ANNAMALAI UNIVERSITY
ANNAMALAINAGAR

HAND BOOK
2019 - 2020

FACULTY OF MARINE SCIENCES
DEGREE OF MASTER OF SCIENCE
OCEAN SCIENCE AND TECHNOLOGY
(5 YEAR INTEGRATED)

ANNAMALAI UNIVERSITY

REGULATIONS FOR THE FIVE-YEAR INTEGRATEDPOST GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

These Regulations are common to all the students admitted to the Five Year Integrated Master's Programmes in the Faculties of Arts, Science, Indian Languages, Marine Sciences, and Education from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

1.1 **University** refers to Annamalai University.

1.2 **Department** means any of the academic departments and academic centres at the University.

1.3 **Discipline** refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.

1.4 **Programme** encompasses the combination of courses and/or requirements leading to a Degree. For example, M.A., M.Sc.

1.5 **Course** is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/ Report writing/viva-voce etc. Each course has a course title and is identified by a course code.

1.6 **Curriculum** encompasses the totality of student experiences that occur during the educational process.

1.7 **Syllabus** is an academic document that contains the complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.8 **Academic Year** refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.9 **Semester** is a half-year term that lasts for a minimum of 90 working days. Each academic year is divided into two semesters.

1.10 **Choice Based Credit System** A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.11 **Core Course** is mandatory and an essential requirement to qualify for the Degree.

1.12 **Elective Course** is a course that a student can choose from a range of alternatives.

1.13 **Value-added Courses** are optional courses that complement the students' knowledge and skills and enhance their employability.

1.14 **Experiential Learning** is a process of learning through experience. It is specifically defined as "learning through reflection on doing".

1.15 **Extension activities** are the activities that provide a link between the University and the community such as lab-to-land, literacy, population education, health awareness and environmental awareness programmes. These are integrated within the curricula with a view to sensitise the students about Institutional Social Responsibility (ISR).

1.16 **Credit** refers to the quantum of course work in terms of number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.17 **Credit Hour** refers to the number of class hours per week required for a course in asemester. It is used to calculate the credit value of a particular course.

1.18 **Programme Outcomes (POs)** are statements that describe crucial and essential knowledge, skills, and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

1.19 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.20 **Learning Objectives also known as Course Objectives** are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

1.21 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.22 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken ina semester. The formula for computing GPA is given in Section11.3

1.23 **Cumulative Grade Point Average (CGPA)** is a measure of overall cumulative performance of a student over all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters.

1.24 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, and RA.

2. Programmes Offered and Eligibility Criteria

The Integrated Programmes offered by the University and the eligibility criteria are detailed below.

Faculty of Marine Sciences	
Programme	**Eligibility**
M.Sc. Ocean Science & Technology	A pass in H.S.E. (10+2 level) OR Equivalent thereto under Academic Stream in the following subjects Mathematics, Physics, Chemistry & Biology.

2.1 In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for all the above Programmes.

3. Reservation Policy

Admission to the various programmes will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. Programme Duration

4.1 The Five Year Master's Programmes consist of five academic years and ten semesters.

4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.

4.3 Each semester will have 90 working days (18 weeks).

5. Programme Structure

5.1 The Five Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Soft Skills, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

5.2 Language Courses

5.2.1 Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.

5.2.2 Language-I shall be Tamil or another language such as Hindi or French.

5.2.3 Language-II shall be English.

5.3 Core courses

5.3.1 These are a set of compulsory courses essential for each programme.

5.3.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

5.4 Allied Courses

5.4.1 Each student shall take courses in two disciplines allied to the main subject of the programme in the first four semesters.

5.4.2 In Arts, Indian Languages, and Education, there will be three Theory Courses each for Allied-I and Allied-II.

5.4.3 In Science and Marine Sciences, each allied discipline shall have two Theory courses and one Practical courseeach for Allied-I and Allied-II.

5.5 Elective Courses

5.5.1 Departmental Electives (DEs) are the Electives that students can choose from a range of Electives offered within the Parent Department offering the Programme.

5.5.2 Interdepartmental Electives (IDEs) are Electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.

5.5.3 Students shall take a combination of both DEs and IDEs.

5.6 Soft Skills

5.6.1 Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.

5.6.2 Soft skills include communication skills, computer skills, social skills, leadership traits, team work, development of emotional intelligence quotients, among others.

5.6.3 Each student shall choose four courses on soft skills from the First to the Sixth Semester from a range of courses offered.

5.7 Value Education

All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

5.8 Experiential Learning

5.8.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

5.8.2 In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

5.9 Extension Activities

5.9.1 It is mandatory for every student to participate in extension activities.

5.9.2 All the students shall enrol under NSS/NCC/YRC/RRC or any other Service Organisation in the University.

5.9.3 Students shall put in a minimum attendance of 40 hour in a year duly certified by the Programme Co-ordinator.

5.9.4 Extension activities shall be conducted outside the class hours.

5.10 Project

5.10.1 Each student shall undertake a Project in the final semester.

5.10.2 The Head of the Department shall assign a Project Supervisor to all the students.

5.10.3 The Project Supervisor shall assign a topic for project and monitor the progress of the student periodically.

5.10.4 Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Project Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

5.11 Value added Courses (VACs)

5.11.1 Students may also opt to take Value added Courses beyond the minimum credits required for award of the Degree. VACs are outside the normal credit paradigm.

5.11.2 VACs enhance the students' employability and life skills. VACs are listed in the University website and in the regulations on Interdepartmental Electives and VACs.

5.11.3 Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.

5.11.4 Classes for VACs are conducted beyond the regular class hours and preferably in the VIII and IX Semesters.

5.12 Online Courses

5.12.1 The Heads of Departments shall facilitate enrolment of students in Massive Open OnlineCourses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.11.2 Students who successfully complete a course in the MOOC platform shall be exempted from one elective course of the programme.

5.12 Credit Distribution

The credit distribution is detailed in the Table.

	Credits
Semester I to VI	
Language-I (Tamil or any other Language)	12
Language-II (English)	12
Core Courses	60-65
Allied-I	10
Allied-II	10
Electives	15
Soft skills	12
Environmental studies (UGC mandated)	2
Value Education	2
Experiential learning	4
Extension activities	1
Total Credits (Semester I to VI)	**140-145**
Semester VII to X	
Core Courses	65-75
Electives	15
Project	6-8
Total Credits (Semester VII to X)	**90-95**
Total Credits Semester I to X (Minimum requirement for the award of Degree)	***230-240**

**Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 230-240 credits.*

5.13 Credit Assignment

Each course is assigned credits and credit hours on the following basis:

1 Credit is defined as

1 Lecture period of one hour per week over a semester

1 Tutorial period of one hour per week over a semester

1 Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

6 Attendance

6.1 Each faculty handling a course shall be responsible for the maintenance of *Attendance and Assessment Record*for students who have registered for the course.

6.2 The Record shall contain details of the students' attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition, the Record shall also contain the organisation of lesson plan of the Course Instructor.

6.3 The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.

6.4 At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.

6.5 The Course Instructor shall intimate to 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.

6.6 Each student should earn minimum of 75% attendance in the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness.

7. Mentor-Mentee System

7.1 To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

7.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

7.3 The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8. Examinations

8.1 The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.2 There will be two CIA Tests and one ESEin each semester.

8.3 The Question Papers will be framed to test different levels of learning based on Bloom's taxonomyviz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

8.4 Continuous Internal Assessment Tests

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable to the course. This requires an element of openness.

8.4.2 The students are to be informed in advance about the assessment procedures.

8.4.3 The pattern of question paper will be decided by the respective faculty.

8.4.4 CIA Test-I will cover the syllabus of the first two units while CIA Test-II will cover the last three units.

8.4.5 CIA Tests will be for one to three hours duration depending on the quantum of syllabus.

8.4.6 A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.5 End Semester Examinations (ESEs)

8.5.1 The ESEsfor the odd semester will be conducted in November and for the even semester in May.

8.5.2 A candidate who does not pass the examination in any course(s) will be permitted to reappear in such course(s) that will be held in November and May in the subsequent semester/year.

8.5.3 The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 Evaluation

9.1 Marks Distribution

9.1.1.Each course, both Theory and Practical as well as Project/Internship/Field work/In-plant trainingshall be evaluated for a maximum of 100 marks.

9.1.2 For the theory courses, CIA Tests will carry 25% and the ESE, 75% of the marks.

9.1.3 For the Practical courses, the CIA Tests will constitute 40% and the ESE 60% of the marks.

9.2. Assessment of CIA Tests

9.2.1 For the CIA Tests, the assessment will be done by the Course Instructor

9.2.2 For the Theory Courses, the break-up ofmarks shall be as follows:

	Marks
Test-I&Test-II	15
Seminar	5
Assignment	5
Total	25

9.2.3For the Practical Courses (wherever applicable), the break-up of marksshall be as follows:

	Marks
Test-I	15
Test-II	15
Viva-voce and Record	10
Total	40

9.3 Assessment of End-Semester Examinations

9.3.1 Double Evaluation for the ESE is done by the University Teachers.

9.3.2 In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

9.4 Assessment of Project/Dissertation

9.4.1 The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.

9.4.2 The Project Work/Dissertation shall carry a maximum of 100 marks.

9.4.3 CIA for Project will consist of Review of literature survey, experimentation/field work, attendance etc.

9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

9.4.5 The Project Evaluation Committee will comprise of the Head of the Department, Project Supervisor, and a senior faculty.

9.4.7 The marks shall be distributed as follows:

Continuous Internal Assessment (25 Marks)		End Semester Examination (75 Marks)	
Review-I 10	Review-II: 15	Project / Dissertation Evaluation	Viva-voce
		50	25

9.5 Assessment of Value-added Courses

9.5.1 VACs shall be evaluated completely by Internal Examiners.

9.5.2 Two CIA Tests shall be conducted during the semester by the Department(s)offering VAC.

9.5.3 A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.

9.5.4 The grades obtained in VACs will not be included for calculating the GPA.

9.6 Passing Minimum

9.6.1 A candidate is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.4 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

10. Conferment of the Master's Degree

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

11. Marks and Grading

11.1 The performance of students in each course is evaluated in terms of Grade Point (GP).

11.2 The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed from the first semester to the currentsemester.

11.3 The GPA is calculated by the formula

$$GGG = \frac{\sum_{GG}^{G} G_G G_G}{\sum_{GG}^{G} G_G}$$

where, G_G is the Credit earned for the Course Gin any semester;

G_G is the Grade Point obtained by the student for the Course G and
G is the number of Courses passed in that semester.

11.4 **CGPA** is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

$$GGGG = \frac{\sum_{GG}^{G}\sum_{GGG}^{G} G_G G_G}{\sum_{GG}^{G}\sum_{GGG}^{G} G_G}$$

where, G_G is the Credit earned for the Course G in any semester;
G_G is the Grade Point obtained by the student for the Course G and
G is the number of Courses passed in that semester.
G is the number of semesters.

11.5 Evaluation of the performance of the student will be rated as shown in the Table.

Letter Grade	Grade Points	Marks %
S	10	90 and above
A	9	80-89
B	8	70-79
C	7	60-69
D	6	55-59
E	5	50-54
RA	0	Less than 50
W	0	Withdrawn from the examination

11.6 Classification of Results. The successful candidates are classified as follows:

11.6.1 For **First Class with Distinction:** Candidates who have passed all the courses prescribed in the Programme *in the first attempt* with a CGPA of 8.25 or above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (*See Section 12 for details*).

11.6.2 For **First Class:** Candidates who have passed all the courses with a CGPA of 6.5 or above.

11.6.3 For **Second Class:** Candidates who have passed all the courses with a CGPA between 5.0 to less than 6.5.

11.6.4 Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

11.7 Course-Wise Letter Grades

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

11.7.2 A candidate is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3 A course successfully completed cannot be repeated for the purpose of improving the Grade Point.

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and 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 student has appeared for clearance of the arrears.

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

12. Provision for Withdrawal from the End Semester Examination

12.1 The letter grade W indicates that a candidate has withdrawn from the examination.

12.2 A candidate is permitted to withdraw from appearing in the ESE for one course or courses in **ANY ONE** of the semesters **ONLY** for exigencies deemed valid by the University authorities.

12.3 Permission for withdrawal from the examination shall be granted only onceduring the entire duration of the programme.

12.3 Application for withdrawal shall be considered **only** if the student has registered for the course(s), fulfilled the requirements for attendance and CIA tests.

12.4 The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

12.5 Withdrawal is **not** granted for arrear examinations of courses in previous semesters and for the final semester examinations.

12.6 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) when the course(s) are offered next.

12.7 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the student to qualify for First Class with Distinction.

13.Academic misconduct

Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students' work, removing/defacing department library or computer resources, stealing other students' notes/assignments, electronically interfering with other students'/University's intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitised on issues of academic integrity and ethics.

14. Transitory Regulations

Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. *Notwithstanding anything contained in the above pages as Rules and Regulations governing the Five Year Integrated Master's Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council*

M.Sc. OCEAN SCIENCE & TECHNOLOGY

(Five Year Integrated CBCS Course)
(For the students admitted during the year 2019 – 2020 onwards)

SEMESTER WISE SCHEME OF COURSES AND CREDITS

Course Code	Course Title	Hours/ Week			C	Marks		
		L	T	P		CIA	ESE	Total
Semester-I								
ITAC 11	Language I	3			3	25	75	100
IENC 12	English I	3			3	25	75	100
IOST 13	Marine Invertebrates and Prochordates	4			4	25	75	100
IOST 14	Marine Vertebrates	4			4	25	75	100
ICEC 15	Environmental Studies	2			2	25	75	100
IANM 16	Allied course - I:Ancillary Mathematics – I	4	1		5	25	75	100
IOSP 17	Practical I - Marine Invertebrates and Prochordates			3	1	40	60	100
IOSP 18	Practical II - Marine Vertebrates			3	1	40	60	100
	Total Credits				23			
Semester-II								
ITAC 21	Language II	3			3	25	75	100
IENC 22	English II	3			3	25	75	100
IOST 23	Marine Plants	4			4	25	75	100
ICAC 24	Soft skill-I: Computer Application I	3			3	25	75	100
IANM 25	Allied Course - I:Ancillary Mathematics – II	4	1		5	25	75	100
IOET 11	Elective course – I	4			4	25	75	100
IOEP 12	Practical III – Elective course – I			3	1	40	60	100
IOSP 28	Practical IV - Marine Plants			3	1	40	60	100
	Total Credits				24			
Semester-III								
ITAC 31	Language III	3			3	25	75	100
IENC 32	English III	3			3	25	75	100
IOST 33	Ocean and Coastal Ecology	4			4	25	75	100
ICAC 34	Soft skill - II: Computer Application II	3			3	25	75	100
IANT 35	Allied Course - II: Ancillary Physics – I	4			4	25	75	100
IOET 21	Elective course – II	4			4	25	75	100
IOSP 36	Practical VI - Ocean and Coastal Ecology			3	1	40	60	100
IANP 37	Practical V - Allied Course - II: Ancillary Physics – I			3	1	40	60	100
IOEP 22	Practical VII - Elective course – II			3	1	40	60	100
	Total Credits				24			
Semester-IV								
ITAC 41	Language IV	3			3	25	75	100

IENC 42	English IV	3			3	25	75	100
IOST 43	Physical Oceanography	4			4	25	75	100
IOST 44	Chemical Oceanography	4			4	25	75	100
IANT 45	Allied Course - II: Ancillary Physics – II	4			4	25	75	100
IOET 31	Elective course – III	4			4	25	75	100
IANP 46	Practical VIII - Allied Course -II: Ancillary Physics - II			2	1	40	60	100
IOSP 48	Practical IX - Physical Oceanography			2	1	40	60	100
IOSP 48	Practical X - Chemical Oceanography			2	1	40	60	100
IOEP 32	Practical XI - Elective course – III			2	1	40	60	100
	Total Credits				26			
Semester-V								
IOST 51	Biological Oceanography	4			4	25	75	100
IOST 52	Atmospheric Science and Meteorology	4			4	25	75	100
IOST 53	Marine Geology	4			4	25	75	100
IOST 54	Marine Pollution	4			4	25	75	100
IOST 55	Computer Application – III	4			4	25	75	100
ISKC 56	Soft Skill - III: Communication Skill	3			3	25	75	100
IOSP 57	Practical XII - Biological Oceanography			2	1	40	60	100
IOSP 58	Practical XIII - Marine Geology			2	1	40	60	100
IOSP 59	Practical XIV - Marine Pollution			2	1	40	60	100
IOSP 60	Practical XV - Computer Application – III			2	1	40	60	100
	Total Credits				27			
Semester-VI								
IOST 61	Fluid Mechanics	4			4	25	75	100
IOST 62	Waves and Tides	4			4	25	75	100
IOST 63	Instrumentation and Analytical Methods	4			4	25	75	100
IOST 64	Soft Skill - IV: Personality Development	3			3	25	75	100
IOST 65	Practical XVI (IOST 61)			3	1	40	60	100
IOSP 66	Practical XVII (IOST 62)			3	1	40	60	100
IOSP 67	Practical XVIII(IOST 63)			3	1	40	60	100
	Value Education	2			2	25	75	100
	Experimental Learning : In-plant training/field trips/internships/industrial visits				4			100
	Extension Activities				1			100
	Total Credits				25			
	Total Credits from semester I to VI				149			
Semester-VII								
IOST 71	Coastal and Marine Resources	4			4	25	75	100
IOST 72	Survey Technology of Coastal Environment	4			4	25	75	100
IOST 73	Satellite Oceanography	4			4	25	75	100
IOST 74	Marine instrument for oceanographic Measurements	4			4	25	75	100
IOST 75	Air sea Interaction	4			4	25	75	100
IOST 76	Integrated Coastal Zone Management	4			4	25	75	100
IOSP 77	Practical XIX - Survey Technology of			2	1	40	60	100

	Coastal Environment							
IOSP 78	Practical XX - Satellite Oceanography			2	1	40	60	100
IOSP 79	Practical XXI - Marine instrument for Oceanographic Measurements			2	1	40	60	100
	Total Credits				**27**			
Semester-VIII								
IOST 81	Geographic Information System	4			4	25	75	100
IOST 82	Renewable energy systems	4			4	25	75	100
IOST 83	Dynamical Oceanography	4			4	25	75	100
IOST 84	Disaster Management	4			4	25	75	100
IOSP 85	Ocean Management	4			4	25	75	100
IOET 41	Elective course - IV	4			4	25	75	100
IOSP 87	Practical XXII - Geographic Information System			3	1	40	60	100
IOSP 88	Practical XXIII - Renewable energy systems			3	1	40	60	100
IOEP 42	Practical XXIV - Elective course - IV: Fishery Technology		3	40+60	1	40	60	100
	Value added course	2			2			
	Total Credits				**28**			
Semester-IX								
IOST 91	Underwater Acoustics and Optics	4			4	25	75	100
IOST 92	Coastal and estuarine dynamics	4			4	25	75	100
IOST 93	Numerical modeling for coastal processes	4			4	25	75	100
IOST 94	Environmental Impact Assessment	4			4	25	75	100
IOET 51	Elective course - V	4			4	25	75	100
IOSP 96	Practical XXV - Underwater Acoustics and Optics			3	1	40	60	100
IOSP 97	Practical XXVI - Coastal and estuarine dynamics			3	1	40	60	100
IOEP 52	Practical XXVII - Elective course - V			3	**1**	40	60	100
	Value added course	2			2			
	Total Credits				**25**			
Semester-X								
IOET 61	Elective course - VI	4			4	25	75	100
IOET 71	Elective course - VII	3			3	25	75	100
IOPV 103	Project and viva-voce				8			100
	Total Credits				**15**			
	Semesters VII - X Total Credits				**96**			
	Semesters I-X Total Credits				**245**			

L- Lectures; T-Tutorial; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination

Overall credits - 245

ELECTIVE COURSES FROM SEMESTER I TO VI

Course Code	Elective	Course Title	Hours/ Week			C	Marks		
			L	T	P		CIA	ESE	Total
IOET 11	IDE	Elective course - I: Chemistry	4			4	25	75	100
IOEP 12	IDE	Practical - Elective course - I: Chemistry			3	1	40	60	100
IOET 21	DE	Elective course - II: Statistics	4			4	25	75	100
IOEP 22	DE	Practical - Elective course - II: Statistics			3	1	40	60	100
IOET 31	DE	Elective course - III: Cytology, Genetics and Immunology	4			4	25	75	100
IOEP 32	DE	Practical - Elective course - III: Cytology, Genetics and Immunology			3	1	40	60	100
		Total Credits				15			

ELECTIVE COURSES FROM SEMESTER VII TO X

Course Code	Elective	Course Title	Hours/ Week			C	Marks		
			L	T	P		CIA	ESE	Total
IOET 41	DE	Elective course - IV: Fishery Technology	4		25+75	4	25	75	100
IOEP 42	DE	Practical XXIV - Elective course - IV: Fishery Technology		3	40+60	1	40	60	100
IOET 51	DE	Elective course - V: Coastal Aquaculture	4		25+75	4	25	75	100
IOEP 52	DE	Practical XXVII - Elective course - V: Coastal Aquaculture		3	40+60	1			
IOET 61	IDE	Elective course - VI: Project Planning Analysis and Management	4		25+75	4	25	75	100
IOET 71	DE	Elective course - VII: Marine Recreation	3		25+75	3	25	75	100
		Total credits				**17**			

Note:

1.Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.

2. Students may opt for any Value-added Course listed in the University website.

Programme Outcomes

On successful completion of program, the students will be able to gain the following knowledge and skills

PO1:	**Domain knowledge:** Demonstrate basic knowledge on the marine environment, their existing organisms and their structural, functional as well as ecological behaviour
PO2:	**Resource Utilization:** Promotethe learning and practical skills with the help of appropriate learning resources including library, e-learning resources and by arranging a trip to visualize the existing organism in the marine environment.
PO3:	**Analytical and Technical skills:** Develop the ablity to handle/use the appropriate tools/techniques/ instruments and to work practically on the softwares which related to remote
PO4:	**Creative thinking and troubleshoot the problems:** Identify and critically analyse the pertinent problems in the relevant discipline using appropriate tools and techniques as well as to troubleshoot the problems arised during the analytical part.
PO5:	**Individual and Effective team work:** To effectively accomplish the task independently either as a member or teamwork and to achieve the results wit respect to the work
PO6:	**Effective Communication:** Communicate effectively in spoken as well as written form which help to improve the ability to write dissertations, reports and will be helpful for more effective presentation and documentation
PO7:	**Project Developmet Programme:** Ability to get more number of projects in the relevant field and perform with the good dedication and improve the progress with statistical performance.

Programme Specific Outcomes

At the end of the programme, the student will be able to

PSO1:	Understand the ecological and economical importance pertaining to marine vertebrates and invertebrates
PSO2:	Understand the basic concepts of elasticity, Surface tension and viscosity their practical applications as well as explain the behaviour of thermal expansion of solids, liquids and gases.
PSO3:	Acquaint knowledge on the marine microbes, non-flowering and flowering plants of the coastal and marine environments.
PSO4:	To get a good exposure to the basic concepts of chemistry to enable them to pursue careers related to chemistry
PSO5:	Communicate on the physical, chemical and biological oceanography and the statistical tools to determine the remote sensing and GIS tools

I SEMESTER

IOST13MARINE 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.

REFERENCEBOOKS

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

Course Outcome:

On completion of this course, students should be able to:

CO1: Gain fundamental knowledge about marine invertebrates and prochordates

CO2: Understand the classification, functional morphology and life history of protozoans and sponges.

CO3: Describe about crustaceans their evolution

CO4:Describe about molluscs evolution

CO5:Explain life cycle of Ehinodermates and Prochordates

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	3	-	-	3	3	3	-	-	3
CO2	3	-	-	3	-	-	3	3	3	-	-	3
CO3	3	-	-	3	-	-	3	3	3	-	-	3
CO4	3	-	-	3	-	-	3	3	3	-	-	3
CO5	3	-	-	3	-	-	3	3	3	-	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	--	- -	3
CO2	3	3	-	-	3
CO3	3	3	-	-	3
CO4	3	3	-	-	3
CO5	3	3	-	-	3
Total	15	15	-	-	15

IOST 14 MARINE VERTEBRATES

Objectives :

The objectives of this course 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.

REFERENCE BOOKS

1. Ayyar, E.K. and T.N. Ananthakrishnan, 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. & Brownel 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, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
10. Lagler, K.F., J.E. Bardach and R.R. Miller, 1962. Icthyology. John Wiley & Sons Inc., New York.
11. Orr R.T. 1976. Vertebrate Biology. W.B. Sanunders 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 conversation, protection and management of wild cetaceans (eds) J. Mann , R. C. Connor, P.L Tyack & H Whitehead in Cetacean societies : field studies of dolphins and whales. Chicago : University of Chicago Press ISBN 226503402

Course Outcome:

CO1: Study and impart knowledge about the marine vertebrates

CO2: Students can be specialized in identifying the vertebrate specimens

CO3: Learn about the biology of fish, reptiles and birds

CO4: Learn the origin of reptiles

CO5:Gain adequate knowledge on the general characteristics of marine mammals and their economic importance

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	3	3	-	3	3	3	3	3	-	-
CO2	-	3	3	3	-	3	3	3	3	3	-	-
CO3	-	3	3	3	-	3	3	3	3	3	-	-
CO4	-	3	3	3	-	3	3	3	3	3	-	-

CO5	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**3**	**3**	**3**	**-**	**-**
CO2	**3**	**3**	**3**	**-**	**-**
CO3	**3**	**3**	**3**	**-**	**-**
CO4	**3**	**3**	**3**	**-**	**-**
CO5	**3**	**3**	**3**	**-**	**-**
Total	**15**	**15**	**15**	**-**	**-**

IANM 16 - ANCILLARY MATHEMATICS - I

Objectives:

The main objective of the course is to prepare the students with the basic knowledge of higher mathematics such as 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.

Course outcome:

After completing this course, students should be able to

CO1: Understands the theory of equations

CO2: Understands the basic concepts of matrices

CO3: Can able to solve the solution of simultaneous linear algebraic equations

CO4: To compute the numerical derivatives for numerical differentiation

CO5: To solve the solution of ordinary differential equations

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	3	-	-	3	-	3	-	3	-	-
CO2	-	3	3	-	-	3	-	3	-	3	-	-
CO3	-	3	3	-	-	3	-	3	-	3	-	-
CO4	-	3	3	-	-	3	-	3	-	3	-	-

CO5	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**3**	**-**	**-**

CO/ PO	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**-**	**3**	**-**	**3**	**-**	**-**
CO2	**-**	**3**	**-**	**3**	**-**	**-**
CO3	**-**	**3**	**-**	**3**	**-**	**-**
CO4	**-**	**3**	**-**	**3**	**-**	**-**
CO5	**-**	**3**	**-**	**3**	**-**	**-**
Total	**-**	**15**	**-**	**15**	**-**	**-**

IOSP 17 PRACTICAL I: MARINE INVERTEBRATES & PROCHORDATES

Identification of coastal invertebrate fauna of Parangipettai

1. Mounting of gastropod radulae
2. Mouth parts of *Squilla* and appendages of shrimps
3. Anatomy of shrimp, gastropod and bivalve

IOSP 18 PRACTICAL II: 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

IISEMESTER

IOST 23MARINE 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.

REFERENCE BOOKS

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

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, 2nd 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.

Course outcome:

Upon successful completion of this course, students should be able to

CO1: Learn the general characteristics of marine microbial flora

CO2: Gain knowledge on the marine phytoplanktons and their role in the marine environment.

CO3: To acquaint knowledge on the seaweeds and their economic importance

CO4: To highlights the physiology and phylogeny of seagrasses

CO5: To understand the distribution of mangroves and their habitats.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	-	3	-	3	-	3	-	3
CO2	3	3	3	3	-	3	-	3	-	3	-	3
CO3	3	3	3	3	-	3	-	3	-	3	-	3
CO4	3	3	3	3	-	3	-	3	-	3	-	3
CO5	3	3	3	3	-	3	-	3	-	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	-	3
CO2	3	-	3	-	3
CO3	3	-	3	-	3
CO4	3	-	3	-	3
CO5	3	-	3	-	3
Total	15	-	15	-	15

IANM 25 ANCILLARY MATHEMATICS - II

Objectives:

To familiar with Solving the algebraic and transcendental equations, ordinary differential equations, numerical integration, empirical laws and curve fitting and assignment problem.

UNIT – I: Solution of Algebraic and Transcendental Equations

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

UNIT – II: Numerical Integration

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

UNIT – III: Numerical solution of Ordinary differential equations

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

UNIT – IV: Empirical Laws and Curve Fitting

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

UNIT – V: Assignment Problem

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

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.

Course Outcome:

After completing this course, students should be able to

CO1: To get the solution of Algebraic and Transcendental Equations.

CO2: To understand the numerical integration methods.

CO3: To solve the ordinary differential equations.

CO4: To understand the empirical laws and curve fitting.

CO5: Learning the assignment problem

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	3	-	-	3	-	3	-	3	-	-
CO2	-	3	3	-	-	3	-	3	-	3	-	-
CO3	-	3	3	-	-	3	-	3	-	3	-	-
CO4	-	3	3	-	-	3	-	3	-	3	-	-
CO5	-	3	3	-	-	3	-	3	-	3	-	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	--	3	-	-
CO2	3	-	3	-	-
CO3	3	-	3	-	-
CO4	3	-	3	-	-
CO5	3	-	3	-	-
Total	15	-	15	-	-

IOET 11 ELECTIVE COURSE - I: CHEMISTRY

Objectives:

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

UNIT-1: METALLURGY

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

UNIT- 2: ORGANIC CHEMISTRY

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

UNIT- 3: PHYSICAL CHEMISTRY

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

UNIT-4: KINETICS AND CATALYSIS

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

UNIT- 5: INDUSTRIAL CHEMISTRY

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

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

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.

Course Outcome:

After successful completion of this course, students should be able to

CO1: Know about the mineral wealth in India

CO2: To gain an in-depth knowledge on physical chemistry

CO3: To gain an in-depth knowledge on organic chemistry

CO4:To obtain knowledge on the kinetics and catalyst

CO5:Know about the industrial chemistry

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	-	3	3	3	3	3	3	-	3
CO2	3	3	3	-	3	3	3	3	3	3	-	3
CO3	3	3	3	-	3	3	3	3	3	3	-	3
CO4	3	3	3	-	3	3	3	3	3	3	-	3
CO5	3	3	3	-	3	3	3	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

IOEP 12 PRACTICAL III: ELECTIVE COURSE - ICHEMISTRY

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

IOSP 28 PRACTICAL IV: 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

III SEMESTER

IOST 33 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.

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, 3rd edition 640 pp.

Course Outcome:

After successful completion of the work, the students can able to

CO1: Know the basic knowledge on the marine ecology and uniqueness of coastal organisms

CO2: To study the coastal ecology
CO3: To study the ocean ecology
CO4: To understand the coral reef ecosystem
CO5:Acquaint deep knowledge on coral ecology, estuarine shorelines and different zones in the marine environments

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	3	3	3	3	-	3	3	3	3
CO2	3	-	-	3	3	3	3	-	3	3	3	3
CO3	3	-	-	3	3	3	3	-	3	3	3	3
CO4	3	-	-	3	3	3	3	-	3	3	3	3
CO5	3	-	-	3	3	3	3	-	3	3	3	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	3	3
CO2	-	3	3	3	3
CO3	-	3	3	3	3

CO4	**-**	**3**	**3**	**3**	**3**
CO5	**-**	**3**	**3**	**3**	**3**
Total	**-**	**15**	**15**	**15**	**15**

IANP 35 ANCILLARY PHYSICS - I

Objective:

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

Unit-1 Mechanics and General Properties of Matter:

Elasticity: Strain and stress, elastic limit, Hooke's law; Moduli (Young's, Bulk, Rigidity) and Poisson's ratio, Surface tension: Surface tension and surface energy, angle of contact, capillary action, Flow of liquids and gases: Streamline and turbulent flow, equation of continuity, Bernoulli's theorem, Torricelli's theorem; Coefficient of viscosity, Reynold's number and critical velocity, Stoke's law; Turbulence and chaos.

Unit-2 Thermal Physics:

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

Unit-3 Sound:

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

Unit-4 Optics:

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

Unit-5 Radiation Effects on Biological Systems:

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

REFERENCE BOOKS

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

Course Outcomes:

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

CO1: Gain adequate knowledge on the theories and law with respect to mechanics and matter

CO2: Familiarized with the law of thermodynamics and diffusion process.

CO3: Acquaint knowledge on the properties of sound, waves, acoustics

CO4: To understand the optics properties.

CO5:Comprehend the properties of light and the effects of biological radiations on biological systems.

Outcome mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	3	3	-	3	3	3	3	-	-	-
CO2	-	3	3	3	-	3	3	3	3	-	-	-
CO3	-	3	3	3	-	3	3	3	3	-	-	-

CO4	-	3	3	3	-	3	3	3	3	-	-	-
CO5	-	3	3	3	-	3	3	3	3	-	-	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-
CO2	3	3	-	-	-
CO3	3	3	-	-	-
CO4	3	3	-	-	-
CO5	3	3	-	-	-
Total	15	15	-	-	-

IOET 21 ELECTIVE COURSE-II: 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

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.

Course Outcome:

Upon successful completion of this course, students should be able to

CO1: Understand the basic concept of statistics and interpretation of qualitative and quantitative data

CO2: Learn the basic concept of sampling and dispersion of biological charaters

CO3: To acquaint knowledge on the correlation and regression coefficients and equality of variances

CO4: To interpret the large amount of data in a simpler way

CO5: To understand the fundamentals of hardware and software

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	-	3	-	3	-	3	-	3	-	3
CO2	3	3	-	3	-	3	-	3	-	3	-	3
CO3	3	3	-	3	-	3	-	3	-	3	-	3
CO4	3	3	-	3	-	3	-	3	-	3	-	3
CO5	3	3	-	3	-	3	-	3	-	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	- -	3	- -	3
CO2	3	-	3	-	3
CO3	3	-	3	-	3
CO4	3	-	3	-	3
CO5	3	-	3	-	3
Total	15	-	15	-	15

IOSP 36 PRACTICAL V: 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

IANP 37 PRACTICAL VI: 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 byMercury 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

IOEP 22PRACTICAL VII: ELECTIVE COURSE - II: 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 χ^2
3. Calculation of correlation coefficient values and finding out the probability values.
4. Calculation of b and a values and plotting of regression lines.
5. Calculation of F value and finding out the probability value for F value

IVSEMESTER

IOST 43 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

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.

Course Outcome:

After successful completion of this course, students should be able to

CO1: Understand the physical properties of sea water and their physic-chemical characteristics

CO2: Acquaint knowledge on the waves, wave generation and their theories behind it

CO3: Know about the wave velocity and coastal sediment transport

CO4: Understand the concept behind small amplitude waves and finite amplitude waves

CO5: To gain knowledge on the Ocean tides and currents

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	-	3	3	-	3	-	3	3	-	3
CO2	3	3	-	3	3	-	3	-	3	3	-	3
CO3	3	3	-	3	3	-	3	-	3	3	-	3
CO4	3	3	-	3	3	-	3	-	3	3	-	3
CO5	3	3	-	3	3	-	3	-	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

IOST 44 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.

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.

Course Outcome:

Upon successful completion of this course, students should be able to

CO1: Understand the Chemical system of the ocean

CO2: Acquaint knowledge on the chemical composition of the seawater

CO3: Know about ozone depletion and global warming

CO4: Gain in-depth knowledge on the seasonal variations in the nutrients and organic matters

CO5: Understand the role of nutrients and the productivity

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	3	3	-	3	3	3	3	-	3
CO2	3	-	-	3	3	-	3	3	3	3	-	3
CO3	3	-	-	3	3	-	3	3	3	3	-	3
CO4	3	-	-	3	3	-	3	3	3	3	-	3
CO5	3	-	-	3	3	-	3	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**3**	**3**	**3**	**- -**	**3**
CO2	**3**	**3**	**3**	**-**	**3**
CO3	**3**	**3**	**3**	**-**	**3**
CO4	**3**	**3**	**3**	**-**	**3**
CO5	**3**	**3**	**3**	**-**	**3**
Total	**15**	**15**	**15**	**-**	**15**

IANP 45 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- IElecricity

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

Unit – 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 Millican's experiment – photo electric cells – applications.

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

Unit – IV Nuclear Physics

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

Unit – 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

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

Course Outcome:

Upon successful completion of this course, students should be able to

CO1: Understand the basic knowledge behind the electricity and the transformers

CO2: Learn the concept of magnetism and applications of Ferrites in computer memory

CO3: To acquaint knowledge nuclear physics

CO4:To acquaint knowledge on the modern and wave mechanics

CO5:To understand the concepts behind nuclear physics and laser physics

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	3	-	3	3	-	3	-	3	-	3
CO2	-	3	3	-	3	3	-	3	-	3	-	3
CO3	-	3	3	-	3	3	-	3	-	3	-	3
CO4	-	3	3	-	3	3	-	3	-	3	-	3
CO5	-	3	3	-	3	3	-	3	-	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	-	3
CO2	3	-	3	-	3
CO3	3	-	3	-	3
CO4	3	-	3	-	3
CO5	3	-	3	-	3
Total	15	-	15	-	15

IOET 31 ELECTIVE COURSE - III:CYTOLOGY, GENETICS AND IMMUNOLOGY

Objectives:

The paper is aimed at teaching the students on varied aspects of cytology, genetics and immunology. This paper includes the knowledge about the Structural Organization, transport mechanism and cell cycle. Modern trends in cell biology and prospects of chromosomal manipulations and the latest techniques of cytology, genetics and immunological aspects in fish also dealt with.

UNIT I -Cell

Structural Organisation

Prokaryotic and eukaryotic cells; Ultrastructur:*Cell wall* – middle lamella, primary and secondary cell wall; *Plasma lemma* – models of membrane structure, pinocytosis and phagocytosis; *Nucleus* – nuclear envelope, nucleolus and chromatin fibres.

Transport Mechanism: *Active* – uniport, antiport, symport, Na^+ - K^+ AT ^{phase} and Ca $^{++}$ AT ^{phase} ; passive and facilitated; endocytosis and exocytosis.

Cell – Cycle : *Mitosis* – interphase (G1, Synthesis and G2).

UNIT II – Genetics

The Vehicle of Inheritance: *Chromosomes* – morphology (number, size, chromatid, centromere, telomere, euchromatin & heterochromatin), organisation of chromatin fibres (coiled DNA model & nucleosome – solenoid model), special chromosomes (lampbrush chromosome & polytene chromosome); Chemical composition and function. *Genes* – definition and chemical structure.

Bridge of Heredity: *Meiosis* – significance, first meiotic division and second meiotic division.
Patterns of Inheritance:History of genetics (brief); Sexual reproduction; *Mendelism* – breeding experiment, mendelian law's of seggregation and Independent assortment; Linkage and Crossover.

UNIT III- Applied and Advanced Genetics

Chromosomal manipulations:Androgenesis, gynogenesis, sex reversal, triploidy and polyploidy.
Techniques in molecular genetics:Gel electrophoresis, blotting; Fundamentals of PCR, Gene sequencing and Mapping of Genes
Genetic Internet resources: Internet and Browsing; *WEB resources* – NCBI, EMBL & DDJB (brief description); Genetic Computer Group packages; BLAST

UNIT IV - Immunology

Vertebrates (fish):Elements of Immunology; Antigen, antigenicity, epitope and haptens; Cells of lymphoreticular system; Antibody production; *Immunoglobulins* –structure, function, classes, allotypes and isotypes; Innate and acquired immunity; Vaccines; Monoclonal and polyclonal antibodies.

UNIT V - Immunology

Invertebrates (Crustaceans): Non-specific immune response; *Immunological factors* – humoral and clotting; Cellular components; *Chemical constituents* – haemocyanin and total protein; Osmality and electrolytes; Glucose and other energy components, acid-base balance, tissue enzymes and hormones.
Techniques: Agglutination, Immuno-precipitation and ELISA.

Text Books:

1. Molecular Cell Biology - Lodish *et al.,* Scientific American, 2000.
2. Cell and molecular Biology - Roberts and DeRoberts, Waverly Pvt. Ltd., 96.
3. Genetics - Elseth and Baumgardner, Addison -wesley Publishing Company, London, 84.
4. Essential Immunology (9^{th} edition) – Roitt I M, Blackwell Sci.
5. Immunology (3^{rd} edition) – Kuby, Reeman, 97.
6. Cellular and Molecular Immunology – *Abbs et al.,*W.B. Saunders Company, 97.
7. Fundamentals of Genetics – B. D. Singh, Kalyani Publishers, 98.
8. Molecular genetics – J.T. Hancock, Arnold, 2001
9. Bioinformatics – Westhead *et al.,*BIOS Scientific Publishers Ltd., 2003

Course Outcome:

After completing this course, students should be able to

CO1: Understand the structural organization of cell.

CO2: Learn about the changes and variations in the chromosome structures and number.

CO3: To acquaint about the applied advanced genetics

CO4:To understand the vertebrate's immunology.

CO5:To understand the invertebrate's immunology.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	-	3	-	-	3	-	-	-	-
CO2	3	3	3	-	3	-	-	3	-	-	-	-
CO3	3	3	3	-	3	-	-	3	-	-	-	-
CO4	3	3	3	-	3	-	-	3	-	-	-	-
CO5	3	3	3	-	3	-	-	3	-	-	-	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	-
CO2	3	-	-	-	-
CO3	3	-	-	-	-
CO4	3	-	-	-	-
CO5	3	-	-	-	-
Total	15	-	-	-	-

IOSP 46 PRACTICAL VIII : 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

IOSP 47 PRACTICAL IX : CHEMICAL OCEANOGRAPHY

Titrimetric Procedures

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

Colorimetric Procedures to pollutants

1) Bromide, fluoride and iodide
2) Nitrite
3) Nitrate
4) Phosphate
5) Total Phosphorus
6) Particulate organic carbon
7) Hydrogen Sulphide
8) Ammonia
9) Organic nitrogen
10) Reactive Silicate

IOSP 48 PRACTICAL X : 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

IOEP 31PRACTICALS XI : ELECTIVE COURSE - III:CYTOLOGY, GENETICS AND IMMUNOLOGY

1. Mitosis – Slide preparation
2. Meosis – Slide preparation
3. Fish chromosome mounting
4. Gel electrophoresis
5. PCR (demonstration)
6. BLAST search
7. Blood Cell count and identification of lymphoid cells in blood smears
8. Antigenes and antibody reaction & Haemagglutination
9. ELISA (using commercially available Kits)

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.

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: 9th Edition. McGraw-Hill Higher Education.

8. Garrison, T., 2011. Essentials of Oceanography: 6th edition. Cengage Learning.
9. Garrison, T., 2012. Oceanography: An Invitation to Marine Science – 8th edition. Cengage Learning.
10. Karleskint, G., R. Turner, and J. Small, 2012. Introduction to Marine Biology: 4th edition. Cengage Learning.

Course Outcome:

Upon successful completion of this course, students should be able to

CO1: Understand the biological system of the marine environment

CO2: Acquaint deep knowledge on phytoplankton and zooplankton

CO3: Know about nekton and their characteristics

CO4: Gain in-depth knowledge on the benthic environment and their organisms

CO5: Know about the biological process involved during primary production and marine environment

Outcome Mapping:

CO/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	- -	3	3	- -	3	3	- -	3	3	- -	3
CO2	3	-	3	3	-	3	3	-	3	3	-	3
CO3	3	-	3	3	-	3	3	-	3	3	-	3
CO4	3	-	3	3	-	3	3	-	3	3	-	3
CO5	3	-	3	3	-	3	3	-	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

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.

UNIT – IICloud Physics and Dynamic Meteorology:

Cloud classification, Condensation Nuclei, Growth of Cloud drops and ice-crystals, Precipitation Mechanisms: precipitation 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 – IIIGeneral Circulation:

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.

UNIT – IVSynoptic 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, dward 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

Course Outcome:

Upon successful completion of this course, students should be able to

CO1: Acquire solid foundation in the application of physical, chemical and mathematical principles to a broad range of atmospheric phenomena

CO2: Basic concepts involved in the analysis of weather phenomena on a global and local scale

CO3: Understand cloud physics and dynamic meteorology.

CO4: To acquaint about the general circulation in the atmosphere

CO5:Address the tropical meteorology and satellites used for meteorological studies.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	3	3	-	-	-	-	3	-	3	3
CO2	3	-	3	3	-	-	-	-	3	-	3	3
CO3	3	-	3	3	-	-	-	-	3	-	3	3
CO4	3	-	3	3	-	-	-	-	3	-	3	3
CO5	3	-	3	3	-	-	-	-	3	-	3	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	- -	3	3
CO2	-	3	-	3	3
CO3	-	3	-	3	3
CO4	-	3	-	3	3
CO5	-	3	-	3	3
Total	-	15	-	15	15

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, isostacy sea floor spreading. Emergent and submergent margins, convergent and divergent boundaries, changing sea level.Crustal deformation- folds, faults.

Unit–II Products of Earth process

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

Unit–III Introduction and Concepts in Marine Geology

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

Unit–IV Depositional environment and features

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

Unit–V Marine mineral resources

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

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: Englewiid Cliffs, NJ, Prentice-Hall.
7) Davis, G.H. and Reynolds, S.J., 1996, Structural geology of rocks and regions: New york, John Wiley and Sons.
8) Duxbury, A.C., and Duxbury, A.B., 1994, An introduction to the world's oceans, 4the ed: Dubuue, Iowa, Wm. C. Brown.
9) Dyer, K.R. 1986. Coastal and Estuarine sediment dynamics, New York, Wiley-Intersciences.
10) Hardisty,J., 1990, Beaches, form and process: New York, Karper Collins Academic.
11) Sharma, P.V., 1986., Geophysical Methods in Geology, (2nd edition) New York, Elsevier.
12) Benn, D.I., and Evans, D.J.A., 1998. Glaciers and Glaciation, London, Arnold.
13) Chorley, R.J., Schumm, A.A., and Sugden, D.E., 1995, Geomorphology: New York, Methuen.
14) Johnston, A.C., and Kanter, L.R.., 1990. Earthquakes in stable continental crust: Scientific American, V.262, no.3,p.68-75.
15) Kearey, P., and Vine, F.J., 1990 Global Tectonics: Oxford, Blackwell Scientific.

Course Outcome:

Upon successful completion of this course, students should be able to
CO1: basic concepts in earth science Understand.
CO2: Determine particle morphology and grain-size and texture.
CO3: Learn about the major coastal deposits, landforms and marine mineral resources.
CO4: To understand the marine deposits in the coastal region,
CO5: Acquire the knowledge in marine resources

Outcome Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	3	-	3	3	-	-	-	-	3	-	3	3
CO2	3	-	3	3	-	-	-	-	3	-	3	3
CO3	3	-	3	3	-	-	-	-	3	-	3	3

CO4	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**
CO5	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**

CO/ PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**- -**	**3**	**- -**	**3**	**3**
CO2	**-**	**3**	**-**	**3**	**3**
CO3	**-**	**3**	**-**	**3**	**3**
CO4	**-**	**3**	**-**	**3**	**3**
CO5	**-**	**3**	**-**	**3**	**3**
Total	**-**	**15**	**-**	**15**	**15**

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.

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

Course Outcome:

After successful completion of the work, the students can able to

CO1: Know the major pollutants in the marine environment

CO2: Acquaint deep knowledge on Sewage, industrial, agricultural and domestic discharges in the marine environment

CO3: Know about Heavy metal pollution and the impacts of dredging and mining in the marine environment

CO4: Gain in-depth knowledge on oil pollution, thermal pollution.

CO5: The environmental impact assessment on protecting the marine environment,

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**3**	-	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**
CO2	**3**	-	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**
CO3	**3**	-	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**
CO4	**3**	-	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**
CO5	**3**	-	**3**	**3**	**3**	-	-	-	**3**	**3**	-	**3**

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

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 Ouput - Loops - For Loops- While Loops - Conditional Statements – If Statement- Switch Statement - String Matrices – Arrays – Multidimensional Arrays – Structure Arrays – Functions – Matrix Functions - Elementary Mathematical Functions – User Defined Functions- Working with Data Files - Plotting – XY Plotting functions - Subplots and Overlay plots – Special Plot types – 2-Dimensional and 3-Dimensional Plots.

UNIT – V : MATLAB

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

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++, 3rd Edition,Tata McGraw Hill
3. Balagurusamy, E., 2007. Programming in Ansi C, 4th Edition, Tata Mc Graw Hill

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

CourseOutcome:

Upon completion of this course the students will be able to

CO1: Learn the software languages used in the field of remote sensing

CO2: Perform the coding software efficiently such as MATLAB and programming languages

CO3: Understand the MATLAB basic learning principles and perform independently

CO4: Develop the hydrodynamic modeling

CO5: Develop the two and three dimension plots.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	-	3	-	-	3	3	3	3
CO2	3	3	3	3	-	3	-	-	3	3	3	3
CO3	3	3	3	3	-	3	-	-	3	3	3	3
CO4	3	3	3	3	-	3	-	-	3	3	3	3
CO5	3	3	3	3	-	3	-	-	3	3	3	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	3	3
CO2	-	3	3	3	3
CO3	-	3	3	3	3
CO4	-	3	3	3	3
CO5	-	3	3	3	3
Total	-	15	15	15	15

IOSP 57 PRACTICAL XII : BIOLOGICAL OCEANOGRAPHY

1. Identification of phytoplankton and zooplankton (diatoms, dinoflagellates, hydromedusae copepods, pterpods, chaetognatha, 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.

IOSP 58 PRACTICAL XIII : 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)

IOSP 59 PRACTICAL XIV : MARINE POLLUTION

Analysis and estimation of critical pollutants in seawater.

1. Estimation of Ammonia (NH_3) in seawater
2. Estimation of hydrogen sulfide (H_2S) 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

IOSP 60 PRACTICAL XV: 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

VI SEMESTER

IOST 61 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 & uniform- laminar & turbulent flow –rotational and irrotational flow-one, two and three dimensional flow –flow pattern: stream line, stream tube and path line-basic principles of fluid flow-continuity equation- rotational and irrotational motion.

Unit – IV: Fluid dynamics

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

Unit – V: Fluid machines

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

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

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.

Course Outcome:

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

CO1: Learn the basic principle involving in fluid mechanics

CO2: Understand the concepts of fluid static

CO3: Understand the concepts of fluid kinematics

CO4:Develop engineering skill on the construction of harbor, jetties, etc., for employability

CO5: Acquire the basic principles of fluid mechanisms and how machines operate with the help of fluid mechanisms.

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	-	3	-	3	3	-	3	-	3	3	-	3
CO2	-	3	-	3	3	-	3	-	3	3	-	3
CO3	-	3	-	3	3	-	3	-	3	3	-	3
CO4	-	3	-	3	3	-	3	-	3	3	-	3
CO5	-	3	-	3	3	-	3	-	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

IOST 62 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.

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.

Course Outcomes:

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

CO1: Learn the wave characteristics and its estimations

CO2: Understand the concepts tide generation and its characteristics

CO3:Understand the conceptsLong waves

CO4: Understand the concepts Wind waves

CO5: Acquire the basic knowledge about the coastal currents generated by tides

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	3	-	-	3	-	3	3	-	3
CO2	3	-	-	3	-	-	3	-	3	3	-	3
CO3	3	-	-	3	-	-	3	-	3	3	-	3
CO4	3	-	-	3	-	-	3	-	3	3	-	3
CO5	3	-	-	3	-	-	3	-	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

IOST 63 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.

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.

Course Outcome:

After culmination of the course the students will be able

CO1: Learn and efficiently use on site marine field instruments

CO2: Study the principles and basic concepts of different microscopes

CO3: Learn the working principles of Spectrometer and analyze environmental parameters using the same

CO4: Comprehend and perform the techniques involves in extraction of different compounds efficiently using the Centrifugation and chromatography method.

CO5: To know the techniques to operate instrument in research vessels.

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	3	3	3	-	3	3	3	-	3
CO2	3	-	-	3	3	3	-	3	3	3	-	3
CO3	3	-	-	3	3	3	-	3	3	3	-	3
CO4	3	-	-	3	3	3	-	3	3	3	-	3
CO5	3	-	-	3	3	3	-	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

IOSP 65 PRACTICAL XVI: FLUID MECHANICS

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

IOSP 66 PRACTICAL XVII: 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

IOSP 67 PRACTICAL XVIII: INSTRUMENTAION 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 dissolve petroleum hydrocarbon in seawater
5. Flame Photometer: Estimation of Na, K and Ca in seawater
6. ICP Spectrometer: Estimation of heavy metals in seawater

VII SEMESTER

IOST 71 COASTAL AND 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.

Course Outcomes:

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

CO1: Learn the marine resources and its availability

CO2: Understand the concepts of marine resources and importance

CO3: Learn about Living marine resources

CO4:Understand the concepts of resource exploration and exploitation

CO5: Acquire the basic information necessary to formulate their own opinions on ocean-related environmental issues in future.

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3	3	3	-	3	3	-	3
CO2	3	3	3	3	3	3	3	-	3	3	-	3
CO3	3	3	3	3	3	3	3	-	3	3	-	3
CO4	3	3	3	3	3	3	3	-	3	3	-	3
CO5	3	3	3	3	3	3	3	-	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

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 – IIIHydrographic 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.

REFERENCE BOOKS

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

CourseOutcome:

Upon completion of this course the students will be able to comprehend

CO1: The basic concepts in surveying using different methods

CO2: Surveying methods deals with tides and theodolite surveying and principles and concept

CO3: To solving abilities, creativity, and innovation for coastal construction

CO4: To incorporate survey technology in coastal environment

CO5:The advanced measurements of GPS and its applications

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	-	3	-	-	3	3	3	3
CO2	3	3	3	3	-	3	-	-	3	3	3	3
CO3	3	3	3	3	-	3	-	-	3	3	3	3
CO4	3	3	3	3	-	3	-	-	3	3	3	3
CO5	3	3	3	3	-	3	-	-	3	3	3	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	3	3
CO2	-	3	3	3	3
CO3	-	3	3	3	3
CO4	-	3	3	3	3
CO5	-	3	3	3	3
Total	-	15	15	15	15

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.

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 3rd edition. W.H. Freeman and Company, New York.
3. Lillesand, T.M. and R.W. Kefer, 2000. Remote Sensing and image interpretation. John Wiley & Sons. Inc.
4. Anji Reddy, M., 2000. Remote sensing and Geographical Information System. The Book Syndicate, Hydrabad.
5. Edmund P. Green, Peter J. Mumby, Aladair J. Edwards and Christopher D. Clark, 2000. Remote Sensing Handbook for tropical coastal management. Coastal Management sourcebooks 3, UNESCO Publication, 316 pp.
6. Lucas, L.F. Janseen, Wim H. Bakker, Ben G.H. Gorte, John A. Horn, Christine Pohl, Anupma Prakash, Colin V. Reeves, Michael J.C. Weir, Tsehaie Woldai, 2001. Principals of Remote Sensing An Introductory Text Box, 2nd edition, ITC Educational Textbook Series.
7. Miller, Richard L., Del Castillo, Carlos E. and McKee, Brent A., 2005. Remote Sensing of Coastal Aquatic Environments. Technologies, Techniques and Applications Series: Remote Sensing and Digital Image Processing, Vol.7, Springer, 347pp.

8. Yeqiao Wang, 2009. Remote sensing of coastal environments. Taylor & Francis, CRC press, 457pp.
9. James B. Campbell and Randoiph H. Wynne, 2011. Introduction to Remote Sensing . Guilford press, 667pp
10. Sebnem Duzgun and Nuray Demirel, 2011. Remote Sensing of the Mine Environment. CRC press, 220pp.

Course Outcome:

After completion of this course the students will be able to

CO1: Comprehend the basic principles and concepts of remote sensing

CO2: Obtain information regarding the spatial features deals with basics of spatial features

CO3: Perform independently image processing and data analysis and obtain spatial data from different resources

CO4: Have complete knowledge on the importance of the remote sensing applications in the field of meteorology and oceanography

CO5: Gather the knowledge about the applications of remote sensing in various subject

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	-	3	-	3	-	-	3	3	3	-
CO2	3	3	-	3	-	3	-	-	3	3	3	-
CO3	3	3	-	3	-	3	-	-	3	3	3	-
CO4	3	3	-	3	-	3	-	-	3	3	3	-
CO5	3	3	-	3	-	3	-	-	3	3	3	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	- -	3	3
CO2	-	3	-	3	3
CO3	-	3	-	3	3
CO4	-	3	-	3	3
CO5	-	3	-	3	3
Total	-	15	-	15	15

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

REFERENCE BOOKS

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

Course Outcome:

After completion of this course the students will be able to

CO1: Comprehend the basic principles and concepts of available oceanographic instruments and sensors.

CO2: Obtain information regarding the fixed, buoy and ship based platform

CO3: Acquiring knowledge in wide range of surveying equipments.

CO4: Understand complete knowledge on the data analysis in the field of meteorology and Oceanography.

CO5: Understand the concept of marine sensor

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	-	3	-	3	-	-	3	3	3	-
CO2	3	3	-	3	-	3	-	-	3	3	3	-
CO3	3	3	-	3	-	3	-	-	3	3	3	-
CO4	3	3	-	3	-	3	-	-	3	3	3	-
CO5	3	3	-	3	-	3	-	-	3	3	3	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	3	- -
CO2	-	3	3	3	-
CO3	-	3	3	3	-
CO4	-	3	3	3	-
CO5	-	3	3	3	-
Total	-	15	15	15	-

IOST 75 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–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 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: Climate Modelling - 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.

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.

Course Outcome:

On successful completion of this course students will be able to

CO1: The basic principle deals with understanding in atmosphere, structure and the mechanism of solar radiation

CO2: Understand the role of atmosphere, humidity and wind pattern in hydrological cycle and rainfall pattern

CO3: Will have knowledge on air pressure, wind pressure and the role of Coriolis effect in determining the wind effect and pressure.

CO4: Comprehend the role of weather forecasting in cyclone and thunderstorms especially withstorm surges and EL-Nino
CO5: Acquire the knowledge in climate modeling

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	-	3	3	-	3	-	3	3	3	-
CO2	3	3	-	3	3	-	3	-	3	3	3	-
CO3	3	3	-	3	3	-	3	-	3	3	3	-
CO4	3	3	-	3	3	-	3	-	3	3	3	-
CO5	3	3	-	3	3	-	3	-	3	3	3	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	3	- -
CO2	-	3	3	3	-
CO3	-	3	3	3	-
CO4	-	3	3	3	-
CO5	-	3	3	3	-
Total	-	15	15	15	-

IOST 76 INTEGRATED COASTAL ZONE MANAGEMENT

Objective:

To introduce and describe importance of our coastal zone, the interactions of land and sea. The objective is for the student to gain an appreciation in monitoring the ecosystem for sustainable development. Necessary management strategies are also discussed

UNIT—I Introduction

Definitions – Integration - Coastal zones and importance - Sea and Oceans - Coastal resources management programme - Integrated Coastal Zone Management - need, scope, potentials and constraints for ICZM.

UNIT—II 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—III 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.

UNIT—IV Management methods

Major principles and premises ICZM. Ecological land use/water use planning. Overview of Environmental monitoring and EIA. Ecological Economics – Economic benefits of protected areas and economic valuation. GIS and remote sensing for ICZM. Coastal information management & communication - Basic Principles.

UNIT—V Law of the sea

United Nations Convention on the Law of the Sea (UNCLOS) I, II, III – Internal water, Territorial water, Archipelagic water, high sea, continental shelf, Exclusive Economic Zone (EEZ) and its significance, limits of territorial water and International sea bed area. International Convention for the Prevention of Pollution from Ships (MARPOL).

REFERENCE BOOKS

1. Barnabe, G., 2000. Ecology and management of coastal waters. Praxis, 396pp.
2. Bartlett, D. and J. Smith, 2005. GIS for coastal zone management, CRC Press, 310pp.
3. Jean – Marina Massin, 1994. Remote sensing for the control of marine pollution. Academic Pub-lishers, Plenus Press, 466pp.
4. John R. Clark. 1995. Coastal zone management handbook. Lewis publishers, Washington, D.C. 694pp.
5. Kay, R. and J. Aider, 2005., Coastal planning and management, 2/e. Taylor and Francis, 380pp.

Course Outcome:

After completion of this course the students will be able to

CO1: Comprehend the basic principles maintaining the functional integrity of the coastal resource systems

CO2: Obtain information regarding reducing resource-use conflicts in coastal area

CO3: Have knowledge on an importance of the coastal environment

CO4: Know the value of coastal ecological economics and benefits

CO5: Understand complete knowledge on the Integrated Coastal Zone Management

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	**3**	**3**	-	**3**	-	**3**	-	-	**3**	**3**	**3**	-
CO2	**3**	**3**	-	**3**	-	**3**	-	-	**3**	**3**	**3**	-
CO3	**3**	**3**	-	**3**	-	**3**	-	-	**3**	**3**	**3**	-
CO4	**3**	**3**	-	**3**	-	**3**	-	-	**3**	**3**	**3**	-
CO5	**3**	**3**	-	**3**	-	**3**	-	-	**3**	**3**	**3**	-

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	**3**	**3**	**3**	- -
CO2	-	**3**	**3**	**3**	-
CO3	-	**3**	**3**	**3**	-
CO4	-	**3**	**3**	**3**	-
CO5	-	**3**	**3**	**3**	-
Total	-	**15**	**15**	**15**	-

IOSP 77 PRACTICAL XIX : SURVEY TECHNOLOGY OF COASTAL ENVIRONMENT

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).

IOSP 78 PRACTICAL XX : 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 / mosciking / image enhancement
8. Geometric correction
9. Radiometric correction
10. On screen visual interpretation of digital data (water, vegetation, mangrove, corals etc.)
11. Supervised Classification
12. Unsupervised Classification
13. Chlorophyll retrieval
14. SSC retrieval
15. SST retrieval
16. Map composer

IOSP 79 PRACTICAL XXI : MARINE ISNTRUMENT 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

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.

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. 2nd edition. John Wiley & Sons, Inc.
6. O'Sullivan, D. and D. J. Unwin, 2003. *Geographic Information Analysis*. John Wiley & Sons, New Jersey, 436p.
7. Paul A. Longley, Michael F. Goodchild, David J. Maguire and David W. Rhind. 2001. Geographic Information Systems and Science. John Wiley & Sons, Inc.
8. Michael Kennedy , 2009. Introducing Geograophic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, 2nd Edition, Wiley Publication, 624pp.
9. Pinde Fu and Jiulin Sun, 2010. Web GIS: Principles and Applications. ESRI, 312pp.
10. Cheiarian Harder, 2011. Understanding GIS: An ArcGIS Project workbook. ESRI, 378pp.
11. Vasilis D. Valavanis, 2011. Marine Geographical Information Systems: Theory and Applications (Advances in Geographic Information Science). Springer, 500pp.
12. Rolf A de By, Martin C. Wllis, Yola Georgiadou, Wolfgang Kainz, Richard, A. Knippers, Menno-Jan Kraak, Mostafa M. Radwan, Edmund J. Sides, Yuxian Sun,

Michael J.C. Weir and Cees J. van Westen, 2001. Principals of Geographic Information Systems: An introductory textbook. 2nd edition. , ITC Educational Textbook Series

13. Kang Tsung Chang, 2006. Introduction to Geographic Information Systems, TATA McGraw Hill, 3rd edition, 431 pp.

CourseOutcome:

Upon successful completion of this course the students will be able to

CO1: Comprehend the Geographic Information Systems and its basic principles and Concepts

CO2: Learn and acquire adequate knowledge on GIS and its importance in spatial analysis

CO3: Acquire the knowledge in spatial and temporal images

CO4: Understand the GIS techniques in online modeling

CO5:Understand the application of GIS especially in exploring and Mapping of Marine Resources

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	-	3	-	3	-	-	3	3	-	3
CO2	3	3	-	3	-	3	-	-	3	3	-	3
CO3	3	3	-	3	-	3	-	-	3	3	-	3
CO4	3	3	-	3	-	3	-	-	3	3	-	3
CO5	3	3	-	3	-	3	-	-	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	3	- -	3
CO2	-	3	3	-	3
CO3	-	3	3	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3
Total	-	15	15	-	15

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.

REFERENCE BOOKS

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

Course Outcome:

After completion of this program the students will

CO1: Have adequate knowledge on the importance of renewable energy

CO2: Learn the importance of solar energy on renewable resource

CO3: Able to learn the significance of wind and geo thermal energy on renewable resource

CO4: Understand the tidal and wave renewable energy

CO5: Acquire the knowledge about the renewable energy sources in OTEC

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	3	3	-	3	-	-	-	-	-	3
CO2	3	-	3	3	-	3	-	-	-	-	-	3
CO3	3	-	3	3	-	3	-	-	-	-	-	3
CO4	3	-	3	3	-	3	-	-	-	-	-	3
CO5	3	-	3	3	-	3	-	-	-	-	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	- -	- -	- -	3
CO2	3	-	-	-	3
CO3	3	-	-	-	3
CO4	3	-	-	-	3
CO5	3	-	-	-	3
Total	15	-	-	-	15

IOST 83 DYNAMICAL OCEANOGRAPHY

Objectives:

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

UNIT – I Statics and Kinematics

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

UNIT – II Equations of Motion-Nonlinear and Magnetic terms

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

UNIT – III Currents without Friction

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

UNIT – IV Currents with Friction

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

UNIT – V 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 2nd 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.

CourseOutcome:

Upon completion of this course the students will be able to

CO1: Learn the statics and Kinematic process and their uses in mathematical modeling

CO2: Understand the role of Ekman's Transport and upwelling in ocean water current friction

CO3: Have adequate knowledge on major world ocean currents and its role in marine environment

CO5: Understand the thermohaline circulation

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	-	-	3	-	3	3	3	-	3
CO2	3	-	-	-	-	3	-	3	3	3	-	3
CO3	3	-	-	-	-	3	-	3	3	3	-	3
CO4	3	-	-	-	-	3	-	3	3	3	-	3
CO5	3	-	-	-	-	3	-	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

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.
6.

Course Outcome:

Upon completion of this course the students will have efficient knowledge on

CO1:Understand mitigation of the risk attached to disaster and its severity/consequences.

CO2: Knowthe preparedness to handle a disaster of any magnitude

CO3: Rehabilitation and reconstruction of the disaster-hit area

CO4: Creativity of knowledge in prompt or quick response to such a situation

CO5: Understanding evacuation and relief operations at a situation

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	-	3	-	3	3	3	-	3
CO2	3	3	3	3	-	3	-	3	3	3	-	3
CO3	3	3	3	3	-	3	-	3	3	3	-	3
CO4	3	3	3	3	-	3	-	3	3	3	-	3
CO5	3	3	3	3	-	3	-	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

IOST 85OCEAN 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 – IIIOcean management

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

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

UNIT – IV Management of coral reefs

Management of coral reefs – protection, monitoring, research capacity building and coral restoration and rehabilitation.Management of coral reef for resilience and resistance to climate change- resilience factors, resistance factors and strategies for enhancing resilience.

UNIT – VManagement of mangroves

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

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

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. 6th 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.

Course Outcome:

Upon completion of this course the students will have efficient knowledge on

CO1: Coastal zone importance and problems related to global coastal zone modificaitons

CO2: The importance of coastal zone regulations to mitigate the environmental issues

CO3: Prevention, management and mitigation from natural disasters

CO4:To study the coral management in marine environment

CO5: To study the mangrove management in coastal

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	-	-	3	-	3	3	3	-	3
CO2	3	-	-	-	-	3	-	3	3	3	-	3
CO3	3	-	-	-	-	3	-	3	3	3	-	3
CO4	3	-	-	-	-	3	-	3	3	3	-	3

CO5	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**3**

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**3**	**3**	**3**	**- -**	**3**
CO2	**3**	**3**	**3**	**-**	**3**
CO3	**3**	**3**	**3**	**-**	**3**
CO4	**3**	**3**	**3**	**-**	**3**
CO5	**3**	**3**	**3**	**-**	**3**
Total	**15**	**15**	**15**	**-**	**15**

IOET 41 ELECTIVE COURSE - IV: 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.

Text books

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

Reference Books

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

Course Outcome:

After successful completion of this course, students should be able to

Co1: Familarize on the status of World and Indian fisheries

Co2: Know about the methods implemented during fisheries survey

Co3: Understand the population dynamics of fish species and know about the principle methods of fish explotation

Co4: Gain knowledge on the different types of net used for fishing

Co5: Understand the preservation and processing of fish species

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	_	_	_	3	_	3	_	3	_	_	3
CO2	3	-	-	-	3	-	3	-	3	-	-	3
CO3	3	-	-	-	3	-	3	-	3	-	-	3
CO4	3	-	-	-	3	-	3	-	3	-	-	3
CO5	3	-	-	-	3	-	3	-	3	-	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	- -	- -	3
CO2	-	3	-	-	3
CO3	-	3	-	-	3
CO4	-	3	-	-	3
CO5	-	3	-	-	3
Total	-	15	-	-	15

IOSP 87 PRACTICAL XXII : GEOGRPAHIC INFROMATION SYSTEM

1. DATA Encoding

a. Raster Encoding

b. Run — Length coding

c. Quad tree coding

d. Scanning and conversion of images

2. Digital mapping

Overview of Arc View and Arc GIS tools.

a. Digitizing / Creating new shape files and area estimation

b. Edited coverage: – Clipping , merging , Intersect , Union, Dissolve and Assign data by location (Spatial Join).

c. Buffering

d. Projection and Transformation

e. Downloading GPS data and other XY coordinates data for GIS use

f. Preparation of contour maps using different Softwares :

i) Surfer

ii) Arc GIS

g. Chart preparation

h. Lay out preparation / Labeling and Annotation

i. DEM – Demo

IOSP 88 PRACTICAL XXIII : RENEWABLE ENERGY SYSTEM

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

IOEP 42 PRACTICAL XXIV: ELECTIVE COURSE - IV: 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

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.

REFERENCE BOOKS

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

CourseOutcome:

Upon culmination of the course successfully the students will be able to

CO1: Understand the fundamental principles of sound transmission in underwater

CO2: Learn the ocean optical parameters and their importance in analyses

CO3: To study the concept of array

CO4:Acquire knowledge in ocean optics

CO5:Comprhend the optical properties of Case I and Case II water

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	3	-	3	-	3	-	3	-	3
CO2	3	-	-	3	-	3	-	3	-	3	-	3
CO3	3	-	-	3	-	3	-	3	-	3	-	3
CO4	3	-	-	3	-	3	-	3	-	3	-	3
CO5	3	-	-	3	-	3	-	3	-	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	- -	3	- -	3
CO2	3	-	3	-	3
CO3	3	-	3	-	3
CO4	3	-	3	-	3
CO5	3	-	3	-	3
Total	15	-	15	-	15

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.

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.

Course Outcome:

Upon successful completion of this course the students will be able to

CO1: Obtain efficient knowledge on coastal and estuarine profile and how to prevent the coastal erosion due to different factors

CO2: To study the sediment transport in marine environment

CO3: Understand the transportation of sediments via different medium and sea level changes due to various environmental parameters

CO4:Gain knowledge on estuarine characteristics and its dynamic nature

CO5:To study the concepts of estuarine sedimentation processes.

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	-	-	3	-	3	3	3	-	3
CO2	3	-	-	-	-	3	-	3	3	3	-	3
CO3	3	-	-	-	-	3	-	3	3	3	-	3
CO4	3	-	-	-	-	3	-	3	3	3	-	3
CO5	3	-	-	-	-	3	-	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

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.

Course Outcome:

Upon successful completion of this course the students will be able to

CO1: Obtain efficient knowledge on hydrodynamic modeling in coastal environment.

CO2: Understand the different pollution scenarios using coastal modeling.

CO3: Gain knowledge on numerical modeling application in coastal processes and development

CO4: Understand the concept of numerical water quality models

CO5:To acquire the knowledge software numerical, ecological, and water quality, harbor layout and jetty for modeling in the port layout

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	-	-	3	-	-	-	-	3	3
CO2	3	3	3	-	-	3	-	-	-	-	3	3
CO3	3	3	3	-	-	3	-	-	-	-	3	3
CO4	3	3	3	-	-	3	-	-	-	-	3	3
CO5	3	3	3	-	-	3	-	-	-	-	3	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	- -	- -	3	3
CO2	-	-	-	3	3
CO3	-	-	-	3	3
CO4	-	-	-	3	3
CO5	-	-	-	3	3
Total	-	-	-	15	15

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.

Course Outcome:

Upon completion of this course the students will be able to

CO1: Obtain thorough knowledge on legal and regulatory aspects of Marine environments.

CO2: Learn and assessed the impacts on different environmental plans.

CO3: Understand the NGO's roles and responsibilities in EIA and know about the Constitution and law.

CO3**:** Learn and Implement the environmental impact assessment plan in essential sectors.
CO4: Understand the concept of EIA essential sectors and issues
CO5:To study on environmental consequences of any development project and prediction in marine sector for industries, harbor, etc.,

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3	3	3	3	3	3	-	3
CO2	3	3	3	3	3	3	3	3	3	3	-	3
CO3	3	3	3	3	3	3	3	3	3	3	-	3
CO4	3	3	3	3	3	3	3	3	3	3	-	3
CO5	3	3	3	3	3	3	3	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

IOET 51 ELECTIVE COURSE - V:COASTAL AQUACULTURE

Objectives

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

UNIT- I Introduction

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

UNIT - II Biology of important cultivable species

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

UNIT - III Shrimp culture techniques

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

UNIT - IV Finfish culture

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

UNIT - V Other culture systems and techniques

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

Text books

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

References books

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

Course Outcome:

Upon the culmination of the course program the students will be able to

CO1: Recognize the importance of coastal aquaculture and present status in India

CO2: Comprehend the importance of good yielding cultivable different species

CO3: To understand the concepts in shrimp culture technique

CO4: Learn the ornamental fish culture technique

CO5: Learn the various techniques and methods used in different culture systems

Outcome Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	-	-	-	-	3	-	3	3	3	-	3
CO2	3	-	-	-	-	3	-	3	3	3	-	3
CO3	3	-	-	-	-	3	-	3	3	3	-	3
CO4	3	-	-	-	-	3	-	3	3	3	-	3
CO5	3	-	-	-	-	3	-	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

IOSP 96 PRACTICAL XXV: 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

IOSP 97 PRACTICAL XXVI : 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.

IOEP 52 PRACTICAL XXVII : ELECTIVE COURSE -V: COASTAL AQUACULTURE

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

X SEMESTER

IOET 61 ELECTIVE COURSE – VI : 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.,3rd ed., 1992.
5. Harold Kerzner: Project Management; A System approach to planning,Scheduling and controlling, New Delhi, CBS Publishers and Distributors, 2nd 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.

Course Outcome:

Upon completion of this course the students will be able to

CO1: Have thorough knowledge on project planning and survey

CO2: Learn the project selection factors

CO3: Learn the use of technology in feasibility such as Cost benefit analysis and Economic analysis

CO4: To understand the project finance

CO5:Learn and Implement the methods in project monitoring and evaluation efficiently

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	-	3	-	3	3	3	-	3
CO2	3	3	3	3	-	3	-	3	3	3	-	3
CO3	3	3	3	3	-	3	-	3	3	3	-	3
CO4	3	3	3	3	-	3	-	3	3	3	-	3
CO5	3	3	3	3	-	3	-	3	3	3	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	- -	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Total	15	15	15	-	15

IOET 71 ELECTIVE COURSE – VII : 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

REFERENCE BOOKS

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.

Course Outcome:

Upon completion of this course the students will be able to

CO1: Have thorough knowledge of beach importance and needs.

CO2: Gain knowledge of the different recreational games and marine tourisms.

CO3: Learn and Implement the methods in safety assurances in the marine environment.

CO4: Acquire the knowledge about safety in marine recreation

CO5: To understand the marine recreational facilities

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	-	-	-	-	3	-	-	3
CO2	3	3	3	3	-	-	-	-	3	-	-	3
CO3	3	3	3	3	-	-	-	-	3	-	-	3
CO4	3	3	3	3	-	-	-	-	3	-	-	3
CO5	3	3	3	3	-	-	-	-	3	-	-	3

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	- -	3	- -	- -	3
CO2	-	3	-	-	3
CO3	-	3	-	-	3
CO4	-	3	-	-	3
CO5	-	3	-	-	3
Total	-	15	-	-	15

IOPV 103 PROJECT AND VIVA-VOCE

CO-PO MAPPING SCORES

Courses Impact	PSO1	PSO2	PSO3	PSO4	PSO5
1	15	15	-	-	15
2	15	15	15	-	-
3	15	-	15	-	15
4	-	15	15	15	15
5	-	15	15	-	15
6	15	15	15	-	15
7	-	15	15	-	15
8	-	15	-	15	15
9	-	15	-	15	15
10	-	15	15	-	15
11	-	15	15	15	15
12	-	15	15	15	-
13	-	15	15	-	15
14	-	15	15	-	15
15	15	15	15	-	15
16	-	15	15	-	15
17	-	15	15	15	15
18	-	15	-	15	15
19	-	15	15	15	-
20	15	15	15	-	15
21	-	15	15	-	15
22	15	-	-	-	15
23	15	15	15	-	15
24	15	15	15	-	15
25	-	15	-	-	15
26	15	-	15	-	15
27	15	15	15	-	15
28	-	-	-	15	15
29	15	15	15	-	15
30	15	15	15	-	15
Total Score	**195**	**390**	**345**	**135**	**405**