLAS) - preparedness for coastal hazards - natural disasters - Role of coast guards in assuring safety at sea - Pollution due to marine recreation activities - marine debris due to marine recreation

### **UNIT – V MARINE RECREATIONAL FACILITIES**

Recreational opportunities:- Recreational areas: Marine parks - theme parks - Personal Water Craft (PWC) - Jetski - fishing gear - surf board - water ski gear - snorkel and SCUBA - under-water cameras - canoes, boats and cruise liners

### **References**

1. Mark Orams, 1999. Marine Tourism: Development, Impacts and Management, Psychology Press, 115 pp.
2. Orams MB. 2004. Use of the sea for recreation and tourism. A management challenge for the 21st century. In The Oceans: Key Issues in Marine Affairs. Smith HD. (Ed), 161-173. Kluwer Academic Publishers, Dordrecht, TheNetherlands
3. Brian Garrod, Stefan Gössling, 2008. New Frontiers in Marine Tourism: Diving Experiences, Sustainability, Management, Elsevier, 220pp
4. Garrod, B., and J.C. Wilson. (Eds.). (2003). Marine ecotourism: issues and experiences. Clevedon, UK: Channel View
5. Brian Garrod, Julie C. Wilson, 2003. Marine Ecotourism: Issues and Experiences, Channel View Publications, 266 pp.

**X SEMESTER**  
**IOST 101- PROJECT PLANNING, ANALYSIS AND MANAGEMENT**

**Objectives:**

This course will aim to train the students to undertake 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.

## **REFERENCE 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., 3<sup>rd</sup> ed., 1992.
5. Harold Kerzner: Project Management; A System approach to planning, Scheduling and controlling, New Delhi, CBS Publishers and Distributors, 2<sup>nd</sup> ed., 2000.
6. Joy P.K.: Total Project Management: The Indian Context, New Delhi, Macmillan India Ltd., Updated, 1996.
7. Rao PCK: Project Management Control, New Delhi, Sultan Chand & Sons, 1997.

## **IOST 102 Dissertation and Viva-Voce**