



ALAGAPPA UNIVERSITY



(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India



FACULTY OF SCIENCE DEPARTMENT OF OCEANOGRAPHY AND COASTAL AREA STUDIES



**M.Sc., MARINE BIOLOGY
(5 YEARS INTEGRATED)**

REGULATIONS AND SYLLABUS

(For the candidates admitted from the
Academic Year 2022 - 2023)

DEPARTMENT OF OCEANOGRAPHY AND COASTAL AREA STUDIES
M.Sc., Marine Biology (Five Years Integrated)

REGULATIONS AND SYLLABUS
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]



ALAGAPPA UNIVERSITY
(A State University Accredited with “A+” grade by NAAC (CGPA: 3.64) in the Third Cycle
and Graded as Category-I University by MHRD-UGC)
Karaikudi -630003. Tamil Nadu.

The panel of Members-Broad Based Board of Studies

<p>Chairperson:Name:Dr.C.Stella, Designation:Professor and Head Department Oceanography and Costal Area Studies, Alagappa University, Karaikudi, Teaching Experience:24, Research Experience:27,Area of Research: Biodiversity, Ecology-EIA andMolluscanTaxonomy&Biology</p>	
<p>ForeignExpert:Name:ParticioRDelosRios-Escalante, Designation:Assistant Professor, Department: Faculty of Natural Resources, University: Catolica De Temuco, Chile, Teaching Experience: 20, Research Experience: 22, Area of Research: Systematics and Ecology.</p>	
<p>Indian Expert: Name: Dr. M. Kalaiselvam, Designation: Director Department:CAS in Marine Biology, Faculty of Marine Sciences, University: AnnamalaiUniversity, Teaching Experience: 20 Years, Research Experience: 28, Area of Research: Marine Microbiology (MarineMycology).</p>	
<p>IndianExpert:Name:Dr.C.Raghunathan,Designation:JointDirector,Institution: ZoologicalSurveyofIndia,ResearchExperience:28,AreaofResearch:MarineBiolo gy,ZoologyandEcology.</p>	
<p>IndustryExpert: Name: Dr.S.Sanche Hullas, Designation:Aquaculture Consultant Company name and address: Avanti feeds Ltd, Kovur- 534350 West Godavari District, Andhra Pradesh. Experience:21Area :Aquaculture</p>	
<p>Members (All Department faculty)</p>	
<p>Name: Dr.V.Sugumar, Designation: Assistant Professor Department Oceanography and Costal Area Studies, Alagappa University, Karaikudi, Teaching Experience: 14 Years, Research Experience:14Years, Area of Research: Crustacean Biology& Marine Biomaterials</p>	
<p>Name:Dr.S.Paramasivam, Designation: Assistant Professor Department Oceanography and Costal Area Studies, Alagappa University, Karaikudi, Teaching Experience: 14 Years, Research Experience:14Years, Area of Research: Marine Microbiology/Sea food Safety</p>	
<p>Alumnus/Alumna:Name:Dr.V.Yoganathan Current position: Assistant Professor, Type of Profession: Teaching and Research: 10 Yrs, Professional address: Department of Marine Sciences: Bharathidasan University,Tiruchirappalli-24</p>	

ALAGAPPAUNIVERSITY
DEPARTMENT OF OCEANOGRAPHY AND COASTAL AREA STUDIES
Karaikudi-630003, Tamil Nadu.

REGULATIONS AND SYLLABUS-(CBCS-University Department)
[For the candidates admitted from the Academic Year 2022–2023 onwards]

Name of the Department : Oceanography and Coastal Area Studies
Name of the Programme : M.Sc., Marine Biology (5 Years Integrated)
Duration of the Programme : Full Time (Five Years)

Choice-Based Credit System

A choice-Based Credit System is a flexible system of learning. This system allows students to gain knowledge at their own tempo. The student shall decide on electives from a wide range of elective courses offered by the University Departments in consultation with the Department committee. Students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intra-disciplinary approach to learn, and make the best use of the expertise of available faculty.

Programme

“Programme” means a course of study leading to the award of a degree in a discipline.

Courses

‘Course’ is a component (a paper) of a programme. Each course offered by the Department is identified by a unique course code. A course contains lectures/ tutorials /laboratory/seminar/project/practical training/report writing/Viva-voce or a combination of these, to meet effectively the teaching and learning needs.

Credits

The term “Credit” refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses credits will be assigned on the basis of the number of lectures/tutorials /laboratory and other forms of learning required to complete the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory /field work one credit is equal to two hours.

Medium of Instruction:

English

Semesters

An Academic year is divided into two **Semesters**. In each semester, courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for conduct of examination and evaluation purposes. Each week has 30 working hours spread over 5 days a week.

Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programmes offered by the Department including the conduct of entrance tests/selection, verification of records, admission, and evaluation. The Departmental Committee determine the deliberation of courses and specifies the allocation of credits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practical seminars etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committees. Courses approved by the Departmental Committees shall be approved by the Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA -I, CIA-II, assignments and seminar) of all the students registered for the course. The Non-major elective programme and MOOCs coordinator are responsible for submitting the performance sheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programmes offered by the department. Then forward the same to be Controller of Examinations.

Eligibility for admission:

The Eligibility criteria for M.Sc, Marine Biology (5 Years Integrated): A Pass in Higher Secondary (+2) with Biology or Bio-Maths (with 50% marks for others and for SC/ST 45% marks)

The Exit Option in 5 Years Integrated Programme of M.Sc. Marine Biology

The Exit Option shall be allowed at the end of 3rd year of five-year Integrated Programmes with all fulfilling mandatory conditions as per the UGC norms and TANSICHE. The minimum number of credits to be completed for a period of 3 years UG degree is 140, including mandatory courses. The students are permitted to exercise the Exit Option at any time after the completion of 3 years, provided the students has cleared all papers within the stipulated period with minimum required credits. The nomenclature of appropriate UG degree to the students who are exercising the Exit Option given in the Table.

Semesters	Credit	Total credits	Normal Duration	Exit Points/Awards
Sixth semesters (UG-Programme)	140	140	Six semesters	B.Sc. Marine Biology

Minimum Duration of programme

The programme is for a period of five years. Each year shall consist of two semesters viz. Odd and Even semesters. Odd semesters shall be from June / July to October / November and even semesters shall be from November / December to April / May. Each semester there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

Components

A UG programme consists of a number of courses. The term “course” is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a “paper” in the conventional sense. The following are the various categories of the courses suggested for the PG programmes:

- a. Core courses (CC)- “Core Papers” means “the core courses” related to the programme concerned including practicals and project work offered under the programme and shall cover Core competency, critical thinking, analytical reasoning, research skill.
- b. Discipline-specific electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students and shall cover additional academic knowledge, critical thinking, and analytical reasoning.
- c. Non-Major Electives (NME)- Exposure beyond the discipline
 - i. Students have to undergo a total of two Non-Major Elective courses (UG) with 2 credits offered by other departments (one in III semester another in IV Semester).
 - ii. A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives.
 - iii. Non-Major Elective courses offered by the departments UG Programme pertaining to a semester should be announced before the end of the previous semester.
 - iv. Registration process: Students have to register for the Non-Major Elective course within 15 days from the commencement of the semester either in the department or NME portal (University Website).
- d. Self-Learning Courses from MOOCs platforms.
 - i. MOOCs shall be on voluntary for the students.
 - ii. Students have to undergo a total of 2 Self Learning Courses (MOOCs) one in III semester another in IV semester.
 - iii. Students have to undergo a total of two Non-Major Elective courses with 2 credits offered by other departments (one in II Semester another in III Semester).
 - iv. The actual credits earned through MOOCs shall be transferred in the credit plan of programmes as extra credits. Otherwise, 2 credits/course be given if the Self Learning Course (MOOCs) is without credit.
 - v. While selecting the MOOCs, preference shall be given to the course related to employability skills.

Projects/Dissertation/Internships:

The duration of the Project/Dissertation/internship shall be a minimum of three months in the final semester of UG programme duration and the same in the PG duration. The student shall undertake the dissertation work during the fourth semester

Project/Dissertation

Plan of work

The candidate shall undergo Project/Dissertation Work during the final semester. The candidate should prepare a scheme of work for the dissertation/project and should get approval from the guide. The candidate, after completing the dissertation/project work, shall be allowed to submit it to the university departments at the end of the final semester. If the candidate is desirous of availing the facility from other departments /universities/ laboratories/organizations they will be permitted only after getting approval from the guide and HOD. In such a case, the candidate shall acknowledge the same in their dissertation/project work.

Format to be followed for dissertation / project report

The format/certificate for thesis to be followed by the student are given below

Title page-Format of the title page

Title of Dissertation/Project work

Dissertation/Project submitted in partial fulfilment of the requirement for the degree of UG Programme in -----to the Alagappa University, Karaikudi-630003.

By (Student Name)
(Register Number)
University Logo

Department of-----

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi - 630003 (Year)

Certificate – Format of certificate–Guide

Certificate

This is to certify that the Dissertation/thesis entitled“-----” submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the B.A./ B.Sc./ B.F.A./ B.P.A./ Integrated Programmes in-----by Mr/Miss (Reg-----No) under my supervision. This is based on the results of studies carried out by him/ her in the Department of-----, Alagappa University, Karaikudi-63003. This dissertation/project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi Date: __

Research Supervisor

Certificate–Format of Certificate-HOD

Certificate (HOD)

This is to certify that the Dissertation/Project work entitled “” submitted by Mr/Mis.-- ----- (Reg No:-----) to the Alagappa University, in partial fulfilment for the award of the B.A./B.Sc./B.F.A./B.P.A./Integrated Programmes is a bonafide record of research work done under the supervision of-----, Assistant Professor, Department of -----, Alagappa University. This is to further certify that the thesis or any part there of has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi

Head of the Department

Date: _____

- Declaration-Format of declaration by Student

Declaration (student)

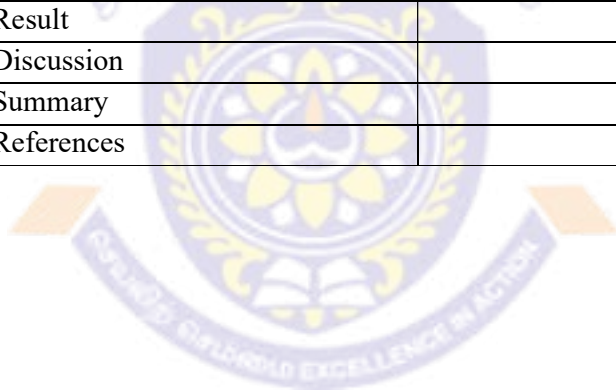
I here by declare that the dissertation/project entitled“ ----- ” Submitted to the Alagappa University for the award of the B.A/B.Sc./B.F.A/integrated programme in ----- has been carried out by me under the guidance of -----, Assistant Professor, Department of-----, Alagappa University, Karaikudi – 630003. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Date: __

(-----)

- Acknowledgment
- Content as follows:

Chapter No	Title	Page number
1	Introduction	
2	Aim and objectives	
3	Materials and methods	
4	Result	
5	Discussion	
6	Summary	
7	References	



Internship

The students who have opted for an Internship must undergo industrial training in thereputed organizations to accrue industrial knowledge in the final semester. The student has to find industry related to their discipline (Public limited/Private Limited/owner/NGOs etc.,) inconsultation with the faculty in charge / Mentor and get approvalfrom the head of the department and Departmental Committee before going for an internship.

➤ **Formattobe followedforInternshipreport**

The format /certificate for internship report to be followed by the student are givenbelow

- **Title page-Format of the title page**

Title of internship report

Internship report submitted in partial fulfilment of the requirement for theBA/B.Sc/B.FA/B.Com degreein ----- to the Alagappa University,

Karaikudi-630003.

By (Student Name)

(Register Number)

UniversityLogo

Department of-----

Alagappa University

(A StateUniversityAccreditedwith "A+" grade by NAAC(CGPA:3.64)intheThirdCycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216,QSBRICSRank-104,QSIndiaRank-20)

Karaikudi - 630003(Year)

- **Certificate-Format of certificate–faculty in-charge**

Certificate

This is to certify tha the Internship report entitled“-----
----” submitted to Alagappa University, Karaikudi-630003 inpartial fulfillment for the B.A./B.Sc./B.F.A./B.P.A./Integrated Programmes in-----by Mr/Mis -----(Reg No -----)under my supervision. This is basedonthework, carriedoutby him/her in the Organization M/S-----.This Internship reportor any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place:

Date: _____

• **Certificate-Format of certificate (HOD)**

Research Supervisor

Certificate (HOD)

This is to certify that the Internship report entitled“ ----- ”
Submitted by Mr/Mis.----- (Reg No-----)tothe Alagappa University, in
Partial fulfillment for the award of the B.A./B.Sc./B.F.A./B.P.A./Integrated Programmes is a
bonafide record of Internship report done under the supervision of -----, Assistant Professor,
Department of-----, Alagappa University and the work carried outby him/her in the
organization M/S -----. This is to further certify that the thesis or any part thereof
has not formed the basis of the award to the student of any degree, diploma, fellowship,or anyother
similartitle of any University or Institution.

Place: Karaikudi

Head of the Department

Date: _____

□ **Certificate-(Format of certificate–Company supervisor/Head of the Organization)**

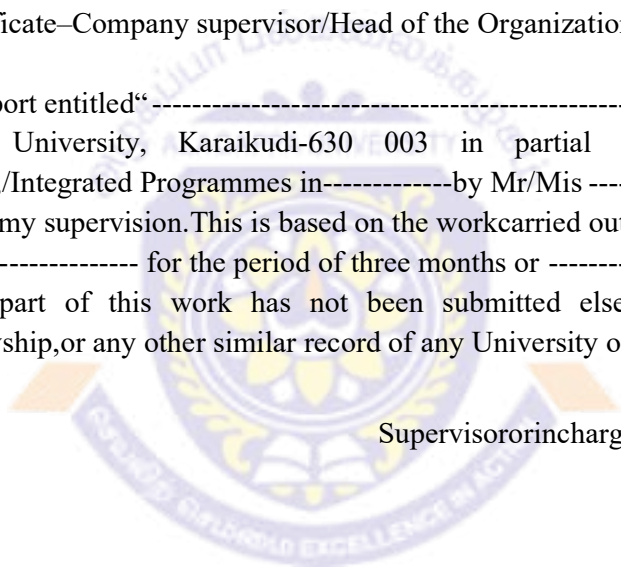
Certificate

This is to certify that the report entitled“ ----- ”
submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the
B.A./B.Sc./B.F.A./B.P.A./Integrated Programmes in-----by Mr/Mis ----- (Reg
No -----)under my supervision. This is based on the workcarried out by him/herinour
Organization M/S----- for the period of three months or ----- .This
Internship report or any part of this work has not been submitted elsewhere for any
otherdegree,diploma, fellowship,or any other similar record of any University or Institution.

Place:

Supervisor or incharge

Date: _____



□ Declaration- **Format of declaration by Student**

Declaration (student)

I hereby declare that the dissertation/project entitled “-----” submitted to the Alagappa University for the award of the B.A/B.Sc./B.F.A/ integrated programme in-----has been carried out by me under the guidance of-----, Assistant Professor, Department of -----, Alagappa University, Karaikudi-630 003. This is my original and independent work carried out by me in the organization M/S -----for the period of three months or-----and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

- Acknowledgment
- Content as follows:

Chapter No	Title	Page number
1	Introduction	
2	Aim and objectives	
3	Organization profile/details	
4	Methods/work	
5	Observation and knowledge gained	
6	Summary and outcome of the Internship study	
7	References	

➤ **No. of copies of the dissertation/project report/internship report**

The candidate should prepare three copies of the dissertation/project/internship report and submit the same for the evaluation of the examiners. After evaluation, one copy will be retained in the department library, one copy will be retained by the guide and the student shall hold one copy.

Teaching methods:

Chalk and Talk, PowerPoint, Online

Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall re-do the semester (s) after completion of the programme

Examination and Evaluation

The examinations shall be conducted separately for theory and practical to assess (remembering, understanding, applying, analyzing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

e. Internal Assessment

The internal assessment shall comprise maximum of 25 marks for each subject. The following procedure shall be followed for forwarding internal marks.

Theory-25 marks

Sr.No	Content	Marks
1	Average marks of two CIA test	15
2	Seminar/group discussion/quiz	5
3	Assignment/field trip report/case study report	5
	Total	25

Practical -25/40 Marks

1	Major Experiment	10/marks
2	Minor Experiment	5 marks
3	Spotter (2x5/4x4) or any other mode	10 marks
	Total	25 Marks

Project/Dissertation-25 Marks (assess by Guide & HOD/in charge/supervisor)

1	Two presentations (mid-term)	15 Marks
2	Progress report	10 Marks
	Total	25 Marks

Internship – 150 Marks (assess by in charge/ HOD/ Organizations supervisor)

1	Two presentations (mid-term)	90 Marks
2	Progress report	60 Marks
	Total	150 Marks

f. External Examination

- There shall be examinations at the end of each semester, for odd semesters in the month of October/November; for even semesters in April/May.
- A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October /November or April / May. However candidates who have arrears in Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semester.
- A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit / regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.
- For the Project Report/ Dissertation Work / internship the maximum marks will be 75/150 percent for project report evaluation and for the Viva-Voce it is 25/50 percent (if in some programmes, if the project is equivalent to more than one course, the project marks would be in proportion to the number of equivalent courses).
- Viva-Voce: Each candidate shall be required to appear for Viva-Voce Examination (in defense of the Dissertation Work/Project/internship).

g. Scheme of External Examination (Question Paper Pattern)

Theory-Maximum 75 Marks

Section A	10 questions. All questions carry equal marks. (Objective type questions)	10 x 1 = 10 Marks	10 questions – 2 each from every unit
Section B	5 questions Either / or type like 1.a (or) b. All questions carry equal marks.	5 x 5 = 25	5 questions – 1 each from every unit
Section C	5 questions Either / or type like 1.a (or) b. All questions carry equal marks.	5 x 8 = 40	5 question – Should cover all units

Practical–Maximum 60Marks

SectionA	Majorexperiment	10 Marks
SectionB	Minorexperiment	5Marks
SectionC	Experimental setup	5 Marks
SectionD	Spotters(5x5marks)	25 Marks
SectionE	Record note	10 Marks
SectionF	Vivovoce	10 Marks

Dissertation/ProjectreportSchemeof evaluation

Dissertation/Projectreport	50 Marks
Viva voce	25Marks

Internship reportSchemeofevaluation

Internshipreport	150 Marks
Viva voce	100 Marks

Results

The results of all the examinations will be published through the Department where the student underwent the course as well as through University Website.

Passing minimum

A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 40% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.

- The passing minimum for CIA shall be 40% out of 25/15* marks (i.e. 10/6* marks) in Theory papers and 40% out of 40/10* marks (i.e. 16/4* marks) in Practical Examinations.
- The passing minimum for University Examinations shall be 40% out of 75/ 60* marks (i.e. 30/24* marks) for Theory papers and 40% out of 60/40* marks (i.e. 24/16* marks) for Practical papers.
- The candidates not obtained 40% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests and by submitting assignments.

- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and /or in University examinations.
- A candidate shall be declared to have passed in the Dissertation/Project report/Internship report if he / she get not less than 40% in each of the Report and Viva-Voce.
- A candidate who gets less than 40% in the Dissertation / Internship/ Project Report must resubmit the thesis. Such candidates need take again the Viva-Voce on there submitted report/thesis.

Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Course/ Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0–10.0	O	Outstanding
80-89	8.0–8.9	D+	Excellent
75-79	7.5–7.9	D	Distinction
70-74	7.0–7.4	A+	Very Good
60-69	6.0–6.9	A	Good
50-59	5.0–5.9	B	Average
40-49	4.0–4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

- a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90–100 shall be declared to have Outstanding (O).
- b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80-89 shall be declared to have Excellent (D+).
- c) Successful candidates passing the examinations and earning GPA between 7.5–7.9 and marks from 75-79 shall be declared to have Distinction (D).
- d) Successful candidates passing the examinations and earning GPA between 7.0–7.4 and marks from 70-74 shall be declared to have Very Good (A+).
- e) Successful candidates passing the examinations and earning GPA between 6.0–6.9 and marks from 60-69 shall be declared to have Good (A).
- f) Successful candidate passing the examinations and earning GPA between 5.0–5.9 and marks from 50-59 shall be declared to have Average (B).
- g) Successful candidates passing the examinations and earning GPA between 4.0–4.9 and marks from 40-49 shall be declared to have Satisfactory (C).
- h) Candidates earning GPA between 0.0 and marks from 00-39 shall be declared to have Re-appear (U).
- i) Absence from an examination shall not be taken as an attempt.

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively by **Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)**. These two are calculated by the following formulae

$$\text{GRADE POINT AVERAGE (GPA)} = \frac{\sum C_i G_i}{\sum C_i}$$

GPA = $\frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a Semester}}$

Classification of the final result

The final result of the candidate shall be based only on the CGP A earned by the candidate.

- a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+) and those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class–Exemplary*.
- b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+) and those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.
- c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+) and those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.
- d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B) and those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.
- e) Successful candidates passing the examinations and earning CGPA between 4.0 and 4.4 shall be given Letter Grade (C) and those who earned CGPA between 4.5 and 4.9 shall be given Letter Grade (C+) and declared to have passed in Third Class.
- f) Absence from an examination shall not be taken as an attempt.

Final result

CGPA	Grade	Classification of Final Result
9.5–10.0	O+	First Class–Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++D+	First Class with Distinction*
8.0 and above but below 8.5	D	
7.5 and above but below 8.0		
7.0 and above but below 7.5	A++A+	First Class
6.5 and above but below 7.0	A	
6.0 and above but below 6.5		
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.5 and above but below 5.0	C+	Third Class
4.0 and above but below 4.5	C	
0.0 and above but below 4.0	U	Re-appear

$$\text{CUMMULATIVE GRADE POINT AVERAGE(CGPA)} = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i}$$

CGPA = Sum of the multiplication of grade points by the credits of the entire Programme / Sum of the credits of the course for the entire Programme

Where 'Ci' is the Credit earned for Course i in any semester; 'Gi' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the UG Programme (Major, Allied and Elective courses alone) are alone eligible for this classification.

Maximum duration of the completion of the programme

The maximum period for completion of the Degree in B.Sc., Marine Biology shall not exceed Ten semesters continuing from the first semester and the maximum period for completion of M.Sc., Marine Biology (5 Year Integrated) shall not exceed fourteen semesters continuing from the first semester.

Conferment of the Undergraduate Degree programme

A candidate shall be eligible for the conferment of the UG Degree only after he/ she has earned the minimum required credits for the Programme prescribed therefor (i.e. 140 + Ex Credits for three years UG Programmes and 160+ Ex credits for four years UG Programmes credits).

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the PG Degree only after he/ she has earned the minimum required credits for the Programme prescribed there fore (i.e.90 credits Programme).

Village Extension Programme

The Sivaganga and Ramnad districts are very backward districts where a majority of people lives in poverty. The rural mass is economically and educationally backward. Thus, the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three day based on the theme. 1. Environmental awareness 2. Hygiene and Health. A minimum of two faculty members can accompany the students and guide them.

ALAGAPPAUNIVERSITY, KARAİKUDI
M.SC MARINE BIOLOGY (FIVE YEARS INTEGRATED)

Programme –Credit Structure

Sem.	Part	Course Code	Title of the Paper	T/P	Cr.	Hrs./ Week	Max.Marks		
							Int.	Ext.	Total
I	I	911T/F	Tamil/OtherLanguages-I	T	3	6	25	75	100
	II	912CE	CommunicativeEnglish-I	T	3	6	25	75	100
	III	548101	Physical Oceanography	T	5	5	25	75	100
		548102	Physical Oceanography	P	4	4	40	60	100
		9MB1A1	General Chemistry – I	T	3	3	25	75	100
		9MBP1	General Chemistry - I	P	2	2	40	60	100
	IV	SEC-I	Value Education	T	2	2	25	75	100
		Library				2			
		Total			22	30	205	495	700
II	I	921T/F	Tamil/OtherLanguages-II	T	3	6	25	75	100
	II	922CE	CommunicativeEnglish-II	T	3	6	25	75	100
	III	548201	Theory–IIChemicalOceanography	T	5	5	25	75	100
		548202	Practical-IIChemicalOceanography	P	4	4	40	60	100
		9MB2A1	General Chemistry – II	T	3	3	25	75	100
		9MBP2	General Chemistry – II	P	2	2	40	60	100
	IV	SEC-II	EnvironmentalStudies	T	2	2	25	75	100
		Library				2			
		Total			22	30	205	495	700
III	I	931T/F	Tamil/OtherLanguages-II	T	3	6	25	75	100
	II	932CE	English–III	T	3	6	25	75	100
	III	548301	Theory-III-BiologicalOceanography	T	3	3	25	75	100
		548302	Theory-IV-Invertebrates	T	3	3	25	75	100
		548303	Practical-III Biological Oceanography; Invertebrates	P	3	3	40	60	100
		9MB3A2	Theory – IIA- Botany	T	3	3	25	75	100
		9MB3P2	Practical-IIA – Botany	P	2	2	40	60	100
IV	SEC-III	Entrepreneurship		2	2	25	75	100	
	SEC -IV	NME-I Mariculture/Aquariumkeeping		2	2	25	75	100	
		Total			24	30	255	645	900
IV	I	941T/F	Tamil/OtherLanguages-IV	T	3	6	25	75	100
	II	942CE	English–IV	T	3	6	25	75	100
	III	548401	Ecology and zoogeography	T	4	4	25	75	100
		548402	Vertebrates	T	4	4	25	75	100
		548403	Practical-IV	P	3	3	40	60	100
		9MB4A2	Theory - IIB- Botany	T	3	3	25	75	100
		9MB4P2	Practical - IIB – Botany	P	2	2	40	60	100
IV	SEC-V	NME.II Mariculture / Aquarium keeping		2	2	25	75	100	
		Total			24	30	230	570	800

V	III	548501	Theory-VII-Cell and Molecular biology	T	4	4	25	75	100	
		548502	Theory-VIII-Developmental Biology	T	4	4	25	75	100	
		548503	Theory-IX Fish and Fisheries	T	4	4	25	75	100	
		548504	Theory-X Coastal and brackish water Aquaculture	T	4	4	25	75	100	
		548505	Practical-V Cell and Molecular biology, Developmental Biology	P	4	6	40	60	100	
		548506	Practical-VI Fish and Fisheries, Coastal and brackish water Aquaculture	P	4	6	40	60	100	
			Career development/employability skills			2				
			Total		24	30	180	420	600	
			Internship		24	30	150	250	400	
			Or							
VI	III	548601	Marine Biodiversity and Conservation	T	6	6	25	75	100	
		548602	Coastal Zone Management	T	6	6	25	75	100	
		548603	Mariculture	T	6	6	25	75	100	
		548604	Aquarium keeping	T	6	6	25	75	100	
			Library/Yoga etc.			2				
			Career development/ employability skills/ Fieldtrip		-	4	-	-		
				24	30	100	300	400		
				Or						
			548605	Project		6	10	25	75	100
			548606	Coastal Disaster Management	T	6	6	25	75	100
		548607	Marine Pollution	T	6	6	25	75	100	
		548608	Marine Resources	T	6	6	25	75	100	
			Library/Yoga/Career development /employability skills/Field trip etc.			2				
			Total		24	30	100	300	400	
			GrandTotal		140	--	--	--	4100	
VII	IV	548701	Animal physiology	T	5	5	25	75	100	
		548702	Biochemistry	T	5	5	25	75	100	
		548703	Immunology	T	4	4	25	75	100	
		548704	Genetics	T	4	4	25	75	100	
		548705	Lab-I: Animal physiology, Biochemistry, Immunology, Genetics	P	4	8	25	75	100	
		DSE -1	Marine Resources (or) Marine Pollution and Management	T	3	3	25	75	100	
			Library/Yoga/counseling/Fieldtrip			1				
			T		25	30	150	450	600	
VIII	IV	548801	Application of Remote Sensing & GIS	T	4	4	25	75	100	
		548802	Evolution	T	4	4	25	75	100	
		548803	Biotechnology	T	4	4	25	75	100	
		548804	Post-Harvest Technology	T	4	4	25	75	100	
		548805	Lab-II: Application of Remote Sensing & GIS, Evolution, Biotechnology Post-Harvest Technology	P	4	8	25	75	100	
		DSE - 2	Fermentation Technology (or) Ornamental Fish Culture	T	3	3	25	75	100	
			Non-Major Elective**	T	2	3	25	75	100	
			Self-learning course (SLC)-MOOCs***		Extra credit					
			25	30	175	525	700			

	V	548901	Marine Microbiology	T	4	4	25	75	100	
		548902	Environmental impact Assessment	T	4	4	25	75	100	
IX	V	548903	Research Methods in Marine Biology	T	4	4	25	75	100	
		548904	Marine Biodiversity and conservation	T	4	4	25	75	100	
		548905	Lab-III: Marine Microbiology, Environmental impact Assessment, Research Methods in Marine Biology	P	4	8	25	75	100	
		DSE -3	Marine Farming (or) Marine Biofouling, Prevention and Management	T	3	3	25	75	100	
		Non-Major Elective**		T	2	3	25	75	100	
		Self-learning course (SLC)–MOOCs***		Extra credit						
						25	30	175	525	700
X	V	548999	****Dissertation Work or Internship programme		15	30	50	150	200	
					15	30	50	150	200	
			Total		90+	30	550	1650	2200	

T-Theory P-Practical

As per TANSCHÉ, the Professional English book will be taught to all four streams apart from the existing hours of teaching/additional hours of teaching (1 hour/day) as a 4 credit paper as an add on course on par with Major paper and completion of the paper is a must to continue his/her studies further.

Sem	Part	Course Code	Title of the Paper	Cr.	Hrs./Week	Max. Marks		
						Int.	Ext.	Total
I	III	AECC-I	Professional English for Life Science/Physical Science-I	4	4	25	75	100
II		AECC-II	Professional English for Life Science/Physical Science-II	4	4	25	75	100
III		AECC-III	Professional English for Life Science/Physical Science-III	4	4	25	75	100
IV		AECC-IV	Professional English for Life Science/Physical Science-IV	4	4	25	75	100

T/OL-Tamil/Other Languages, (Ref. Common Syllabus)

- E-English
- CC-Core course– Core competency, critical thinking, analytical reasoning, research skill & team work
- Allied-Exposure beyond the discipline
- AECC—Ability Enhancement Compulsory Course (Professional English & Environmental Studies)-Additional academic knowledge, psychology and problem solving etc.,
- SEC-Skill Enhancement Course-Exposure beyond the discipline (Value Education, Entrepreneurship Course, Computer application for Science etc.,)
- NME-Non-Major Elective–Exposure beyond the discipline
- DSE–Disciplines specific elective --Student choice–either or
 - Internship
 - Marks=Internal=150(75+75) two midterm valuation through viva-voce and External 250 marks(Report=150+VivaVoce=100)=Total 400 marks
 - Theory papers or
 - Project +3 theory papers.
- Extension activity & MOOCs–Voluntary basis

I - SEMESTER					
Core	Course Code 548101	PHYSICAL OCEANOGRAPHY	T	Credits:5	Hours: 5
UNIT-I					
Objective 1	The objective of this course is to offer the students about the history of Oceanography.				
History of Oceanography: Early exploration and Historical Review the Development of Oceanography– Foundation of Modern Oceanography – National Expeditions –Post War Oceanography – Modern Trends.					
Outcome 1	Student will study the physical properties and dynamic processes.			K2	
UNIT – II					
Objective 2	To provide the basic knowledge about Ocean Currents - General character and Origin of Ocean currents - Types of Ocean currents.				
Physical properties of seawater: Units of temperature – Pressure and their changes in the Sea- Density of Sea water - Thermal Properties of seawater - Colligative and other solid suspension properties of sea water-Properties of sea ice-Transmission of sound-Absorption of radiation-Eddy conductivity – Diffusivity-Viscosity.					
Outcome 2	The students will study the interaction of the ocean with the atmosphere.			K2	
UNIT – III					
Objective 3	To provide basic knowledge about the Physical properties of seawater, waves, tides, currents, Estuaries, deltas, coastal lagoons, meteorology and clouds precipitation.				
Waves, Tides and Currents : Hydrodynamics, refraction, Wave modification near the coast-Wave height and wave energy – Wave in shallow waters – Internal and standing waves- Energy from waves. Tides – Tidal curves- Dynamic theory of the tide- Tidal currents – Tidal current in coastal areas-Tidal effect in coastal area. Type of currents-Littoral and rib currents-Ekman spiral, Geostrophic current – Boundary current - Western, Eastern and equatorial currents- Thermocline, Temperature and salinity diagram and coastal upwelling.					
Outcome 3	Students can able to understand not only how the ocean behaves at a given point in time, but also how the ocean changes and fluctuations.			K2	
UNIT – IV					
Objective 4	To make the students predict the weather map and climatic conditions of Coastal regions and to comprehend the El Nino and La Nina effects.				
Estuaries, coastal wetlands and Mud flats : Coastal process and estuaries - regional and global effects of sea level changes- Effect of sea level changes on shorelines. Coast and Coastal process - Estuaries- Classification -Type of estuaries - Origin and fate-Estuarine circulation. Global warming - Greenhouse effect - Ozone deflection. El Nino and La Nina - Southern Oscillation - ENSO and its impact on Indian Monsoon.					
Outcome 4	Student will study the climatic changes and global warming and its impact.			K4	

UNIT - V

Objective 5 To provide basic knowledge of the global warming and greenhouse effect.

Fundamental Principles of Meteorology- Indian climatology with special reference to seasonal distribution. Climatic Zones of India. Clouds and their classification. Monsoons & Cyclones: Synoptic features associated with monsoon and tropical cyclones. General Circulation of the atmosphere. Satellite Meteorology: Polar orbiting and Geostationary satellites-visible and infrared radiometers - Multi-scanner radiometers. Identification of synoptic systems, fog and sandstorms, detection of cyclones, estimation of SST, cloud top temperatures, winds and rainfall - temperature and humidity soundings.

Outcome 5 Students will learn the meteorological technology.

K4

Suggested Readings:-

Alan P. Trujillo. (2013). *Essentials of Oceanography (11th ed)*: Pearson.
 Bharatdwaj. K. (1993). *Physical Geography-Oceanography*: Discovery Publishing House.
 Duxbury,A.C.,Duxbury,A.B.,andSverdrup,K.A.(2000).*AnIntroductiontoTheWorld’sOceans*. UK: Wm. C. Brown Publishers.
 Lal. D.S. (2010). *Oceanography*. Allahabad: Sharda Pustak Bhawan.
 Matthew Fontaine Maury. (1855). *The Physical Geography of the Sea*. Harper & Brothers.
 Natarajan, M., Balasubramanian, T. (2001). *Oceanographic equipments*. ENVIS Centre, CAS in Marine Biology. Annamalai University.
 Paul. R. Pinet. (1992). *Oceanography - An Introduction to the Planet Oceans*. UK: West PublishingCompany.
 Paul. R. Pinet. (2000). *Invitation to Oceanography (2nd ed.)*. Massachusetts: Jones and Bartlett Publishers.
 Robert. H. Stewart. (2008). *Introduction to Physical Oceanography*: Texas A & M University.
 Roland Stull. (2015). *Practical meteorology - An algebra-based survey of Atmospheric Sciences*. Vancouver, Canada: The University of British Columbia.

Online resources

- <https://divediscover.whoi.edu/history-of-oceanography/>
- <http://oceans.mit.edu/JohnMarshall/research/ocean-dynamics/>
- <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=86507>
- <https://endurance22.org/science/meteorology-oceanography>
- <https://rwu.pressbooks.pub/webboceanography/chapter/13-7-sea-level-change/>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	M(2)	M(2)
W.AV	2.8	2.4	2.4	2.4	2.6	2.2	2.2	2.4	2.0	1.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	S(3)	M(2)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	L(1)	S(3)	S(3)	M(2)	M(2)
CO5	M(2)	M(2)	S(3)	M(2)	M(2)
W.AV	2.4	2.6	2.6	2.2	2.0

S–Strong(3),M-Medium(2),L-Low(1)

Core	Course Code: 548102	PHYSICAL OCEANOGRAPHY PRACTICAL-I	P	Credits:4	Hours: 4
1.	Watersamplingdevices: Mayer's water sampler-Knudsen water sampler –universal watersampler - Nansen water sampler - Horizontal water sampler – Niskin water sampler - Bacteriological water sampler.				
2.	Lightmeasuringdevices: Secchidisc –Luxmeter–Turbiditymeter –underwater Photometer.				
3.	Temperatureandpressuremeasuringdevices: Towing surface thermometer–Six's maximum and minimum thermometer –Reversing thermometer- Bathy thermograph – Thermo hydrobarograph -Fortin's barometer.				
4.	Currentmeasuringdevices: Watt'scurrentmeter-Directreadingcurrentmeter.				
5.	Bottomsamplingdevices: Ekman's dredge-Peterson's grab –VanVeen's grab-Vertical gravity corer- Oozesucker-Mud snapper-Boxcorer-Boomerang watersampler, grab and corer.				
6.	Depthmeasuringdevices –Echo sounder, SidescanSonar.				
7.	Weather Instruments: Thermometers, Barometers, Humidity Sensors,Wind Speed,WindVane, RainGauge, HailPad, Campbell Stokes Recorder, Hygrometer, Panevaporation,weather prediction charts of the localregion.				



I – SEMESTER					
Allied	Course Code 9MB1A1	GENERAL CHEMISTRY-I	T	Credits:3	Hours:3
UNIT – I					
Objective 1	To provide knowledge about Metallurgy: ores – minerals - general methods Alloys and Amalgams: Alloys of Copper and Nickel –Applications of alloys and amalgams. Inorganic polymers: Synthesis, properties and uses of Silicones – Preparation and applications of Fuel gases -Biodegradable polymers.				
To prepare the students with strong knowledge of Metallurgy of ores in minerals and in Alloys and Amalgams of preparation and applications and Inorganic polymers.					
Outcome 1	The Students learn the What the general chemistry is. How to Classification of ores and minerals, What are the different types of alloys and amalgams and What is Inorganic polymers and their application of fuel and Which type of polymer are biodegradable polymer.			K2	
UNIT – II					
Objective 2	To prepare the students with strong knowledge of Definition of coordination complexes, ligands and classification of ligands. Naming of complexes. Effective atomic number rule. Chelates definition and applications of chelate formation. Biological roles of haemoglobin and chlorophylls. Metal carbonyls, classification and modern applications as catalysts.				
To prepare the students with strong knowledge of Naming of complexes and definition of coordination complexes, Chelates definition and applications of chelate formation. ligands and classification of ligands. Effective atomic number rule. Chelates definition and applications Metal carbonyls, classification and modern applications as catalysts.					
Outcome 2	Students gain knowledge about What are the compounds are coordination complexes, What are the Chelates and their applications, How to calculated Effective atomic number rule, What is Metal carbonyls and modern applications of the catalysts.			K2	
UNIT – III					
Objective 3	To learn about the Fundamental concepts of Valency in organic compounds. Hybridization of orbitals in carbon – sp ³ , sp ² and sp hybridization and shapes of molecules. Isomerism in organic compounds. Reaction intermediates of Homolytic bond fission and Heterolytic bond fission. Order of stabilities of bonds. Organic reactions – Types of organic reactions and polymerization				
To prepare the students with strong knowledge of Fundamental concepts in Valency of carbon in organic compounds. Hybridization of orbitals in carbon – sp ³ , sp ² and sp hybridization. Isomerism in organic compounds. Various types of structural and stereoisomerisms. Reaction intermediates of Homolytic bond fission and Heterolytic bond fission. Order of stabilities. Organic reactions Types of organic reactions and polymerization					
Outcome 3	Students gain knowledge about what are the Fundamental concepts in Valency of carbon in organic compounds. How much types of Hybridization of orbitals in carbon types. Which types of Isomerism is possible to in organic compounds. How much Various types of structural and stereoisomerisms. What are the Reaction intermediates of their types Homolytic bond fission and Heterolytic bond fission. What are the Order of stabilities.			K3	

UNIT – IV					
Objective 4	To learn about the Amino acids classification peptide formation and isoelectric point, protein types. Carbohydrates Classification and examples and structure of glucose, fructose and sucrose. Vitamins Definition, classification, sources and deficiency and diseases. Chemotherapy: Definition and examples.				
To prepare the students with strong knowledge of classification of amino acids, peptide formation, isoelectric point and proteins types. Carbohydrates Classification and examples – reducing and non-reducing sugars. Structure of glucose, fructose and sucrose. Vitamins Definition, classification, sources and deficiency and diseases. Chemotherapy Definition and examples.					
Outcome 4	Students gain knowledge about what are the types of classification of amino acids, peptide formation, isoelectric point and proteins types. How many types of Carbohydrates Classification and example. What are the Reducing and non-reducing sugars. How to find out the Structure of glucose, fructose and sucrose. What are the Vitamins Definition, classification, sources and deficiency and diseases. What is Chemotherapy Definition and examples.				K2
UNIT – V					
Objective 5	To learn about the Rubber in Natural and synthetic rubbers, composition of rubber, Neoprene, styrene butadiene rubber (SBR). Fibres, Resins and plastics Definition of Natural and synthetic fibres, classification of plastics and their properties. Soap Definition and General consideration in soap making, manufacture of soap, toilet and transparent soaps. Detergents: Definition and classification of face active agents and shampoo.				
To prepare the students with strong knowledge of Rubber in Natural and synthetic rubbers, composition of rubber, Neoprene, styrene butadiene rubber (SBR). Fibres, Resins and plastics Definition of Natural and synthetic fibres, classification of plastics and their properties. Soap Definition and General consideration in soap making, manufacture of soap, toilet and transparent soaps. Detergents: Definition and classification of face active agents and shampoo.					
Outcome 5	Students gain knowledge about what is Rubber and their types in Natural and synthetic rubbers, composition of rubber, Neoprene, styrene butadiene rubber (SBR). What is Fibres, Resins and plastics Definition of Natural and synthetic fibres, How many types are classification of plastics and their properties. What is Soap Definition and General consideration in soap making, manufacture of soap, toilet and transparent soaps. What is Detergents: Definition and classification of face active agents and How to prepared shampoo.				K2/ K3
Suggested Readings: Inorganic chemistry – R.D. Madhan Advanced Inorganic Chemistry – Sathyaprakash Inorganic Chemistry – J.D. Lee P.L. Soni – “Text Book of Organic Chemistry”, 26th Ed., (1994), S. Chand & Co, New Delhi. Arun Bahl and B.S. Bahl – “Text Book of Organic Chemistry”, 11th and 18th Ed., (2006), S.Chand, New Delhi.					
K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M (2)	L(1)	M(2)
CO2	S(3)	L(1)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	M (2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	S(3)	L(1)	M(2)	M(2)
W.AV	2.4	2.0	2.2	2.4	2.4	2.6	2.4	2.2	1.8	2.0

S–Strong (3), M-Medium (2),L-Low(1)

CourseOutcomeVSProgrammeSpecificOutcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	S(3)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	M(2)	M(2)	M(2)
CO4	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	M(2)	S(3)	S(3)	M(2)	S(3)
W.AV	2.6	2.8	2.6	2.2	2.4

S–Strong (3), M-Medium(2),L-Low(1)

Allied	Course Code 9MBP1	ALLIED PRACTICAL I - INORGANIC QUALITATIVE ANALYSIS	P	Credits: 2	Hours: 2
To analyse an inorganic salt containing one simple (chloride/ nitrate/ sulphate) anion/ interfering anion and one cation.					



II - SEMESTER					
Core	Course Code 548201	CHEMICAL OCEANOGRAPHY	T	Credits: 5	Hours: 5
UNIT-I					
Objective 1	To understand the chemical composition of the oceans and their physical, chemical, and biological processes governing the composition in the past and present.				
Composition of seawater: Marine Chemistry – Chemical properties of seawater - structure of water molecules. Ionic composition of sea water-Elements present in sea water- Oxidation-Reduction Potential of seawater-Constancy of ionic composition – Factors affecting constancy-Analytical chemistry of seawater constituents – Concept of chlorinity and salinity of seawater-Methods of measurement					
Outcome 1	To know the historical background of the marine chemistry and history of expedition.			K2	
UNIT – II					
Objective 2	To Provide basic knowledge of the chemical properties of seawater.				
Dissolved Gases : Basic Concepts-Solubility of gases in seawater Carbon dioxide – Origin- Importance and distribution – CO ₂ -CO ₃ systems. Dissolved oxygen-Origin and factors governing the distribution- BOD and COD – Air and sea gas exchange– Non-reactive gases-Minor reactive gases. Gases other than carbon dioxide and Oxygen-N ₂ -H ₂ S, Methane-Noble gases-Their origin-distribution and importance.					
Outcome 2	Students will study the chemical properties and dynamic mixing system.			K2	
UNIT – III					
Objective 3	To learn about the trace elements distribution. Interaction of major and Minor elements with marine organisms.				
Trace elements Concept–Type of distribution– Input trace elements to the coastal waters- Cycling of trace elements in coastal waters. Basic concepts-Solubility of gases in seawater Carbon dioxide – Origin-Importance and distribution – CO ₂ -CO ₃ systems. Dissolved oxygen-Origin and factors governing the distribution- BOD and COD -Abundance and residence time- Anoxic Basin-Interaction of major and Minor elements with marine organisms.					
Outcome 3	Students will learn about the Major and Minor elements in sea water.			K2	
UNIT – IV					
Objective 4	Major and Minor elements in sea water Cycling of carbon, nitrogen, phosphorus, silicon, and oxygen, and processes of primary production, export production, remineralization, diagenesis and air-sea gas exchange.				
Organic matter: Dissolved and particulate sources classification – Composition-Estimation – Distribution-Seasonal Variation-Ecological processes and significance- Growth promoting and growth inhibiting effects.					
Outcome 4	To gain knowledge about the nutrients and its cycles.			K4	

UNIT - V

Objective 5	Dissolved and particulate organic matter-sources classification-composition estimation.				
Nutrients : Origin-Fertilityofthesea–Nitrogen–Phosphorus–Determination–Cycle- Seasonal variation–Nitrogen–Phosphorus ratio. Silicon: Origin, distributioncycle and their significance.					
Outcome 5	Students will learn about the dissolved and particulate organic matter-sources.				K2
Suggested Readings:- Diwan, A.,&Arora, D. (1995). <i>Oceanographic Environment</i> . Anmol Publications Pvt. Ltd. Duxbury, A.C., Duxbury, A.B., & Sverdrup, K.A. (2000). <i>An Introduction to The World’s Oceans</i> . UK: Wm. C. Brown Publishers. Gianguzza, A., Pelizzetti, E.,&Sammartano, S. (1997). <i>Marine Chemistry</i> . Kluwer Academic Publishers. Millero, F. (1996). <i>Chemical Oceanography (2nd ed.)</i> . CRC Press Inc. Pinet, P. (1992). <i>Oceanography</i> . West Publishing Company Satyanarayana, T. (2007). <i>Marine Chemistry</i> . Daya Publishing House.					
Online resources https://www.marinebio.org/oceans/ocean-chemistry/ https://www.britannica.com/science/seawater https://www.britannica.com/science/chemical-element/Composition-of-seawater http://ecoursesonline.iasri.res.in/mod/page/view.php?id=86524 https://www.britannica.com/science/seawater/Dissolved-organic-substances					
K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M (2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
CO2	S(3)	S(3)	M(2)	M (2)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)
CO3	M(2)	L (1)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)
CO5	S(3)	L (1)	M(2)	M(2)	S(3)	S(3)	M (2)	M(2)	S(3)	M(2)
W.AV	2.6	1.8	2.0	2.2	2.6	2.4	2.4	2.4	2.2	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	S(3)	M (2)
CO2	M(2)	M(2)	M (2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	L (1)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	S(3)	L (1)
W.AV	2.4	2.0	2.2	2.6	1.8

Core	Course Code: 548202	CHEMICAL OCEANOGRAPHY PRACTICALS - II	P	Credits:4	Hours: 4
1.	Determination of Salinity				
2.	Total Alkalinity				
3.	Dissolved oxygen				
4.	BOD				
5.	COD				
6.	pH				
7.	TSS				
8.	TDS				
9.	Calcium and magnesium				
10.	Nitrite				
11.	Nitrate				
12.	Reactive Phosphate				
13.	Particulate Phosphorous				
14.	Sulphide				
15.	Ammonia				
16.	Organic nitrogen				
17.	SiO ₂				
18.	Particulate Carbon				
19.	Total Iron				
20.	Total dissolved phosphorous				
21.	Trace Elements				

II - SEMESTER					
Core	Course Code 9MB2A1	GENERAL CHEMISTRY II	T	Credits: 3	Hours:3
UNIT-I					
Objective 1	To provide knowledge about the Match Industry, pyrotechny, and explosives of raw materials needed for the match industry how to manufacturing process. Pyrotechnics in on colored smokes. To provide explosives in the definition and their classification of Nitroglycerin, dynamite, cordite, TNT and picric acid. Corrosion of Metals: Definition of the various methods of preventing corrosion and coating with other metals (galvanizing, tinning and electroplating) of the cathodic protection and painting, corrosion inhibitor. Chemistry of paper: Raw materials of the manufacturing process in the bleaching and colouring.				
To prepare the students with strong knowledge of manufacturing match and pyrotechnics. To prepare what are the explosives and their classification. To prepare know the corrosion of metals and their types. To prepare the chemistry of paper and bleaching and colouring.					
Outcome 1	The students learn about the how to prepare the match, explosive and colored smokes. How to Classification of explosive. The students learn corrosion of metals, define various methods of preventing. The students learn of galvanizing, tinning and electroplating and corrosion inhibitor. To students learn of chemistry of paper.				K2
UNIT – II					
Objective 2	To prepare the students with strong knowledge of Separation and Purification Techniques Solvent extraction of the Soxhelt extraction and their principles and applications of distillation, fractional distillation, steam distillation of the crystallization and sublimation. To prepare desiccants and their classification of choice of desiccant in to the vaccum drying of the drying of solid and liquid. Chromatography of the Column, Paper, Thin layer, Gas and Ion Exchange chromatography – principles, method and applications				
To prepare the students with strong knowledge of Separation and Purification Techniques Solvent extraction technique of Soxhelt extraction and their principles and applications of distillation, fractional distillation, steam distillation of the crystallization and sublimation. To prepare the students with the strong knowledge of desiccants and their classification of choice of desiccant in to the vaccum drying of the drying of solid and liquid. Chromatography of the Column, Paper, Thin layer, Gas and Ion Exchange chromatography and their principles, method and applications					
Outcome 2	Students gain knowledge about Separation and Purification Techniques Solvent extraction technique of soxhelt extraction and their principles and applications of distillation, fractional distillation, steam distillation and crystallization and sublimation. Desiccants of their classification in the choice of desiccant of vaccum drying and drying of solid and liquid. Chromatography: Column, Paper, Thin layer, Gas and Ion Exchange chromatography their principles, method and applications.				K3

UNIT – III

Objective 3	To learn about the Fertilizer in their definition and fertilizer selection based on soil of testing in fertility index of Nitrogenous fertilizers in the effect of nitrogen on plant growth and development. Phosphate fertilizers in the effect of phosphorus on plant growth and development and super phosphate and Bone meals. Potassium fertilizers and their function of potassium on plant growth. Biofertilizers in the nitrogen fixing biofertilizer their application of rhizobium, azospirillum of the phosphate mobilizing biofertilizer of bacteria bacillus, pseudomonas, fungi of the aspergillus, pencillium, preparation of different fertilizer mixtures.
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To prepare the students with strong knowledge of Fertilizer in their definition and fertilizer selection based on soil of testing and development. Phosphate fertilizers in the effect of phosphorus on plant growth and development and super phosphate and Bone meals. Potassium fertilizers and their function of potassium on plant growth. Biofertilizers in the nitrogen fixing biofertilizer their application of rhizobium, azospirillum of the phosphate mobilizing biofertilizer of bacteria bacillus, pseudomonas, fungi of the aspergillus, pencillium, preparation of different fertilizer mixtures.

Outcome 3	Students gain knowledge about what are the Fertilizer in their definition and fertilizer selection based on soil of testing in fertility index of Nitrogenous fertilizers in the effect of nitrogen on plant growth and development. Phosphate fertilizers in the effect of phosphorus on plant growth and development and super phosphate and Bone meals. Potassium fertilizers and their function of potassium on plant growth. Biofertilizers in the nitrogen fixing biofertilizer their application of rhizobium, azospirillum of the phosphate mobilizing biofertilizer of bacteria bacillus, pseudomonas, fungi of the aspergillus, pencillium, preparation of different fertilizer	K4
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UNIT – IV

Objective 4	To learn about the Insecticides of the Nicotine, pyrethrum, and rotenone as insecticides. Inorganic pesticides of the Arsenical fluorides, borates. Organic pesticides of the organo chlorine compounds D.D.T, B.H.C, methoxychlor, chloredane, endosulfon. Organophosphorus compounds of the methylCarbamic acid derivatives and their carbaryl compound structure and mode of action. Fungicides of the compound of inorganic and Sulphur compounds of the Copper compounds in the Mercuric compounds Organic compound in the dithiocarbamates of Dithane M and Boredeaux mixture.
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To prepare the students with strong knowledge of the Nicotine, pyrethrum, and rotenone as insecticides. Inorganic pesticides of the Arsenical fluorides, borates. Organic pesticides of the organo chlorine compounds D.D.T, B.H.C, methoxychlor, chloredane, endosulfon. Organophosphorus compounds of the methylCarbamic acid derivatives and their carbaryl compound structure and mode of action. Fungicides of the compound of inorganic and Sulphur compounds of the Copper compounds in the Mercuric compounds Organic compound in the dithiocarbamates of Dithane M and Boredeaux mixture.

Outcome 4	Students gain knowledge about what are of the Nicotine, pyrethrum, and rotenone as insecticides. Inorganic pesticides of the Arsenical fluorides, borates. Organic pesticides of the organo chlorine compounds D.D.T, B.H.C, methoxychlor, chloredane, endosulfon. Organophosphorus compounds of the methylCarbamic acid derivatives and their carbaryl compound structure and mode of action. Fungicides of the compound of inorganic and Sulphur compounds of the Copper compounds in the Mercuric compounds Organic compound in the dithiocarbamates of Dithane M and Boredeaux mixture.	K2
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UNIT - V

Objective 5	<p>To learn about the what are the Dyes and their definition in Otto-Witt theory of colour and constitution and their classification of bathochromic shift and hypsochromic shift. Classification of dyes with examples according to structure and applications. Preparation and uses of following dyes some important dyes such as Methyl orange, phenolphthalein, indigo and alizarin.</p> <p>To learn about the clinical chemistry and the Composition of blood such as blood grouping how to determination of blood groups and matching definition of blood pressure type of hypertension how do determination. Determination of glucose in serum determine Nelson method and somogyi method. To learn about the estimation of glucose in urine for Benedict's test. Estimation of Haemoglobin how do Detection of diabetes and anemia.</p>
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To prepare the students with strong knowledge are the Dyes and their definition in Otto-Witt theory of colour and constitution and their classification of bathochromic shift and hypsochromic shift. Classification of dyes with examples according to structure and applications. Preparation and uses of following dyes some important dyes such as Methyl orange, phenolphthalein, indigo and alizarin. To prepare the clinical chemistry and the Composition of blood such as blood grouping how to determination of blood groups and matching definition of blood pressure type of hypertension how do determination. Determination of glucose in serum determine Nelson method and somogyi method. To learn about the estimation of glucose in urine for Benedict's test. Estimation of Haemoglobin how do Detection of diabetes and anemia.

Outcome 5	<p>Students gain knowledge about the Dyes and their definition in Otto-Witt theory of colour and constitution and their classification of bathochromic shift and hypsochromic shift. Classification of dyes with examples according to structure and applications. Preparation and uses of following dyes some important dyes such as Methyl orange, phenolphthalein, indigo and alizarin. To prepare the clinical chemistry and the Composition of blood such as blood grouping how to determination of blood groups and matching definition of blood pressure type of hypertension how do determination. Determination of glucose in serum determine Nelson method and somogyi method. To learn about the estimation of glucose in urine for Benedict's test. Estimation of Haemoglobin how do Detection of diabetes and anemia.</p>	K4
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Suggested Readings:-

- R.Gopalan, P.S.Subramanian and K.Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 1995.
- P.L. Soni – “Text Book of Organic Chemistry”, 26th Ed., (1994), S. Chand & Co, New Delhi.
- Arun Bahl and B.S. Bahl – “Text Book of Organic Chemistry”, 11th and 18th Ed., (2006), S.Chand, New Delhi.
- Text Book of Pharmaceutical Chemistry – Jeyashree Gosh – 2003, S.Chand and company, New Delhi
- Medicinal Chemistry – G.R.Chatwal, 2002, Himalaya Publishing House, New Delhi.
- Advanced Inorganic Chemistry – Sathyaprakash

Online resources<https://www.primaryinfo.com/matches.htm><https://periodictable.com/Stories/015.8/index.html><https://en.wikipedia.org/wiki/Dye><https://www.britannica.com/technology/dye><https://www.drsoilhealth.com/pesticides-inorganic/><https://byjus.com/question-answer/inorganic-pesticides-remain-active-on-the-surfaces-of-fruits-and-vegetables-for-several-days-after/>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)
CO5	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)
W.AV	2.8	2.6	2.8	2.8	2.8	2.6	2.8	2.6	2.6	2.8

S–Strong (3), M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	M(2)	M(2)	S(3)	S(3)
CO3	M(2)	S(3)	S(3)	S(3)	M(2)
CO4	M(2)	S(3)	S(3)	M(2)	S(3)
CO5	S(3)	M(2)	S(3)	M(2)	S(3)
W.AV	2.6	2.6	2.8	2.6	2.8

S–Strong (3), M-Medium(2),L-Low(1)

Allied	Course Code 9MBP2	ALLIED GENERAL CHEMISTRY PRACTICAL II-	P	Credit:2	Hours:2
S. No	Standard	Link	Estimation		
Acid – Base neutralization					
1	Sodium carbonate	Hydrochloric acid	Sodium hydroxide		
2	Oxalic acid	Sodium hydroxide	Oxalic acid		
3	Sodium carbonate	Hydrochloric acid	Sodium Carbonate		
Redox – Permanganometry					
4	Oxalic acid	Permanganate	Ferrous sulphate		
5	Ferrous ammonium sulphate	Permanganate	Ferrous sulphate		
6	Oxalic acid	Permanganate	Oxalic acid		
7	Ferrous ammonium sulphate	Permanganate	Oxalic acid		
Dichrometry					
8	Ferrous ammonium sulphate	Potassium dichromate	Ferrous sulphate		
Iodimetry					
9	Potassium dichromate	Sodium thiosulphate	Potassium dichromate		
10	Potassium dichromate	Sodium thiosulphate	Copper sulphate		
11	Potassium dichromate	Sodium thiosulphate	Permanganate		



III - SEMESTER					
Core	Course Code 548301	BIOLOGICAL OCEANOGRAPHY	T	Credits:3	Hours: 3
UNIT-I					
Objective 1	The main objective of this course is to make the students aware of the major life forms in the ocean, describes the characteristics that differentiate these life forms and how these forms interact with each other.				
Sea as biological environment - divisions of marine environment - pelagic- benthic - coastal - oceanic - zones. Marine diversity - plankton - nekton - benthos –classification - composition.					
Outcome 1	Students will be able to define the major life forms in the sea and describe the characteristics.				K2
UNIT – II					
Objective 2	To study the Phytoplankton and zooplankton and their interrelationship.				
Primary Productivity of the coastal Environment: Phytoplankton - Definition and classification; Methods of estimation of standing stock and biomass-factors affecting phytoplankton distribution in the sea; Phytoplankton blooms- Red Tide phenomena and causes; Harmful algal blooms-Phytoplankton succession Methods of estimation of Marine Primary Productivity; Factors affecting primary productivity. Regional difference in primary production in oceans. Primary Productivity in the Bay of Bengal and the Arabian Sea.					
Outcome 2	They will study the primary productivity and food web of marine environment.				K2
UNIT – III					
Objective 3	Primary and secondary productions methods of estimation of primary production.				
Secondary Productivity of the coastal Environment: Zooplankton- Definition and taxonomic classification; Horizontal and Vertical distribution of Zooplankton; Factors affecting the Zooplankton distribution; Concept of indicator species; Zooplankton as bio-indicators; Secondary Productivity: Methods of estimation of secondary production; Factors affecting secondary production, Regional difference in secondary production with special reference to the Bay of Bengal and the Arabian Sea. Zooplankton and fisheries.					
Outcome 3	Students will aware of seaweed culture techniques.				K4
UNIT – IV					
Objective 4	To explain how marine organisms, influence the cycling of bio elements, particularly carbon.				
Coastal Vegetation: Coastal vegetation: Intertidal, littoral and sublittoral. Seaweeds - Occurrence and distribution in India - economic importance. Life cycles of economic important seaweeds. Seagrasses - morphological and anatomical adaptations ecological role. Mangroves - distribution, adaptation, conservation and ecological role. Saltmarsh and sanddunevegetation- morphological, anatomical and physiological features, ecological role, uses and conservation.					
Outcome 4	They will able to explain how marine organisms influence cycling of bio elements and describe the prominent characteristics of the primary marine habitats.				K4
UNIT - V					
Objective 5	Conservation and management of coastal ecosystems.				
Animal association: Animal association in the marine environment – Endoecism –Inquilinism-Phoresis –Epizoism-MutualismCommensalism –Symbiosis- Parasitism.					
Outcome 5	The students will know about different type of animal associations.				K2

Suggested Readings:-

Chapman, V.J. and D.J. Chapman. (1980). *Seaweeds and Their Uses*. London: Chapman & Hall Ltd.
 Kinne, O. (2004). *Marine Ecology*. Comprehensive integrated treatise on life in oceans and coastal waters vol (1-5). New York: Wiley-Interscience.
 Lali, C., & Parsons, T. (1993). *Biological Oceanography: An Introduction (2nd ed)*. Butterworth Heineman Publications.
 Nybakken, J.W (2001). *Marine Biology– An Ecological Approach*. London: Addison Wesley Edu. Pub. Inc
 Sakhare, V., & Jadhav, H. (2017). *Plankton and Fisheries*. Discovery Publishing House Pvt. Ltd.

Online resources

<https://www.britannica.com/science/plankton>

<https://www.sciencedirect.com/science/article/abs/pii/S0304420377900263>

<https://www.degruyter.com/document/doi/10.1515/bot-2018-0056/html?lang=en>

<https://seawatersolutions.org/importance-of-coastal-vegetation/>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M(2)	L(1)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)
CO2	S(3)	M(2)	M (2)	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO5	L (1)	M(2)	M(2)	M(2)	S(3)	S(3)	S(3)	M (2)	S(3)	M(2)
W.AV	2.2	2.0	1.8	2.4	2.6	2.8	2.4	2.4	2.2	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M(2)	L(1)	M(2)	S(3)
CO2	S(3)	M(2)	M (2)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	S(3)	M(2)
CO4	M(2)	M(2)	M(2)	S(3)	M(2)
CO5	L (1)	M(2)	M(2)	M(2)	S(3)
W.AV	2.2	2.0	1.8	2.4	2.4

III - SEMESTER					
Core	Course Code 548302	INVERTEBRATES	T	Credits: 3	Hours: 3
UNIT-I					
Objective 1	To study the diversity of major invertebrate phylum				
Protozoa and Cnidaria : Classification – Morphology – Reproduction - life history and phylogenetic relationships of Protozoa and sponges. Coelenterate – polymorphism, life history, theories on coral reefs, distribution. Structure, Ecosystem & formation					
Outcome 1	Students will understand the diversity of major invertebrates.				K2
UNIT II					
Objective 2	To study the diversity of minor invertebrate phylum				
Minorphyla: Functional morphology, development and evolution: Nemertinea, Endoprocta, Ectoprocta, Phoronida and Pogonophora. Chaetognatha–classification, distribution, morphology ,anatomy, embryology and evolution. Brachiopoda- classification, morphology, palaeontology and evolution.					
Outcome 2	Students will understand the diversity of minor invertebrates				K2/K3
UNIT – III					
Objective 3	To study the basic fundamentals of the systems in invertebrates				
Crustacea and Polychaeta: Classification, comparative morphology, crustacean appendages, larval forms, evolution and palaeontology. Polychaete –m, classification, morphology, feeding methods - reproduction and adaptive radiation					
Outcome 3	The Students know the various systems of invertebrates				K2
UNIT – IV					
Objective 4	To understand the evolutionary significance of invertebrates				
Mollusca: Classification, general characters, torsion, palaeontology, phylogenetic relationships and adaptive radiation, reproduction and embryogeny.					
Outcome 4	Students will be exposed to a variety of invertebrate organisms and their evolutionary origin.				K3
UNIT - V					
Objective 5	To understand the reproductive biology of invertebrates.				
Echinodermata and Prochordata : Echinodermata – Classification, structure and function, water vascular system, larvae, regeneration, reproduction and larval forms. Prochordata – classification and comparative morphology, reproduction and early development, larval metamorphosis.					
Outcome 5	Student will know the basics of animal taxonomy.				K2
Suggested Readings:-					
Barnes, R.D. (1982). <i>Invertebrate Zoology (4th ed)</i> . Holt saunders International Edn. Barrington, E.J.W. (1979). <i>Invertebrate structure and function (2nd ed)</i> . ELBS & Nelson. Ekambaranatha Ayyar., & T.N. Ananthakrishnan. (1992) Manual of Zoology, Vol(1), part I & II, Chennai: S. Viswanathan Pvt. Ltd.					
Janakiraman, N., & PatchiRajan, G. (1992). “ <i>Biodiversity of Invertebrates</i> ”. Shri Shanmuga Lakshmi Nilayam, Annamalaiyar Street, Vivekanandhapuram North, Devakottai: Seetha Lakshmi Ganesan Publishers.					
Jordan, E.L., & Verma, P.S. (1982). <i>Invertebrate Zoology</i> . New Delhi: S.Chand & Co.					
Kotpal. R.L., Agarwal, K. S., & Khetarpal. R.P.R. (1989). <i>Modern text book of Zoology</i> . Rastogi Publications.					

Online resources

<https://www.dgs.udel.edu/delaware-geology/one-celled-organisms-phylum-protzoa>

<https://www.biotaxa.org/Zootaxa/article/view/zootaxa.1450.1.5>

<http://www.nhc.ed.ac.uk/index.php?page=24.25.312.316>

<https://www.gbif.org/dataset/a0eebab0-5c66-449f-a9b2-00dc5a83f356>

[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3AGeneral_Biology_\(Boundless\)/28%3A_Invertebrates/28.03%3A_Superphylum_Lophotrochozoa/28.3F%3A_Classification_of_Phylum_Mollusca#:~:text=Mollusks%20can%20be%20segregated%20into,types%20of%20shells%20they%20possess.](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3AGeneral_Biology_(Boundless)/28%3A_Invertebrates/28.03%3A_Superphylum_Lophotrochozoa/28.3F%3A_Classification_of_Phylum_Mollusca#:~:text=Mollusks%20can%20be%20segregated%20into,types%20of%20shells%20they%20possess.)

<https://www2.tulane.edu/~bfleury/diversity/labguide/echinchor.html>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	S(3)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)
CO5	S(3)	L(1)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)
W.AV	2.6	2.2	2.2	2.0	1.8	2.4	2.4	2.4	2.4	2.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	L(1)	M(2)
CO2	S(3)	M(2)	M(2)	M(2)	S(3)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	L(1)	S(3)	M(2)	M(2)	S(3)
W.AV	2.2	2.2	2.0	1.8	2.4

Core	Course Code: 548303	BIOLOGICAL OCEANOGRAPHY, INVERTEBRATES PRACTICAL - III	P	Credits: 3	Hours:6
BIOLOGICAL OCEANOGRAPHY					
1.	Identification of phytoplankton and zooplankton and larval forms.				
2.	Identification of marine algae, seaweeds, seagrasses and halophytes including mangrove plants				
3.	Determination of primary production using light and dark bottle techniques.				
4.	Identification of coastal invertebrates and vertebrates (Medusae, polychaetes, Molluscs,				
5.	Echinoderms, Brachiopod, Phoronids, Chaetognaths, Turtles and marine mammals).				
6.	Mounting - Radulae of gastropod-Mouthparts of Squilla and Balanus-Jaw and cartilage of gastropods-Dissection – Digestive and Nervous system of gastropods				
7.	Animal communities in different biotope-Mud flat-Sandy and rocky shore-Mangrove-Oyster bed				
INVERTEBRATES					
1.	Identification of locally available invertebrate fauna				
2.	Mounting of gastropod radula				
3.	Digestive system in gastropods and bivalves				
4.	Identification of sex in crustaceans and molluscs				
5.	Mouth parts of <i>Shrimp</i>				
6.	Appendages of prawns, shrimps and crabs				
7.	Study of digestive, nervous, reproductive systems and different ovarian maturity stages in Shrimp				

III – SEMESTER BOTANY					
Allied	Course Code 9MB3A2	PLANT DIVERSITY, PLANT PATHOLOGY AND ANATOMY THALLOPHYTA	T	Credits:3	Hours:3
UNIT-I					
Objective 1	To understand the characteristic features of algae and fungi				
Algae - General Characters, structure and life history of Cyanophyceae (<i>Oscillatoria</i>) and Rhodophyceae (<i>Polysiphonia</i>). Fungi - General Characters, Structure and Life history of Basidiomycetes (<i>Puccinia</i>). General Features, Structure and Life history of Lichens (<i>Usnea</i>).					
Outcome 1	Students will learn about algae and fungi			K2	
UNIT – II					
Objective 2	To study the bryophyta and plant diseases				
Bryophyta - General Characters, structure and life history of Moss(<i>Polytrichum</i>)- Development of Gametophyte, Sporophyte and sex organs need not be discussed. Plant Pathology - Study of the Following Plant Diseases with reference to causes, symptoms, dissemination, Control and preventive measures. 1. Virus Disease – Bunchy top of Banana 2. Bacterial Disease – Citrus Canker.					
Outcome 2	They will gain knowledge on bryophyta and different plant diseases			K3	
UNIT – III					
Objective 3	To understand the Pteriophyta				
Pteriophyta - General Characters, structure and Life history of <i>Selaginella</i> (Development of gametophyte, sporophyte and sex organs need not be discussed).					
Outcome 3	They will gain knowledge on Pteriophyta			K2	
UNIT – IV					
Objective 4	To study the Gymnosperms				
Gymnosperms - General Characters, structure and Life history of <i>Pinus</i> (Development of <i>Pinus</i> need not be discussed)					
Outcome 4	They will know Life history of <i>Pinus</i>			K3/K4	
UNIT - V					
Objective 5	To study the Simple and permanent tissues				
Anatomy- 1. Tissues – Simple and permanent tissues 2. Normal secondary thickening in dicot and monocot stem.					
Outcome 5	They will gain knowledge in Simple and permanent tissues			K3	
Suggested Readings:					
Pandey B.P.– College Botany, Vol.I & II S.Chand & Co., P.Ltd., Ram Nagar, New Delhi.					
Pandey, B.P. (1978) Plant Anatomy, S.Chand & Co., Calcutta					
Algae					
Vashista B.R – Algae, S.Chand&Co.Ltd., New Delhi.					
Bhatia, K.M. – A Treatise of Algae R.Chand& Co., New Delhi.					
Chopra G.D.A. Text Book of Algae – S.Nagin& New Delhi.					
Gupta G.S. – Text Book of Algae-Oxford & IBH Publishing C., New Delhi.					
Fungi					
Chopra G.L. – A text Book of Fungi – S.Nagin& Co., New Delhi.					
Munkur B.B. – Fungi & Plant diseases.					
Bryophyta					
Watson E.V. – The structure and Life of Bryophyta – Hutchinson, University Library, London.					
Parithar N.S. An Introduction to Bryophyta Vol. I Central Book Depot, Allahabad.					
Pathology					
Rengaswami G – Diseases of crop plant in India.					

Pteridophytes

Pandey B.P. – A text book of Botany (Bryophyta, Pteridophyta& Gymnosperms) – S.Chand& Co., New Delhi.

Parihar N.A. An Introduction of Pteridophyta Vol.II Central Book depot of Allahabad.

Gymnosperms

Gupta M.N. – The Gymnosperms- Shivalal Agarwala & Co., Agra.

Vashista P.C. – Botany for Degree Students – Gymnosperms–S.Chand& Co. New Delhi.

Internal Morphology (Anatomy)

Vashista, P.C. (1968) A Text Book of Plant Anatomy, S.Negin& Co.

Online resources

<https://www.biologydiscussion.com/algae/cyanophyceae-characteristics-occurrence-and-classification/46739>

<https://www.britannica.com/plant/bryophyte>

<https://www.britannica.com/science/plant-reproductive-system/Mosses>

https://courses.botany.wisc.edu/botany_401/lecture/03Lecture.html

<https://ucmp.berkeley.edu/glossary/gloss8/monocotdicot.html>

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)
CO2	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)
CO3	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	L(1)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	L (1)	M(2)	M(2)
W.AV	2.6	2.2	2.4	2.4	2.0	2.0	2.6	2.2	2.0	2.0

S–Strong (3), M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	M(2)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	M(2)	S(3)
CO4	S(3)	S(3)	M(2)	S(3)	M(2)
CO5	S(3)	S(3)	M(2)	S(3)	M(2)
W.AV	2.8	2.6	2.4	2.6	2.4

IV - SEMESTER					
Core	Course Code 548401	ECOLOGY AND ZOOGEOGRAPHY	T	Credits: 4	Hours: 4
UNIT-I					
Objective 1	To make students to understand the divisions of the marine environment and physico-chemical parameters and adaptations of living organisms.				
Classification of Marine Environment: Marine environment – Ecological Factors – Light, Temperature, Salinity, Pressure. Classification of Marine Environment–Pelagic Environment, Planktonic and Nektonic Adaptations, Benthic Environment – Intertidal, Interstitial and Deep – Sea Adaptation. Other Coastal Environments – Coral reefs, Estuaries, Mangroves, Seagrass Beds, Kelp Forests, Polar Seas and Hydrothermal vent. Marine Zoogeography: Barriers, Centre of dispersal, Bipolarity, Endemism, Island fauna.					
Outcome 1	They will know about classification of marine environment.				K2
UNIT – II					
Objective 2	To study the structure and function of marine ecosystems and their feeding relationship in the form of food chain and food web.				
Marine Ecosystem: Concept - Ecosystem Structure and Function- Functional attributes Food chain, Food – web, Ecological Pyramid, Energy Flow. Recycling of Nutrients. Systems Ecology and Modeling- System Structure, Feed-back, Loops and Types of Models, Characteristics and Behavior of a System. Ecosystem Services.					
Outcome 2	The students will learn and gain knowledge on the characteristics of community ecology and the adaptation of animals.				K2
UNIT – III					
Objective 3	To understand the structure, composition and adaptations of community ecology, besides studying the animal associations.				
Population Ecology: Group Attributes, Population Density Variation, Age Structure, Sex Ratio, Population Growth, Carrying Capacity, Dispersal, Density Dependent and Independent Factors. Prey – Predator Relationship, Intra Specific & Inter Specific competition.					
Outcome 3	Students will study the population ecology and prey-predator relationship.				K3
UNIT – IV					
Objective 4	To study the marine biodiversity and threats.				
Community Ecology: Structure Composition and Stratification, Diversity and Stability, Concept of Niche, Edge Effect – Abundance of Diversity, Resilience, Succession, Community-wise Adaptation (e.g. Fouling and Boring Community, Animal Association in the Sea).					
Outcome 4	Students will gain knowledge on animal association and their importance. Awareness on the marine biodiversity and its importance.				K3/ K4
UNIT - V					
Objective 5	To study the biodiversity assessment techniques (Quadrat and Line and Transect method)				
Marine biodiversity: Definition and Importance, Biodiversity Assessment Techniques, Threats to Marine Biodiversity, Over- Exploitation, Physical Alteration, Pollution, Alien Species. Bio-Security.					
Outcome 5	Students will gain knowledge on animal association and their importance, awareness on the marine biodiversity.				K4

Suggested Readings:-

Brown, M. (2010). *Ecology (1st ed.)*. Apple Academic Press Ltd.
 Fennel, W., & Neumann, P. (2015). *Introduction to the Modelling of Marine Ecosystems (2nd ed.)*. Elsevier International Inc.
 Kritzer, J., & Sale, P. (2006). *Marine Metapopulations*. Elsevier International Inc. Kumar, A., & Singh, L. (2006). *Advanced Ecology*. Daya Publishing House.
 Mackenzie, A., Ball, A., & Virdee, S. (2001). *Ecology (2nd ed.)*. Taylor & Francis Publishers.
 Nybakken, J.W. (2001). *Marine Biology – An ecological approach (4th ed.)*. US: Addison Wesley Edu. Pub.

Online resources

<https://www.sciencelearn.org.nz/resources/141-environmental-conditions-affecting-the-sea>
<https://www.britannica.com/science/marine-ecosystem>
<https://www.marinebio.org/conservation/marine-ecology/>
<https://www.britannica.com/science/community-ecology/The-process-of-succession>
<https://www.marinebio.org/conservation/marine-conservation-biology/biodiversity/>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)
CO2	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
CO5	S(3)	M(2)	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	M(2)
W.AV	2.8	2.0	1.8	2.2	2.4	2.2	2.4	2.6	2.4	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	S(3)	S(3)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	S(3)	M(2)
CO4	M(2)	S(3)	M(2)	S(3)	M(2)
CO5	S(3)	M(2)	L(1)	M(2)	M(2)
W.AV	2.2	2.4	2.2	2.4	2.0

Allied	Course Code: 9MB4P1	PLANT DIVERSITY, PLANT PATHOLOGY AND ANATOMY THALLOPHYTA	P	Credits:2	Hours:2
1.	Micro-Preparations and Identification of the Thallophyta prescribed in the Syllabus (<i>Algae-Oscillatoria, Polysiphonia: Fungi-Puccinia: Lichens-Usnea.</i>				
2.	Cutting and Mounting of T.S. of Vegetative parts of <i>Polytrichum, Selaginella</i> and <i>Pinus</i> .				
3.	Identification of Micro preparations of cones of <i>Selaginella, Pinus</i> and capsule of <i>Polytrichum</i> .				
4.	To observe and identify spots and make detailed study of the types of disease studied.				
5.	Cutting, Mounting and identifications of T.S. of dicot and monocot stem.				



IV - SEMESTER				
Core	Course Code 548402	VERTEBRATES	T	Credits: 4 Hours: 4
UNIT-I				
Objective 1	To study the diversity of vertebrate phylum.			
Origin of chordates: Geological time scale – progression of vertebrates through time, chordate features and theories on the origin of chordates.				
Outcome 1	Student will understand the diversity of major vertebrates.			K2
UNIT – II				
Objective 2	To study the phylogenetic relationships of different phyla			
Bony fishes and Amphibia: Characteristic features of ancestral vertebrates – classification and evolution of jawless and primitive vertebrates. Evolution and adaptive radiation of elasmobranchs and bonyfishes. Connecting link (Dipnoi). Origin and distribution of amphibia – anatomical peculiarities and affinities of Urodela and Apoda.				
Outcome 2	Student will understand the phylogenetic relationships of different phyla.			K2
UNIT – III				
Objective 3	To study the basic fundamentals of the systems in vertebrates.			
Origin of reptiles and birds – adaptive radiation of contemporary reptiles, turtles and reptilian features of <i>Seymouria</i> , mammal like reptiles, rise and fall of dinosaurs including mesozoic marine reptiles. Mosasaurs, the giant marine lizards. Marine Crocodile: Estuarine/Salt water crocodile, Sea snakes. Marine birds, adaptations and migration.				
Outcome 3	The learner will know the various systems of vertebrates.			K2
UNIT – IV				
Objective 4	To understand the evolutionary significance of vertebrates.			
Evolution of Mammals: General characters of mammals – classification and evolution of monotremes, marsupials and placentals, human evolution, aquatic mammals – classification, adaptations and evolution of Cetacea and Sirenia. Seals, Walruses and Sea otters. Aquatic adaptations for respiratory and circulatory mechanisms – comparative anatomy of skin derivatives.				
Outcome 4	Student will be exposed to a variety of vertebrate organisms and explains their evolutionary origin.			K3/ K4
UNIT - V				
Objective 5	To understand the reproductive biology of vertebrates.			
Developmental Biology of vertebrates: Fish development – Cleavage – Germ layer formation - Axis formation – Neurulation - Sex determination.				
Outcome 5	Student will know the basics of animal taxonomy.			K4
Suggested Readings:-				
Goran E. Nilsson. (2010). <i>Respiratory physiology of vertebrates</i> . Cambridge University Press.				
Stephan, A. Milk. (2012). <i>Zoology</i> . UK: McGraw– Hill Education.				

Online resources

<https://www.iaszoology.com/chordate-origin/>

[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_\(Boundless\)/29%3A_Vertebrates/29.01%3A_Chordates/29.1D%3A_Characteristics_of_Vertebrates](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/29%3A_Vertebrates/29.01%3A_Chordates/29.1D%3A_Characteristics_of_Vertebrates)

<https://evolution.berkeley.edu/what-are-evograms/the-origin-of-birds/>

<https://www.britannica.com/animal/mammal/Evolution-and-classification>

https://bio.libretexts.org/Courses/University_of_Arkansas_Little_Rock/BIOL3400_Developmental_Biology/04%3A_Vertebrate_development

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

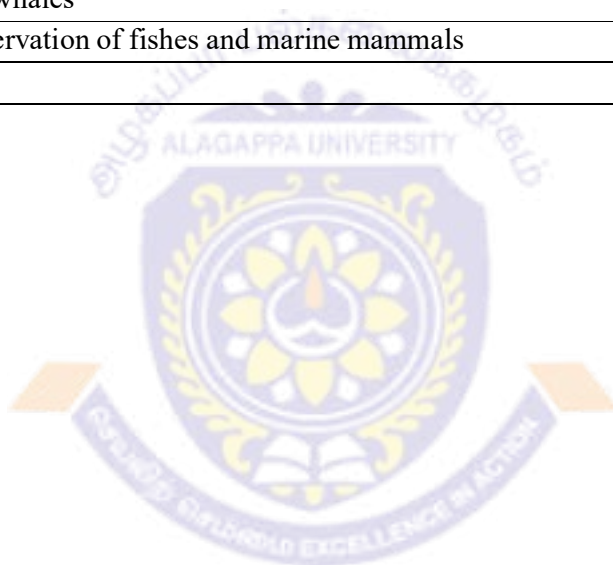
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	M(2)	M(2)
W.AV	2.8	2.4	2.4	2.4	2.6	2.2	2.2	2.4	2.0	1.8

S-Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	S(3)	M(2)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	L(1)	S(3)	S(3)	M(2)	M(2)
CO5	M(2)	M(2)	S(3)	M(2)	M(2)
W.AV	2.4	2.6	2.6	2.2	2.0

Core	Course Code 548403	ECOLOGY AND ZOOGEOGRAPHY, VERTEBRATE PRACTICAL – IV	P	Credits: 3	Hours: 3
ECOLOGY AND ZOOGEOGRAPHY					
1.	Rocky Shore Fauna				
2.	Sandy Shore Fauna.				
3.	Seagrass – Macrofauna&Meiofauna				
4.	Mangrove associated Macrofauna&Meiofauna				
5.	Estimation of Population density in an Ecosystem.				
VERTEBRATE					
1.	Bony fishes				
2.	Study of important vertebrates specimen representing phylum Pisces to Mammalia				
3.	Early embryonic developmental stages of fish - Larval stages				
4.	Mounting of scales of fishes.				
5.	Baleen plates of whales				
6.	Osteological observation of fishes and marine mammals				
7.	Marine turtles				



IV - SEMESTER BOTANY					
Allied	Course Code 9MB4A2	TAXONOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND EMBRYOLOGY OF ANGIOSPERMS	T	Credits: 3	Hours:3
UNIT-I					
Objective 1	To understand the Taxonomy of Angiosperms				
Taxonomy of Angiosperms – Aim and significance of Taxonomy, Herbarium techniques, Outline of Bentham and Hooker of classification.					
Outcome 1	Student will learn about Taxonomy of Angiosperms, Herbarium techniques, Bentham and Hooker of classification				K2
UNIT – II					
Objective 2	To study the different families Angiosperms				
Families – Annonaceae, Rutaceae, Asclepiadaceae, Euphorbiaceae, Poaceae					
Outcome 2	They will gain knowledge on different families Angiosperms				K3
UNIT – III					
Objective 3	To understand economic potential				
Economic Botany- Cereals – Paddy & Ragi, Pulses – Green Gram & Soybean, Fruits – Pomegranate & Mango, Beverages – Coffee & Cocoa, Fibres – Jute & Cotton Essential Oils – Sandalwood & Olive Oil					
Outcome 3	Student will know about the various economic potential				K4
UNIT – IV					
Objective 4	To understand the embryology of Angiosperms				
Embryology of Angiosperms – Structure of an angiosperm, Different types of Ovules, Structure and development of embryo sac (<i>Polygonum</i> type)					
Outcome 4	Student will understand the embryology of Angiosperms				K2
UNIT – V					
Objective 5	To know the Fertilization				
Fertilization – double fertilization, syngamy – significance, Different types of endosperms (Nuclear, cellular, helobial), Structure and development of dicot (<i>Capsella</i>) and monocot embryo (<i>Lazula</i>).					
Outcome 5	Student will know about the various economic potential embryology of Angiosperms				K4
<p>Reference and Text Books:</p> <p>Vasishtha, P.C. Taxonomy of Angiosperms, R.Chand and Co., New Delhi.</p> <p>Kochar, S.L. – Economic Botany, TATA McGraw Hill Publishing Co., Ltd., New Delhi.</p> <p>Bhojwani, S.S. and Bhatnagar S.P. – The embryology of Angiosperms, Vikas Publishing House P.Ltd., New Delhi.</p> <p>Lawrence G.H.M. Taxonomy of Vascular plants Macmillan, New York.</p> <p>Mathur R.C. Systematic Botany Angiosperms, Agra Book Store, Agra.</p>					

Gupta, R.K. A Text Book of Systematic Botany, Atma Ram & Sons, Delhi
 Street, H.E. Essay in Plant Taxonomy, AP London & New York.
 Stace, C.A. The Plant Taxonomy and Biosystematics. Edward Arnold, London.

Online resources

<https://link.springer.com/book/10.1007/978-3-642-69302-1>
<http://www.homeoint.org/morrell/misc/angio.htm>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10311147/>
<https://digitalcommons.unl.edu/bioscisystematics/9/>
<https://byjus.com/neet/important-notes-of-biology-for-neet-plant-taxonomy/>
<https://pubmed.ncbi.nlm.nih.gov/11163162/>

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)
CO5	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
W.AV	2.8	2.6	2.6	2.8	2.8	2.6	2.8	2.6	2.6	2.8

S–Strong (3), M-Medium(2), L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	M(2)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	S(3)	S(3)	M(2)
CO5	S(3)	S(3)	M(2)	S(3)	M(2)
W.AV	2.8	2.6	2.6	2.8	2.6

Allied	Course Code: 9MB4P2	PRACTICAL - IIB - TAXONOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND EMBRYOLOGY OF ANGIOSPERMS	P	Credits:2	Hours:2
1.	Identification of Micro preparations of Dicot and monocot stem				
2.	To assign the given plants specimen to the respective families giving reasons.				
3.	To describe the given plant in technical terms				
4.	To identify the economic products specified in the syllabus pointing out the Botanical Names and their uses.				
5.	Identification of Micro preparations of Anther (<i>Datura</i>), Dicot Embryo (<i>Tridax</i>), different ovules				



V - SEMESTER				
Core	Course Code 548501	CELL AND MOLECULAR BIOLOGY	T	Credits: 4 Hours: 4
UNIT-I				
Objective 1	To know the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles			
Microscopy – Principle and Working mechanism of Compound Electron microscopes – SEM, TEM Cytological techniques Fixatives and fixation techniques. Stains and staining techniques. Comparison of Prokaryotic and eukaryotic cells. Ultrastructure and functions of 1. Mesosome 2. Plasma Membrane 3. Golgi complex and Endoplasmic Reticulum.				
Outcome 1	Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.			K2
UNIT – II				
Objective 2	To understand how cellular components are used to generate and utilize energy in cells.			
Mitochondria (glycolysis, Krebs's cycle, electron transport system, energy generation summary) Ultrastructure & functions of Ribosomes and Lysosomes. Ultrastructure and functions of Nucleus and nucleolus. Chromosomes: Structure & types and Giant Chromosomes.				
Outcome 2	Students will understand how cellular components are used to generate and utilize energy in cells.			K3
UNIT – III				
Objective 3	To study Cellular level: cell cycle and cell division.			
Cell division- Mitosis, Meiosis & their significance. Cancer-Types, properties, causes, treatment and Oncogenes and tumour suppressor genes.				
Outcome 3	Students will know Cellular level: cell cycle and cell division.			K2
UNIT – IV				
Objective 4	To study the interrelationship between nucleic acids.			
DNA – Watson and Crick model of DNA, Replication. DNA as the Genetic material (Transformation, Transduction & Conjugation Experiments) RNA – types and structure Bacteriophage.				
Outcome 4	Student will learn the interrelationship between nucleic acids			K4
UNIT - V				
Objective 5	This paper will emphasize on the molecular mechanisms of DNA replication, repair, protein synthesis, etc.			
Genetic Code – Characters Protein Synthesis – Central dogma, Transcription & Translation. Gene regulation – Lac - Operon model, Types of regulation.				
Outcome 5	The learner will understand the molecular mechanisms of DNA replication, repair, protein synthesis, etc.			K4
Suggested Readings:-				
Karp, G. (2013). <i>Cell Biology</i> : John Wiley & Sons Inc.				
PrakashLohar, (2019). <i>Cell and Molecular Biology</i> , Chennai: MJP Publishers.				

Online resources

<https://www.britannica.com/science/primary-productivity>

<https://biokimicroki.com/microscope-principle-parts-and-application/>

<https://pubmed.ncbi.nlm.nih.gov/36286449/>

<https://bioprinciples.biosci.gatech.edu/module-4-genes-and-genomes/4-1-cell-division-mitosis-and-meiosis/>

<https://thesciencenotes.com/watson-and-crick-double-helix-model-of-dna/>

<https://humanbiology.pressbooks.tru.ca/chapter/5-6-protein-synthesis/>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	M (2)	S(3)	M(2)	M(2)
CO2	M(2)	S(3)	M(2)	M (2)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO5	M(2)	S(3)	M(2)	M(2)	S(3)	M (2)	L (1)	S(3)	S(3)	M(2)
W.AV	2.4	2.6	2.0	1.8	2.4	2.4	2.2	2.8	2.2	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M (2)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	M(2)	M (2)
CO3	M(2)	S(3)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	M(2)	M(2)
CO5	M (2)	L (1)	S(3)	M(2)	M(2)
W.AV	2.4	2.2	2.6	2.0	1.8

V - SEMESTER						
Core	Course Code 548502	DEVELOPMENTAL BIOLOGY		T	Credits: 4	Hours: 4
UNIT-I						
Objective 1	To know the process of gametogenesis.					
Gametogenesis – Spermatogenesis and Oogenesis. Fertilization, cleavage and gastrulation.						
Outcome 1	Student will understand the formation of embryo and earlier development.				K2	
UNIT – II						
Objective 2	To know the process of fertilization.					
Development of Eye, Ear, Brain and Heart in frog. Extra embryonic membranes in chick, Placentation						
Outcome 2	Student will know the process of gametogenesis				K3	
UNIT – III						
Objective 3	To understand how hormone influences the development of animals.					
Organizer concept Amphibian metamorphosis – Biochemical changes and hormonal control, Regeneration types.						
Outcome 3	Student will know the process of fertilization.				K4	
UNIT – IV						
Objective 4	To understand the process of regeneration.					
Hormonal control of Amphibian metamorphosis. Extra-embryonic membranes in chick– Development, Types and Physiology. Placenta in mammals.						
Outcome 4	Student will understand how hormonal influences the development				K2	
UNIT - V						
Objective 5	To know the importance of nuclear transplantation.					
Nuclear Transplantation in acetabularia - regeneration – types – regeneration in Amphibians – regeneration in planaria.						
Outcome 5	The learner will know the importance of nuclear transplantation.				K4	
Suggested Readings:-						
Arumugam, N. (1998). <i>Developmental Biology</i> . Saras Publications.						
Balinsky, B.I. (1981). <i>An Introduction to Embryology</i> , Philadelphia: W.B Saunders Company.						
Banerjee, S. (1981). <i>Development Biology</i> . New Delhi: Dominant Publishers.						
Beril, N.J. (1986). <i>Developmental Biology</i> . New Delhi: Tata McGraw- Hill Publishing Ltd. Berry, A.K. (2007). <i>An Introduction to Embryology</i> . New Delhi: Emkay Publications.						
Browder, L.N. (1980). <i>Developmental Biology</i> . Philadelphia: Saunders College.						
Deuchar, E.M.(1976). <i>Cellular Interaction in Animal Development</i> . London: Chapman and Hall. Veer BalaRastogi. (2010). <i>Developmental Biology</i> . Meerut: KedarnathRamnathPublishers.						
Online resources						
https://ib.bioninja.com.au/higher-level/topic-11-animal-physiology/114-sexual-reproduction/gametogenesis.html						
https://www.toppr.com/guides/biology/structural-organisation-in-animals/frogs/						
https://www.ncbi.nlm.nih.gov/books/NBK10101/						
https://www.ncbi.nlm.nih.gov/books/NBK9986/#:~:text=Hormonal%20control%20of%20amphibian%20metamorphosis,fed%20powdered%20sheep%20thyroid%20gland.						
https://www.biologydiscussion.com/articles/transplantation-of-cell-nuclei-and-experiment-with-acetabularia/4413						
K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create	

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	M (2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)
CO2	M(2)	S(3)	S(3)	S(3)	M(2)	M (2)	M(2)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	S(3)	L (1)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M (2)
W.AV	2.4	2.6	2.2	2.4	2.0	1.8	2.2	2.4	2.4	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	L(1)	M (2)	M(2)	M(2)
CO2	M(2)	M (2)	S(3)	S(3)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	S(3)	M(2)
CO5	M(2)	M(2)	L (1)	M(2)	S(3)
W.AV	2.0	1.8	2.2	2.4	2.2

V - SEMESTER				
Core	Course Code 548503	FISH AND FISHERIES	T	Credits: 4 Hours: 4
UNIT-I				
Objective 1	The main objective of this course is to make students aware of fisheries resources, their biology and management.			
Introduction: General morphology and outline classification of fishes-major group of fishes of the world and their characteristics-Identification of fishes of Indian waters.				
Outcome 1	Students able to classify the fishes.			K2
UNIT – II				
Objective 2	To understand the fishery biology and growth rate parameters.			
Fisheries Biology: Basic anatomy of fish digestive, respiratory, nervous and reproductive system, Food and feeding habits- Age and growth –Length weight relationship-Maturity and fecundity-Reproduction –Embryonic, larval development and juvenile stages of fin fishes and shell fishes. Migration of fishes-Biotic and abiotic factors affecting spawning in fishes.				
Outcome 2	They obtain knowledge on the techniques of identifying fishes.			K2
UNIT – III				
Objective 3	To study concepts and principles of fisheries management.			
Population Dynamics: Theory of fishing-Unit Stock-Mortality-Fish tagging and marking-Methods of surveying the fishery resources-Acoustic methods – Aerial Methods-Survey of fish eggs and larvae, population analysis.				
Outcome 3	Students observed management practices of nursery and stocking ponds.			K4
UNIT – IV				
Objective 4	To impart the students about the different fishing technologies and alternative livelihood options.			
Study of microbial diseases: Methods of isolation –culture-Identification of pathogens and disease control. Microbial quality: changes during processing and storage. Spoilage of seafood-microbial spoilage, spoilage of fresh and processed seafood - factors affecting spoilage, chemical indices of microbial spoilage, Histamine producers, tetrodotoxin, brevetoxin, ciguatera, aflatoxins. Seafood borne human pathogens – bacteria, fungi and viruses. Defects in fish processing technology.				
Outcome 4	They will study different type of microbial diseases			K4
UNIT - V				
Objective 5	To understand the basic knowledge of conservation management of protected areas.			
Conservation and Management Principles of conservation and management – Fisheries administration. Protection preservation and impoundment of resources-Fishery regulation-Organization involved in fisheries conservation.				
Outcome 5	They have sound knowledge on the conservation and management of marine fishery.			K4
Suggested Readings:-				
Agarwal, S. C. (2006). <i>History of Indian Fishery</i> . Daya Publishing House. Aravind, N. S. (2013). <i>Fish and Fisheries</i> . Discovery Publishing House Pvt. Ltd.				
Desai, R. K. (2009). <i>Fish Management and Aquatic Environment</i> . A.K. Publications. Harnell, J. (1995). <i>Marine Fish Farming for India</i> . Asiatic Publishing House.				
Nelson, J. A. (1992). <i>Fishes of the world</i> . John Wiley & Sons, Inc.				
Yadav, B. (1997). <i>Fish & Fisheries</i> . Daya Publishing House.				

Online resources

<https://www.fao.org/3/cc0461en/online/sofia/2022/status-of-fishery-resources.html>

<https://www.britannica.com/animal/fish/Annotated-classification>

<https://trackwellfims.com/fisheries-management-systems/>

<https://agriculturistmusa.com/fishing-technology/>

<https://vikaspedia.in/aspirational-districts/uttar-pradesh/sonbhadra/best-practices/biofloc-fish-farming-an-innovative-sustainable-livelihoods-practice>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	M(2)	L(1)	S(3)	M(2)	M(2)	M (2)	M(2)
CO2	M(2)	S(3)	S(3)	M(2)	M (2)	S(3)	M(2)	S(3)	S(3)	M(2)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)
CO4	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO5	S(3)	S(3)	M(2)	M(2)	M(2)	M (2)	S(3)	S(3)	L (1)	M(2)
W.AV	2.4	2.6	2.4	2.0	1.8	2.4	2.2	2.4	2.2	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M (2)	M(2)	S(3)
CO2	M(2)	S(3)	S(3)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	M (2)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	L (1)	M(2)	M(2)
W.AV	2.2	2.4	2.2	2.0	2.2

V - SEMESTER				
Core	Course Code 548504	COASTAL AND BRACKISH WATER AQUACULTURE	T	Credits: 4 Hours: 4
UNIT-I				
Objective 1	The main objective of this course is to make students aware of the need for aquaculture, farm design and construction, nursery and hatchery management.			
Introduction: Importance of Coastal aquaculture-Natural Stock-Over fishing-Depletion -Present status-Potentialities and socio-economic problems of aquaculture.				
Outcome 1	Students were able to identify the potentials and socio-economic issues of aquaculture.			K2
UNIT – II				
Objective 2	To know the current status of aquaculture and socio-economic problems.			
Farm design and structure: Site selection-Technical consideration- Topography-Soil Characteristics - water supply- Pond type – Dyke -Inlet, outlet - Structures, type and Design of supply and drainage canals - Farm design, construction, operation and maintenance- Open sea forming: cages, pens - Raft - Raceways practices.				
Outcome 2	They will gain knowledge about selection of suitable site for fish farm, design and construction.			K2
UNIT – III				
Objective 3	To study the disease management system of nursery and pond.			
Farm Management: Pond management, nursery management-stocking, feeding schedules, water quality management-control of predators, parasites and disease management – Harvesting-Economics of farming. Seaweed culture-Types of culture-Economic importance of seaweeds.				
Outcome 3	Students will get knowledge about site selection for aquaculture pond, design and construction of pond.			K3
UNIT – IV				
Objective 4	Learn about brood stock rearing, induced breeding, hatchery production of fin and shell fish seeds and larval rearing.			
Hatchery Management: An over view of Crustaceans, Fin fishes and Molluscans culture: Present status- Hatchery production: Collection and maintenance of brood stock-induced breeding-mass production of seeds- Types and components of hatchery.				
Outcome 4	Students will gain knowledge about site selection for hatchery.			K4
UNIT - V				
Objective 5	Aware about aquaculture extension, role of government and non-governmental organization in fisheries and aquaculture extension activities.			
Feed Formulation - Fisheries extension - Principles and approaches- extension methods- Role of Fisheries extension -Fish Farmers - Development Agency-Brackish Water fish Farmers Development Agency (FFDA & BFFDA) and Non- Governmental Agencies in fisheries development.				
Outcome 5	Students accomplish knowledge about water quality, stocking, feed and disease management in aquaculture.			K3
Suggested Readings:-				
Boyd, C., & Tucker, C. (1998). <i>Pond Aquaculture: Water Quality Management</i> . Springer International Publishing.				
Coche, A. G., & Muir, J. F. (1992). <i>Pond Construction</i> . Daya Publishing House.				
Dash, M. C., & Patnaik, P. N. (1994). <i>Brackish Water Prawn Culture</i> . Palani Paramount Publications.				
Gupta, S., Mohapatra, B., & Routray, P. (2008). <i>Textbook of Breeding and Hatchery Management of Carps</i> . Narendra Publishing House.				
Kannupandi, T., Soundarapandiyan, P., & Anantharaman, P. (2002). <i>Hatchery manual for Penaeus monodon fabricus</i> . ENVIS Centre, CAS in Marine Biology, Annamalai University.				
Thomas, P. C., Rath, S., & Mohapatra, K. D. (2013). <i>Breeding and Seed Production of Finfish and Shellfish</i> . Daya Publishing House.				

Online resources

<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=45552>

<https://www.fishfarming.com/services/fish-farm-design-construction.html>

<https://www.slideshare.net/narasimharsha/nursery-pond-management-of-fishes>

<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=86156>

http://www.agritech.tnau.ac.in/expert_system/poultry/Incubation%20and%20Hatching.html

<https://www.fao.org/3/n9317e/n9317e01.htm>

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	L(1)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	M (2)
CO3	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	L (1)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	M (2)	M(2)	M(2)
W.AV	2.2	2.2	2.4	2.4	2.6	2.8	2.4	2.4	2.0	1.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	S(3)	S(3)	M(2)
CO2	S(3)	M(2)	S(3)	S(3)	S(3)
CO3	M(2)	S(3)	M(2)	S(3)	M(2)
CO4	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	S(3)	S(3)	S(3)
W.AV	2.4	2.4	2.6	2.8	2.4

Core	Sub Code: 548505	CELL AND MOLECULAR BIOLOGY, DEVELOPMENTAL BIOLOGY PRACTICAL – V	P	Credits: 4	Hours: 6
CELL AND MOLECULAR BIOLOGY					
1.	Principle, working mechanism and care of compound microscope.				
2.	Mounting of Mitotic stages in the onion root tip.				
3.	Mounting of Meiotic stages from the testis of grasshopper.				
4.	Mounting of Giant Chromosomes in Chironomous larva.				
5.	Mounting of Squamous epithelial cells from the oral mucosa.				
6.	Observation of blood cells in man.				
7.	Isolation of DNA from haemolymph and animal tissue.				
8.	Plasmid DNA isolation.				
9.	Isolation of RNA.				
DEVELOPMENTAL BIOLOGY					
1.	Observation of eggs – Chick				
2.	Cleavage, Blastula, Gastrula stages of Frog				
3.	Whole mounting of Chick blastoderm				
4.	Slides – 18, 24, 33, 48 & 72 hours chick embryo.				
5.	Placenta of Mammals – Pig, sheep, Man & Rabbit				



Core	Course Code: 548506	FISH AND FISHERIES COASTAL AND BRACKISH WATER AQUACULTURE PRACTICAL – VI	P	Credits: 4	Hours: 6
FISH AND FISHERIES					
1.	Identification of commercially important fin and shell fishes and study of their morphology and classification.				
2.	Study of food and feeding habits of fishes.				
3.	Observation of fish maturation cycle, larval and juveniles and adult development.				
4.	Identification of fish parasites.				
5.	Collection of eggs and larvae-collection methods.				
6.	Preparation of media-Microbial population enumeration				
COASTAL AND BRACKISH WATER AQUACULTURE					
1.	Characters of soils, Water Potentials and Water quality				
2.	Technique of induced breeding and rearing techniques of prawn, mollusks, fish etc.				
3.	Identification of locally available seaweeds.				
4.	Fields visits to aquaculture farms – mariculture – seaweed culture.				



VI – SEMESTER					
Core	Course Code 548601	MARINE BIODIVERSITY AND CONSERVATION	T	Credits: 6	Hours:6
UNIT – I					
Objective 1	To protect and restore marine and estuarine ecosystems. Control of invasive species, mitigate dry land salinity, Promote ecologically sustainable grazing				
Introduction - Marine Biodiversity - Importance - levels of biodiversity - biodiversity indices. Definition of extinction of marine bio-resources - rate of extinction – causes of extinction - island / intertidal biogeography - vulnerability to extinction.					
Outcome1	Students will gain knowledge on scientific information and knowledge regarding the status of marine biodiversity, various values associated with it and the necessity for its conservation.				K2
UNIT – II					
Objective 2	To study the marine protected areas.				
Conservation - essential concepts for small populations - problems of small population - applied population biology - establishment of new populations - ex-situ conservation strategies - conservation categories of species - legal protection of species.					
Outcome2	They will gain knowledge on marine biosphere reserve area and its importance.				K2
UNIT – III					
Objective 3	To educate National and international organizations involving the fisheries management.				
Marine protected areas - designing of protected areas - managing protected areas - restoration ecology.					
Outcome3	Students will gain national and international approaches to conservation and sustainable development.				K2/ K3
UNIT – IV					
Objective 4					
Impediments to marine biodiversity conservation - insufficient scientific information inadequate transfer of information - cultural and biological diversity - differing benefits and costs harming aquatic life - jurisdictional gaps and overlaps - use of marine environment - immunity from public scrutiny - fragmented decision making.					
Outcome4	Students will learn about improve scientific knowledge and access to information.				K4
UNIT – V					
Objective 5	To minimize impacts of climate change on biodiversity, Maintain and record indigenous peoples' ethnobiological knowledge, Improve scientific knowledge and access to information.				
Conservation and sustainable development - traditional societies - Government action local legislation - national laws - National Biodiversity Act and National Biodiversity Authority. International approaches to conservation and sustainable development – On going problems - possible responses - role of conservation biologists.					
Outcome5	Students will promote conservation of marine biodiversity and its sustainable use.				K4

Suggested Readings:-

Dasman, R.F. (1984). *Environmental Conservation (5th ed)*. John Wiley & Sons Inc.

Heywood, V., & Watson, R. (1995). *Global Biodiversity Assessment*. Cambridge University Press.

Kannaiyan, S., & Venkatraman, K. (2011). *Marine Biodiversity in India*. Associated Publishing Company

Kumar, S. (2009). *Biodiversity, Environment and Sustainable Management (1st ed)*. A. K. Publications.

Laladhas, K., Nilayangode, P., & Oommen, O. (2017). *Biodiversity for Sustainable Development*. Springer International Publishing.

Online resources

<https://www.marinebio.org/conservation/marine-conservation-biology/biodiversity/>

https://oceans-and-fisheries.ec.europa.eu/ocean/marine-biodiversity/marine-biodiversity-objectives_en

<https://www.drishtiias.com/daily-updates/daily-news-analysis/marine-protected-areas-2>

<https://www.bmu.de/en/topics/water-resources-waste/marine-environment/marine-conservation-what-is-it-all-about>

https://en.wikipedia.org/wiki/Marine_ecosystem

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	L(1)	M(2)	S(3)	M(2)	S(3)	L(1)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	S(3)
CO4	M(2)	S(3)	M(2)	L(1)	S(3)	S(3)	L(1)	M(2)	L(1)	M(2)
CO5	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	L(1)
W.AV	2.4	2.8	2.2	2.2	2.6	2.4	2.4	1.6	2.4	2.4

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	S(3)	M(2)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	M(2)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	M(2)	L(1)
CO5	M(2)	S(3)	M(2)	S(3)	S(3)
W.AV	2.6	2.4	2.6	2.4	2.4

S –Strong (3), M-Medium (2), L- Low (1)

VI – SEMESTER					
Core	Course Code 548602	COASTAL ZONE MANAGEMENT	T	Credits: 6	Hours:6
UNIT –I					
Objective 1	The paper deals with coastal zone management.				
Definition and Concept: Introduction to Coastal Zone: Environment status of the coastal and marine ecosystems: Estuaries, mangroves, coral reef, lagoon, and wetland-Major threats to coastal ecosystem-Scientific expeditions for ascertaining the wealth of the sea-Five major Oceans and their relative importance-law of the sea-UNESCO, UNEP, IMO, regional seas programme- Antarctic expedition convention					
Outcome1	Students will gain knowledge on balancing environmental, economic and human activities relating to coastal zone management.			K2	
UNIT – II					
Objective 2	To provide knowledge about the protected areas and importance.				
Protected Area Management: Marine biosphere reserves, marine park, biosphere reserve and Sanctuaries- Categories background and basic concepts and applications-strict nature-reserve, national park, natural monument-Habitat/species management areas-Protected landscape/seascape-managed resource protected area-Coastal ecosystem-use of Coastal resources-Conservation issue and problems-Species of conservation concern – Recommendation and management practices for future action.					
Outcome2	Students will gain knowledge on protected area management.			K3	
UNIT – III					
Objective 3	To provide basic knowledge of natural hazards, global warming and climatic changes.				
Natural Hazards and mitigation: Natural hazards, volcanoes, tides, tsunamis, cyclones, storm, Global warming and sea level rise, erosion, emergence and submergence and sub-emergence of coastline-Mitigation. Monitoring strategies of marine pollution: Mitigation - Global warming and Climate change. Role of international and national organizations and role of NGO.					
Outcome3	Students will gain national and international approaches to conservation and sustainable development.			K2	
UNIT – IV					
Objective 4	To provide knowledge on coastal protection structures.				
Coastal Protection Structures: Bio shields and their impact on coasts, beach stability, ocean and sea beach nourishment; interaction of waves with structures like seawalls, groins, breakwaters, revetments and replantation. Implementation of CRZ regulation and their Protection					
Outcome4	Students will gain knowledge on natural hazards			K2	
UNIT – V					
Objective 5	To know the roles of various national and international organization regarding coastal zone management.				
Managerial organization: Role of national and international agencies and organizations in ocean management. UNESCO, FAO, IMCO, UNEP, UNDP, NIOT, NIO, MOEFs and CPCB,MPEDA.					
Outcome5	Students will learn the role of international and national organizations.			K4	

Suggested Readings:-

Finkl, C. (2013). *Coastal Hazards*. Springer Publications
 Lein, J. (2003). *Integrated Environment Planning*. Blackwell Science Ltd
 Platzoder, R. (1995). *The 1994 United Nations Convention on the Law of the Sea*. Martinus Nijhoff/Rahman, M.H. (2016). *International Law of the Sea*. Atlantic Publishers and Distributors Pvt. Ltd.
 Trives, T., & Pineschi, L. (1997). *The Law of the Sea*. Martinus Nijhoff Publications.
 Valiela, I. (2006). *Global Coastal Change*. Blackwell Science Ltd.

Online resources

<https://www.jagranjosh.com/general-knowledge/coastal-zone-management-purpose-objective-and-challenges-1510572939-1>
<https://www.eea.europa.eu/publications/92-826-5409-5/page035new.html>
<https://unacademy.com/content/mppsc/study-material/geography/marine-protected-areas-in-india/>
https://www.academia.edu/47676064/Land_ocean_interactions_in_the_coastal_zone_science_plan
<https://earsc-portal.eu/display/EOwiki/Monitor+coastal+ecosystem>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)
CO3	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)	S(3)	S(3)
CO4	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	L(1)	M(2)	L(1)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)
W.AV	2.6	2.6	2.4	2.4	2.4	2.4	2.2	1.8	2.4	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	S(3)	M(2)
CO2	S(3)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	S(3)	S(3)
CO5	M(2)	S(3)	M(2)	M(2)	M(2)
W.AV	2.6	2.2	2.4	2.6	2.2

S –Strong (3), M-Medium (2), L- Low (1)

VI – SEMESTER					
Core	Course Code 548603	MARICULTURE	T	Credits: 6	Hours: 6
UNIT – I					
Objective 1	The objectives of mariculture are the production of protein rich, nutritive, Palatable and easily digestible human food benefiting the whole society through plentiful food supplies at low or reasonable cost				
Importance of Coastal aquaculture-Natural Stock-Over fishing-Depletion-Present status-Potentialities and socio economic problems of aquaculture. History, development and present status of mariculture in India and other countries -importance of mariculture.					
Outcome1	They will get sound knowledge on selection of species for successful mariculture.			K2	
UNIT – II					
Objective 2	To get knowledge from site selection-Technical consideration of aquaculture pond.				
Site selection-Technical consideration-Topography-soil Characteristics - water supply Pond type: Dyke: Inlet, outlet, -Structures, type and design of supply and drainage canals-Farm design, construction, operation and maintenance-Open sea farming: cages, pens - Raft - Raceways practices. Site selection and types of Materials used for open sea farming-Design and construction of open sea farming structures and cages.					
Outcome2	They will have advanced ideas about open sea cage culture and recent trends.			K2/ K3	
UNIT – III					
Objective 3	Providing new species and strengthening stocks of existing fish in natural and man-made water-bodies through artificial recruitment and transplantation.				
An over view of Crustaceans, Fin fishes and Molluscs culture: Present status Hatchery production: Collection and maintenance of brood stock-induced breeding mass production of seeds-Types and components of hatchery. Pond management, nursery management-stocking, feeding schedules, water quality management-control of predators, parasites and disease management-harvesting					
Outcome3	They will get knowledge about fin fish and shell fish culture.			K4	
UNIT – IV					
Objective 4	To get knowledge about the Production of sport fish and support to recreational fishing.				
Selection of cultivable species for mariculture, their biology and culture practices of Chanoschanos, Latescalcarifer, Rachycentron canadum, Mugil cephalus, Epinephelus tautavina and Etroplus suratensis. - Molluscs: Mussel, Crustaceans: Lobster.					
Outcome4	They will gain knowledge about site selection, pond management and disease management.			K4	
UNIT – V					
Objective 5	To know about cage culture and its importance.				
Engineering aspects of open sea cages – care and maintenance of open sea cages – various Indian and international companies and institutes involved in construction of open sea cages. Economics of farming. Seaweed culture-Types of culture-Economic importance of seaweeds. Economics of open sea farming - Recent development and future perspective of open sea farming					
Outcome5	Student will study the advanced hatchery management system.			K4	

Suggested Readings:-

Boyd, C., & Tucker, C. (1998). Pond Aquaculture: Water Quality Management. Springer International Publishing.

Coche, A. G., & Muir, J. F. (1992). Pond Construction. Daya Publishing House.

Dash, M. C., & Patnaik, P. N. (1994). Brackish Water Prawn Culture. Palani Paramount Publications.

Gupta, S., Mohapatra, B., & Routray, P. (2008). Textbook of Breeding and Hatchery Management of Carps. Narendra Publishing House.

Sinha, P. (2011). Fish Processing and Preservation. APHA Publishing Corporation.

Thomas, P. C., Rath, S., & Mohapatra, K. D. (2013). Breeding and Seed Production of Finfish and Shellfish. Daya Publishing House

Online resources

<https://www.jagranjosh.com/general-knowledge/coastal-zone-management-purpose-objective-and-challenges-1510572939-1>

<https://www.eea.europa.eu/publications/92-826-5409-5/page035new.html>

<https://unacademy.com/content/mppsc/study-material/geography/marine-protected-areas-in-india/>

https://www.academia.edu/47676064/Land_ocean_interactions_in_the_coastal_zone_science_plan

<https://earsc-portal.eu/display/EOWiki/Monitor+coastal+ecosystem>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome vs Programme Outcome

s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S (3)	M (2)	M (2)	S (3)	M(2)	S(3))	M (2)	M (2)	M (2)
CO2	S(3)	S(3)	M (2)	S(3)	S(3)	M(2)	S(3)	S(3)	M (2)	M(2)
CO3	S(3)	M (2)	L (1)	S (3)	M (2)	M (2)	S(3)	M (2)	S (3)	S(3)
CO4	M (2)	L (1)	M (2)	L (1)	M (2)	S (3)	S(3)	M (2)	S(3)	M (2)
CO5	S(3)	M(2)	M(2)	S(3)	M (2)	S(3)	M(2)	S(3)	M (2)	M (2)
W.AV	2.6	2.2	1.8	2.4	2.4	2.4	2.6	2.4	2.4	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M (2)	M (2)	S (3)	M(2)
CO2	S(3)	M (2)	S(3)	S(3)	M(2)
CO3	S (3)	L (1)	S (3)	M (2)	M (2)
CO4	L (1)	M (2)	L (1)	S(3)	S(3)
CO5	S(3)	M(2)	S(3)	M (2)	M (2)
W.AV	2.4	1.8	2.4	2.6	2.2

S –Strong (3), M-Medium (2), L- Low (1)

VI – SEMESTER					
Core	Course Code 548604	AQUARIUM KEEPING	T	Credits: 6	Hours: 6
UNIT – I					
Objective 1	The objectives of this study is to review the main infrastructure subsystems and operational procedures in aquarium keeping.				
Introduction to aquarium – types of aquarium – importance of aquarium -Introduction to ornamental aquatic organisms – identification of ornamental fishes – crustaceans - molluscs - ornamental aquatic plants. Status of ornamental fish culture and trade – world and Indian scenario					
Outcome1	Students will be able to gain knowledge about aquarium preparation and maintenance.			K2	
UNIT – II					
Objective 2	To get sound knowledge about how on aquarium systems can also be applied in research laboratories of academic institutions if live organisms have to be kept for experimentation.				
Design and construction aquarium – methods and materials used – setting up of freshwater and marine aquarium - filters and medias used in aquariums – pumps and other equipments – light and its types					
Outcome2	They gain knowledge about disease maintenances of aquarium.			K3	
UNIT – III					
Objective 3	To study and gain knowledge about disease maintenances of aquarium.				
Care and maintenance of aquarium - criteria for selection of ornamental fishes -water quality management and methods – probiotics – fish food and its type					
Outcome3	Students will understand breeding behavior of aquarium fishes.			K3	
UNIT – IV					
Objective 4	To know aquarium missions on research, conservation and education.				
Diseases of ornamental aquarium fishes - bacterial and fungal diseases – control measures and treatment					
Outcome4	They will know about aquarium missions on research, conservation and education.			K4	
UNIT – V					
Objective 5	To study the brood stock management.				
Brood stock management – breeding of ornamental fishes - Ornamental fish farm and hatchery – design and construction – packaging and transport – economics					
Outcome5	Students gain the knowledge about brood stock management. Question: Compare, Determine, given, short notes, Evaluate, Explain, Interpret, Justify, Measure.			K4	
Suggested Readings:-					
Boyd, C., &Tucker, C. (1998). Pond Aquaculture: Water Quality Management. Springer International Publishing.					
Coche, A. G., &Muir, J. F. (1992). Pond Construction. Daya Publishing House.					
Dash, M. C.,&Patnaik, P. N. (1994). Brackish Water Prawn Culture. Palani Paramount Publications.					
Gupta, S., Mohapatra, B., &Routray, P. (2008). Textbook of Breeding and Hatchery Management of Carps. Narendra Publishing House.					
Thomas, P. C., Rath, S.,&Mohapatra, K. D. (2013). Breeding and Seed Production of Finfish and Shellfish. Daya Publishing House					

Online resources

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<https://unacademy.com/content/mppsc/study-material/geography/marine-protected-areas-in-india/>
https://www.academia.edu/47676064/Land_ocean_interactions_in_the_coastal_zone_science_plan
<https://earsc-portal.eu/display/EOWiki/Monitor+coastal+ecosystem>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S (3)	M (2)	M (2)	M (2)	M(2)	M (2)	M (2)	M (2)	S (3)
CO2	S(3)	S(3)	M (2)	M (2)	M(2)	M(2)	M (2)	S(3)	S(3)	S(3)
CO3	S(3)	M (2)	L (1)	S (3)	S(3)	M (2)	L (1)	M (2)	S (3)	M (2)
CO4	M (2)	L (1)	M (2)	S(3)	M (2)	S (3)	M (2)	M (2)	L (1)	M (2)
CO5	S(3)	M(2)	M(2)	M (2)	M (2)	S(3)	M(2)	S(3)	S(3)	M (2)
W.AV	2.6	2.2	1.8	2.4	2.2	2.4	1.8	2.4	2.4	2.4

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M (2)	M (2)	M(2)	M (2)
CO2	M (2)	M (2)	M(2)	M(2)	M (2)
CO3	L (1)	S (3)	S(3)	M (2)	L (1)
CO4	M (2)	S(3)	M (2)	S (3)	M (2)
CO5	M(2)	M (2)	M (2)	S(3)	M(2)
W.AV	1.8	2.4	2.2	2.4	1.8

S –Strong (3), M-Medium (2), L- Low (1)

VI – SEMESTER					
Core	Course Code 548606	COASTAL DISASTER MANAGEMENT	T	Credits: 6	Hours: 6
UNIT –I					
Objective 1	This course is intended to develop the basic understanding of the natural disaster - understanding of the basic concepts in coastal disaster management and its mitigations.				
Definition –Hazards as natural process - Benefits and importance of disasters Naturedisaster- creeping disaster- creeping disaster- Death and Damage - Evaluating hazards - Human response to hazards.					
Outcome1	The students will gain knowledge on various types of disasters and the challengesposed by disasters.			K2	
UNIT – II					
Objective 2	To know the major threats to the coastal ecosystem.				
Major threats to coastal ecosystem- Habitat loss- Landslides -Sea level change, Degradation of water quality, Fisheries resource depletion, Earthquakes, Tsunami, Volcanic activity, Coastal flooding, Cyclones, Erosion, Sea water intrusion, Cause and preventive measures - Hazards Relief and management					
Outcome2	The students will be able to understand the impacts of disasters and riskmanagement strategies.			K3	
UNIT – III					
Objective 3	To understand the disaster mitigation,				
Disaster mitigation, actions to reduce risks, the menu of mitigation actions,classification of mitigation measures, Environmental hazards, typology, assessment and response, the strategies, the scale of disaster, vulnerability, disaster trends.					
Outcome3	They will get knowledge about major threats to the coastal ecosystem.			K4	
UNIT – IV					
Objective 4	To provide the basic knowledge of geohazards effects.				
Nature, humanity and development, disruption of development by disasters, loss of resources, interruption of programs, impact on investment and climate, impact on non- formal sector, socio-political destabilization, development as causes of disaster, fundamentals of disaster, causal factor of disasters, characteristics of particular hazards in disaster.					
Outcome4	Students will gain knowledge on the conservation and management of coastalecosystem.			K3	
UNIT – V					
Objective 5	To study about the long-term disasters - climate change and sea level rise and manmade disasters like nuclear, epidemic and air pollution.				
Geohazards, international decade for natural disaster reduction, problems of financingand insurance, tends in climatology, meteorology and hydrology, trends in seismic activities, training of emergency management personnel.					
Outcome5	Students will learn the basic knowledge of geohazards – effects- training ofemergency management personnel.			K4	

Suggested Readings:-

- Harsh K Gupta. (2013). *Disaster Management*. Universities Press (India) Pvt. Ltd. Pp. 185.
- Haruyama, S & Sugai, T. (2016). *Natural Disaster and Coastal Geomorphology*. Springer. Pp. 165.
- Miguel Esteban, Hiroshi Takagi.,& Tomoya Shibayama. (2015). *Handbook of Coastal Disaster Mitigation for Engineers and Planners*. Butterworth-Heinemann. Pp.788.
- Pranam Dhar. (2011). *Disaster Management and Preventions*. LAP Lambert Academic Publication.
- Sinha, P. C. (1998). *Encyclopaedia of Disaster Management (Vol. 1- 4)*. Anmol Publications Pvt. Ltd.
- Vidyanathan, S. (2011). *An Introduction to Disaster Management*. IKON Books. Pp. 401

Online resources

- https://www.coastalwiki.org/wiki/Threats_to_the_coastal_zone
- <https://www.samhsa.gov/find-help/disaster-distress-helpline/disaster-types>
- <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/dsstr-prvntn-mtgn/bt-dsstr-mtgn-en.aspx>
- https://www.academia.edu/47676064/Land_ocean_interactions_in_the_coastal_zone_science_plan
- <https://earscc-portal.eu/display/EOwiki/Monitor+coastal+ecosystem>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	M (2)	M (2)	S (3)	M(2)	S (3)	M (2)	M (2)	M (2)
CO2	M(2)	S(3)	M(2)	M (2)	M (2)	M(2)	M (2)	S(3)	S(3)	M(2)
CO3	M(2)	M (2)	M (2)	M(2)	M (2)	M (2)	M (2)	M (2)	M (2)	S(3)
CO4	M (2)	M(2)	M (2)	M (2)	M (2)	S (3)	M(2)	S(3)	M (2)	M (2)
CO5	S(3)	M(2)	S(3)	M (2)	M (2)	M (2)	M(2)	M(2)	M(2)	M (2)
W.AV	2.2	2.4	2.2	2.0	2.2	2.2	2.2	2.4	2.2	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	S (3)	M (2)	M(2)	S(3)
CO2	M (2)	M (2)	M(2)	M(2)	S(3)
CO3	M(2)	M (2)	M (2)	M(2)	M (2)
CO4	M (2)	M (2)	M (2)	M (2)	M(2)
CO5	M (2)	M (2)	S(3)	S(3)	M(2)
W.AV	2.0	2.2	2.2	2.2	2.4

S –Strong (3), M-Medium (2), L- Low (1)

VI – SEMESTER					
Core	Course Code 548607	MARINE POLLUTION	T	Credits: 6	Hours: 6
UNIT – I					
Objective 1	To provide students with an understanding of the sources, links and biological effects of major classes of pollutants in the marine environment.				
Marine pollution-definition - role of GESAMP - major pollutant - sources -transport path - dynamics. Toxicology – Lethal and Sub-lethal effects of pollutants to marine organisms bioconcentration, bioaccumulation and biomagnification, methods of toxicity testing, factors influencing toxicity, synergistic and antagonistic effects, role of microcosms & mesocosms					
Outcome1	This course helps the students to prepare for their careers in academic programs and research centers.			K2	
UNIT – II					
Objective 2	To make students aware of how to protect the ocean from marine pollution and also to know policies and government laws of National and International level.				
Sewage pollution - industrial - agricultural - domestic - impact on marine environment - treatment methods. Detergents - composition – interference with eutrophication - ecological impact. Marine debris - plastics - litter - impact in the marine environment					
Outcome2	It provides the basic knowledge of marine pollution and causes of pollution.			K3	
UNIT – III					
Objective 3	To understand the sewage pollution and treatment process.				
Heavy metal pollution - sources - distribution - fate - analytical approaches. Pesticide pollution - classification - sources - distribution - fate and ecological impacts with special reference to marine fishes, birds and mammals.					
Outcome3	Students will study the heavy metal pollution and sources of pollution.			K3	
UNIT – IV					
Objective 4	To provide the basic knowledge of geohazards effects.				
Oil Pollution - composition - sources - biological impacts on fishes, birds and mammals - treatment techniques - bioremediation. Ballast water and bioinvasion. Aquatic noise. Thermal pollution - sources - uses of waste heat. Role of biocides - chlorine - ecological impacts. Radioactive pollution - sources -natural - artificial- biological effects of radiation.					
Outcome4	Students will study the heavy oil pollution and sources of pollution.			K2	
UNIT – V					
Objective 5	To study the heavy metal pollution and their effects of marine and coastal Waters				
Environmental monitoring methods - critical pollutants - objectives, status, limitations and biological indicators – bioaccumulation – bioconcentration -biomaganification - biotransformation - Mussel watch - water quality assessment. Use of analytical instruments - AAS - ICP – GC					
Outcome5	To Understanding of causes, consequences and methods of assessment of marine pollution.			K4	
Suggested Readings:-					
Chhatwal, G. (1997). Encyclopaedia of Environmental, Soil and Marine Pollution (1 st ed). Annol Publications Pvt. Ltd.					
Clark, R.B. (1992). Marine pollution (3 rd ed). Clarendon Press Oxford.					
Diwan, A., &Arora, D. (1995). Marine Pollution (1 st ed). Annol Publications Pvt. Ltd.					

Hammer, M. J. (2006). Water and Wastewater Technologies. Prentice Hall of India Pvt.Ltd.
 Swarup, R. (1992). Encyclopaedia of Ecology, Environment and Pollution Control. Mittal Publications.
 Thompson, M., Sarojini, R.,&Nagabushanam, R. (1988). Marine Bio deterioration. Oxford & IBH Publishing Co. Pvt. Ltd.

Online resources

https://www.coastalwiki.org/wiki/Threats_to_the_coastal_zone
<https://www.samhsa.gov/find-help/disaster-distress-helpline/disaster-types>
<https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/dsstr-prvntn-mtgn/bt-dsstr-mtgn-en.aspx>

Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	M (2)	M (2)	S (3)	M(2)	S (3)	M (2)	M (2)	M (2)
CO2	M(2)	S(3)	M(2)	M (2)	M (2)	M(2)	M (2)	S(3)	S(3)	M(2)
CO3	M(2)	M (2)	M (2)	M(2)	M (2)	M (2)	M (2)	M (2)	M (2)	S(3)
CO4	M (2)	M(2)	M (2)	M (2)	M (2)	S (3)	M(2)	S(3)	M (2)	M (2)
CO5	S(3)	M(2)	S(3)	M (2)	M (2)	M (2)	M(2)	M(2)	M(2)	M (2)
W.AV	2.2	2.4	2.2	2.0	2.2	2.2	2.2	2.4	2.2	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	S (3)	M (2)	M(2)	S(3)
CO2	M (2)	M (2)	M(2)	M(2)	S(3)
CO3	M(2)	M (2)	M (2)	M(2)	M (2)
CO4	M (2)	M (2)	M (2)	M (2)	M(2)
CO5	M (2)	M (2)	S(3)	S(3)	M(2)
W.AV	2.0	2.2	2.2	2.2	2.4

S –Strong (3), M-Medium (2), L- Low (1)

VI – SEMESTER					
Core	Course Code 548608	MARINE RESOURCES	T	Credits: 6	Hours: 6
UNIT – I					
Objective 1	To gain knowledge on marine resources.				
Non-living resources- Ocean resources in coast, shelf, slope and abyssal - Distribution of various kinds particularly in India ocean- Their forms, grade and potentiality- Coastal aquifer its nature, form, migration - Integrated resource management-Preservation and conservation of non-living resources including water-Renewable & non-renewable resources. Resources originated - terrigenous, chemogenous, biogenous, allogenic and antigenic.					
Outcome1	Students will get an idea on fisheries resource management and EEZ			K2	
UNIT – II					
Objective 2	To provide the basic knowledge of marine mineral resources and its importance.				
Marine minerals - Potential in east and west coasts of India-Mineral resources - Mineral enrichment in the Black sea-Marine phosphorites-Placer minerals-Marine sulfides- Manganese nodules and crusts-Methods in the exploration of seafloor minerals deposits- Methods of exploration in manganese nodules, phosphorite and polymetallic sulfides-Sea baulk (non-living resources)					
Outcome2	The students will get awareness about drugs from the marine based organisms.			K2	
Unit – III					
Objective 3	To provide the basic knowledge of fishery resource management				
Fishery resources management and deep-sea fishery potential - Resource potential - Resource estimates-Fish resources of Indian EEZ-Reasons for decline in fish production-Profitable vessel management and requirement - Exploitation of marine fisheries resources and exports-Export management. Living resources – Captures - Sardines, Mackerels, Bombay Duck and Prawn fisheries - Principle methods of exploitation of sea fishes - Indigenous and modern Crafts and Gears.					
Outcome 3	Students will get an idea about biological diversity, fish and seafood supplies.			K3	
Unit – IV					
Objective 4	To get an idea about biological diversity, fish and seafood supplies, oil and gas, minerals, sand and gravel, renewable energy resources, tourism potential, and unique ecosystems like coral reefs.				
Drugs - Marine drugs – Importance – Sources-Carbohydrate and derivatives-Nitrogenous Compounds -Antibiotic compound from marine animals - Bioactive compound – Sources-Natural function -Ecological and distribution in the marine environment.					
Outcome4	They will gain knowledge on oil and gas, minerals, sand gravel, renewable energy resources.			K2	
Unit – V					
Objective 5	To study the marine drugs and importance, toxins from marine animals.				
Toxin from marine animals - Type of toxins- Functional properties – toxin-Venoms- Venom in marine animals - sea snake, fish and mollusks -Pharmacological and toxicological properties-Marine steroids - Types- Marine carotenoids- Sterols of marine invertebrate.					

Outcome5	Students will know about the Tourism potential, and unique ecosystems like coral reefs.	K4
Suggested Readings:- Gautam, A. (1998). <i>Conservation & Management of Aquatic Resources</i> . Daya Publishing House. Madhu, M., Jakhar, P.,& Adhikary, P. (2013). <i>Natural Resource Conservation</i> . Satish Serial Publishing House. Singh, R. (2013). <i>Fishery Resources</i> . Pearl Books Publishing. Teleki, P., Dobson,& M., Moore, R. (1987). <i>Marine Minerals</i> . Reidel Publishing Company. Thompson, M., Sarojini, R.,& Nagabushanam, R. (1991). <i>Bioactive Compounds from Marine Organisms</i> . Yadav, B. N. (1997). <i>Fish & Fisheries</i> . Daya Publishing House.		
Online resources https://www.studyiq.com/articles/major-ocean-relief-features/ https://extension.psu.edu/renewable-and-nonrenewable-resources https://worldoceanreview.com/en/wor-1/energy/marine-minerals/ https://medcraveonline.com/JAMB/indian-deep-sea-fisheries---its-prospects-issues-and-challenges.html		

Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	M (2)	M (2)	S (3)	M(2)	S (3)	M (2)	M (2)	M (2)
CO2	S(3)	S(3)	S(3)	M (2)	M (2)	M(2)	M (2)	M (2)	S(3)	M(2)
CO3	S(3)	M (2)	M (2)	S (3)	M (2)	M (2)	M (2)	M (2)	M (2)	S(3)
CO4	M (2)	S(3)	M (2)	M (2)	M (2)	S (3)	L (1)	M (2)	M (2)	M (2)
CO5	S(3)	M(2)	S(3)	M (2)	M (2)	M (2)	M(2)	M(2)	S(3)	M (2)
W.AV	2.6	2.6	2.4	2.2	2.2	2.2	2.0	2.0	2.4	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S (3)
CO2	M (2)	S(3)	M(2)	M (2)	S(3)
CO3	S(3)	M (2)	M (2)	S (3)	M (2)
CO4	M (2)	M(2)	M (2)	S(3)	M (2)
CO5	S(3)	M(2)	S(3)	M (2)	S(3)
W.AV	2.6	2.4	2.4	2.6	2.6

S –Strong (3), M-Medium (2), L- Low (1)

VII - SEMESTER				
Core	Course Code: 548701	ANIMALPHYSIOLOGY	T	Credits: 5 Hours: 5
UNIT -I				
Objective: 1	To know the process of physiology of animals			
Introduction to Physiology: - Definition-division of physiology- Relationship of physiology with other science-significance of the study. Digestive system: - Nutritional value, Digestion, absorption, energy balance, gastrointestinal enzymes. Respiratory system :- Respiratory pigments, transport, and exchange of respiratory gases waste elimination. Blood :- Blood Corpuscles, plasma function, blood volume and regulation, blood groups, hemoglobin.				
Outcome 1	Student will learn the process of physiology of animals			K2
UNIT -II				
Objective 2	To know various systems of an organism			
Cardiovascular System: -Comparative anatomy of heart structure, myogenic heart, ECG – its principle and significance, heartbeat and cardiac cycle, blood pressure. Excretory system: - kidney, structure, and function of nephron, urine formation, urine concentration, waste elimination, regulation of water balance, electrolyte balance, acid-base balance.				
Outcome 2	Student will learn various systems of an organism			K2
UNIT- III				
Objective 3	To understand the physiology of hibernation and aestivation			
Muscle contraction:- General structure and types of muscles. Ultrastructure of skeletal muscle. Mechanism of muscle contraction. Chemical changes during muscle contraction. Nervous system: - Neurons, nature of nerve impulse – resting potential and action potential, neuro transmitters central and peripheral nervous system, the structure of the synapse, mechanism of synaptic transmission – electrical and chemical transmissions. Sensory organs:- Vision, hearing, and tactile response.				
Outcome 3	Student will understand the physiology of hibernation and aestivation			K3
UNIT-IV				
Objective 4	To understand the functions of the endocrine functions			
Homeostatic Mechanisms: - Thermoregulation in poikilotherms and homeotherms- Tolerance to high temperature, cold and freezing - Physiology of hibernation and aestivation. Osmotic and ionic regulation, Hormonal control of osmoregulation: Adaptation to pressure: High altitude- buoyancy.				
Outcome 4	Student will learn the endocrine functions			K4
UNIT-V				
Objective 5	To know the importance of biological clock			
Endocrinology and reproduction: Endocrine glands, the basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation. Animal behaviour:- Biological clock – endogenous rhythm – the circadian rhythm – circannual and Lunar periodicity.				
Outcome 5	The learner will know the importance of biological clock			K4
Suggested Readings:- Williams S, Hoar. (1966). General and Comparative Physiology. New Delhi: Prentice Hall of India. Rastogi, S.T. (1988). Essentials of Animal Physiology. Madras: Wiley, Eastern Limited. Schmidt Nielson, K. (2002). Animal Physiology – Adaptation and Environment. Cambridge: Cambridge Press. Verma, P. S, Tyagi, B.S & Agarwal, U.V. (2005). Animal Physiology. New Delhi: S. Chand & Company Ltd. Richard W. Hill., Gorden A. Wyse., Anderson, M. (2008). Animal Physiology (2nd ed.). Sinauer Associates, Inc. Richard W. Hill., Gorden A. Wyse., Anderson, M. (2012). Animal Physiology (3rd ed.). Sinauer Associates, Inc. Linda S. Costanzo. (2017). Physiology (6th ed.). Elsevier.				

Online resources

<https://www.physoc.org/explore-physiology/what-is-physiology/>

<https://www.medicalnewstoday.com/articles/cardiovascular-system>

<https://www.visiblebody.com/learn/muscular/muscle-contractions>

[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3AGeneral_Biology_\(Boundless\)/33%3A_The_Animal_Body-_Basic_Form_and_Function/33.11%3A_Homeostasis_-_Homeostatic_Process#:~:text=Adjustment%20of%20physiological%20systems%20within,in%20the%20environment%20is%20changing.](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3AGeneral_Biology_(Boundless)/33%3A_The_Animal_Body-_Basic_Form_and_Function/33.11%3A_Homeostasis_-_Homeostatic_Process#:~:text=Adjustment%20of%20physiological%20systems%20within,in%20the%20environment%20is%20changing.)

<https://www.webmd.com/a-to-z-guides/what-is-a-reproductive-endocrinologist>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	M(2)	S (3)	S (3)
CO2	S (3)	S (3)	M (2)	M (2)	M (2)	S (3)	M (2)	S (3)	M (2)	M (2)
CO3	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)
CO4	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	3	3	2.2	2.8	2.6	3	2.4	2.8	2.8	2.6

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	M (2)	M(2)
CO2	M (2)	M (2)	S (3)	M (2)	S (3)
CO3	S (3)	M (2)	S (3)	M (2)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	2.8	2.6	3	2.4	2.8

S–Strong(3),M-Medium(2),L-Low(1)

VII- SEMESTER					
Core	Course Code: 548702	BIOCHEMISTRY	T	Credits: 5	Hours: 5
UNIT- I					
Objective 1	To know various biomacromolecules in an organism				
Bio - Macromolecules as an energy source – Handerson and Hasselbalch equation – Acidbasemaintenanceandtheirsignificance.Chemicalbondsandtheirsignificance. Thermodynamics – laws and theirsignificance.					
Outcome 1	Student will learn various biomacromolecules in an organism			K2	
UNIT-II					
Objective 2	To study the biomolecules structure and their classification				
Carbohydrates- classification, structure, properties and biological importance of Monosaccharides, Disaccharides and Polysaccharides					
Outcome 2	Student will learn the structure of biomolecules and their classification			K4	
UNIT-III					
Objective 3	To understand the various metabolic pathways				
Proteins- Classification and function of Proteins, structural levels of organization. Denaturation and isoelectric point of Proteins. Amino acids: Classification of amino acids, essential amino acids, reactions of amino and carboxyl groups of amino acids.					
Outcome 3	The learner will understand the various metabolic			K3	
UNIT-IV					
Objective 4	To understand the biochemical functions				
Lipids- Classification and properties of lipids. Types of fatty acids – saturated, unsaturated and essential fatty acids. Significance of lipoproteins and phospholipids. Structure, synthesis and biological significance of cholesterol, HDL and LDL.					
Outcome 4	Student will understand the biochemical functions			K3	
UNIT-V					
Objective 5	To know the importance of laboratory practice				
Metabolic pathways and Fermentations: Glycolytic pathway, Pentose phosphate pathway (HMP), Tricarboxylic acid cycle, Electron transport chain, CytC. Substrate level and oxidative phosphorylation, inhibitors and un-couplers of electron transport chain and function of ATPase (bacterial and mitochondrial), Fermentation- Lactic acid fermentation, Amino acid catabolism- Urea Cycle Deamination and transamination reactions. de novo biosynthesis of purines and pyrimidines, Ribonucleotidereductase and its role in nucleic acid metabolism,					
Outcome 5	The learner will know the importance of good laboratory practice			K4	
Suggested Readings:- Donald Voet.,& Judith G. Voet. (2004). Biochemistry (3rded). USA: John Wiley and Sons. Jeremy, M. Berg., John, L. Tymoczke., and LubertStryer. (2007). Biochemistry (5thed), USA: W.H. Freeman and Company.					

Lehninger. (2006). Principles of Biochemistry (4th ed), D.L. Nelson and M.M. Cox: Macmillan worth Publishers.
 Murray, R.K., Granner, D.K., & Rodwell, V.M. (2006). Harpers Illustrated Biochemistry (28th ed). The McGraw-Hill companies Inc.
 Thomas, M. Devlin. (2006). Textbook of Biochemistry with Clinical Correlations (6th ed): John Wiley & Sons Inc.
 Trevor Palmer. (2004). Enzymes- Biochemistry, Biotechnology and Clinical Chemistry. India: Affiliated East – West Press Pvt. Ltd.

Online resources

<https://www.marinebio.org/oceans/ocean-chemistry/>

<https://www.britannica.com/science/seawater>

<https://www.britannica.com/science/chemical-element/Composition-of-seawater>

<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=86524>

<https://www.britannica.com/science/seawater/Dissolved-organic-substances>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Cr
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M(2)
CO2	M(2)	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S(3)	S (3)
CO3	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S(3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV	2.4	2.8	3	3	3	2.8	2.6	3	2.8	2.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M(2)	S (3)	S (3)	M(2)
CO2	S (3)	M(2)	S(3)	S(3)	M(2)
CO3	S (3)	M(2)	S(3)	S(3)	M(2)
CO4	M (2)	S (3)	S(3)	S(3)	S (3)
CO5	M (2)	S (3)	S (3)	S (3)	S (3)
W.AV	2.6	2.4	3	3	2.4

S–Strong(3),M-Medium(2),L-Low(1)

VII - SEMESTER					
Core	Course Code: 548703	IMMUNOLOGY	T	Credits: 4	Hours: 4
UNIT -I					
Objective: 1	To know the history of immunology				
History and scope of Immunology-Immunity-Types of Immunity-Innate and acquired, Passive and Active- Lymphoid organs - Primary and secondary lymphoid organs - Thymus, Bone marrow, Bursa of fabricius, Spleen, Tonsil, Lymphnode.					
Outcome 1	Student will know the history of immunology			K2	
UNIT -II					
Objective 2	To study various immune systems				
Immunoglobulin and Immune Diseases-Immunoglobulin - Structure,function and biological properties of Immunoglobulin classes.					
Outcome 2	Student will study various immune systems			K3	
UNIT- III					
Objective 3	To understand the types of immunoglobulin				
Interaction of antigen and anti-body- Auto immune diseases – Causes, Classification, Diagnosis and Treatment- Hypersensitivity and its types, Tumour Immunology					
Outcome 3	The learner will understand the types of immunoglobulin			K4	
UNIT-IV					
Objective 4	To understand the diseases caused by immune deficiency				
Lymphocyte and Immune response-Lymphocyte as unit of immune system					
Outcome 4	The learner will understand the diseases caused by immune deficiency			K4	
UNIT-V					
Objective 5	To know the importance of stem cells in immunology				
Stem cells, T cells and its types - B cells and macrophages. Immune response: Primary and secondary response - Humoral immune response (B cell activation) - Cell mediated immune response (T cellactivation).					
Outcome 5	Student will know the importance of stem cells in immunology			K4	
Suggested Readings:-					
Benjamini, E, Coico, R., & Sunshine, G. (2000). Immunology – A short course (4thed). A John Wiley and Sons, Inc.					
Fingerman, M., &Nagabhushanam, R. (2001). Immunobiology and Pathology, Vol -5. Roitt, I. (1984). Essential immunology (5thed), Oxford: Blackwell Scientific publications.					
Tizard, R.I. (1983). Immunology: An introduction. Philadelphia: Saunders college Publishing.					

Online resources

<https://www.biologydiscussion.com/essay/immunology-essay/essay-on-immunology-meaning-history-and-scope/56079>

<https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/history-immunology>

<https://microbenotes.com/introduction-to-antigen-antibody-reactions/>

<https://www.genome.gov/genetics-glossary/Lymphocyte>

<https://teachmephysiology.com/immune-system/cells-immune-system/t-cells/>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	M(2)	S (3)
CO2	S (3)	S(3)	M(2)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	S(3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)
CO4	S (3)	S(3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	M(2)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	2.8	2.8	2.6	3	3	2.8	2.8	3	2.8	3

S–Strong (3), M-Medium (2), L-Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S(3)	S(3)	S(3)	S (3)	M(2)
CO3	S(3)	S(3)	S(3)	S (3)	M(2)
CO4	S(3)	S(3)	S(3)	S (3)	M(2)
CO5	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV	3	3	3	2.8	2.4

S–Strong(3),M-Medium(2),L-Low(1)

VII - SEMESTER					
Core	Course Code 548704	GENETICS	T	Credits: 4	Hours: 4
UNIT -I					
Objective: 1	To develop and demonstrate an understanding of the structure and function of genes.				
Mendelian Genetics: Monohybrid – laws of dominance & segregation; Dihybrid cross – law of independent assortment – simple mendelian traits in man.					
Outcome 1	The student will develop and demonstrate an understanding of the structure and function of genes.			K2	
UNIT -II					
Objective 2	To understand how nucleic acids transport genetic information				
Interaction of Genes: Complementary, Epistasis – Dominant & Recessive Polygenic Inheritance - Skin colour in man.					
Outcome 2	The learner will understand how nucleic acids transport genetic information.			K2	
UNIT- III					
Objective 3	To solve transmission genetics problems, make accurate predictions about inheritance of genetic traits.				
Multiple Alleles - Blood groups in man Linkage & Crossing over in Drosophila.					
Outcome 3	The learner will develop skills to solve transmission genetics problems, make accurate predictions about inheritance of genetic traits.			K3	
UNIT-IV					
Objective 4	An understanding of the inheritance and expression of human blood groups.				
Chromosome mapping, Sex-linked inheritance in man – Colour blindness and Haemophilia. Sex Determination – Types, intersexes, Gynandromorph and sex-mosaics					
Outcome 4	Student will understand the inheritance and expression of human blood groups.			K4	
UNIT-V					
Objective 5	To understand the inborn errors of metabolism				
Inborn Errors of metabolism, Non-disjunction – Syndromes – Klinefelter, Turner, Down, Cri-du-chart. Pedigree analysis, Inbreeding and Out- breeding, Eugenics, Euthenics and Genetic Counselling.					
Outcome 5	Student will understand the inborn errors of metabolism			K4	
Suggested Readings:-					
Gardner, Eeden J. (2001). Principles of Genetics. New Delhi: Wiley Eastern Private Limited.					
Sinnod, Edward W., Dunn, L. C., & Dolzhansky, Theodosios. Principles of Genetics. New York: Me Graw-Hill.					
Tramarin, R.H. (1996). Principles of Genetics (5th ed). WCB publishers.					
Watson, J.D. (1987). The molecular biology of the Gene (3rd ed). W.A. Benjamin. California					
Williams S. Klug., Michale., & Cummings, R. (2000). Concepts of Genetics (6th ed). Prentice Hall.					

Online resources<https://knowgenetics.org/mendelian-genetics/><https://www.ndsu.edu/pubweb/~mcclean/plsc431/mendel/mendel6.htm><http://hobart.k12.in.us/jkousen/Biology/multalle.htm><https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/chromosome-mapping-0><https://www.news-medical.net/health/Inborn-Errors-of-Metabolism.aspx>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	S (3)	M(2)	S (3)	M(2)	M(2)	S (3)
CO2	S (3)	S (3)	M (2)	S (3)	S(3)	M(2)	M (2)	M(2)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	S(3)	M(2)	M (2)	M(2)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S(3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	3	3	2.8	3	2.8	2.4	2.6	2.4	2.8	3

S–Strong(3),M-Medium(2),L-Low(1)**Course Outcome VS Programme Specific Outcomes**

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	M(2)	S (3)	M(2)
CO2	S(3)	S (3)	M(2)	S(3)	M(2)
CO3	S(3)	S (3)	M(2)	S(3)	M(2)
CO4	S(3)	M (2)	M(2)	S(3)	S (3)
CO5	S (3)	M (2)	S (3)	S (3)	S (3)
W.AV	3	2.6	2.2	3	2.4

S–Strong(3),M-Medium(2),L-Low(1)

CourseCode: 548705	LAB-I - ANIMALPHYSIOLOGY,BIOCHEMISTRYI MMUNOLOGY,GENETICS	Credits:4	Hours:8
ANIMAL PHYSIOLOGY			
1	Oxygen consumption by a fish.		
2	Studyofciliary activity/heartbeatofFWMusselinrelation tothetemperature		
3	Preparation of haemin crystals		
4	Osmoregulation–Saltloss & gaininTilapia fish		
5	Determination of Rf values of aminoacid–Paper Chromatography:A]HaemoglobinometerB] Haemocytometer C] Sphygnomanometer D] Kymograph E] pH meter F] Centrifuge G]Electrophoresis		
BIOCHEMISTRY			
1	Qualitative analysis of carbohydrates		
2	Qualitative analysis of Proteins		
3	Qualitative analysisoflipids		
4	Actionofamylaseactivityinrelation tothetemperature.		
IMMUNOLOGY			
1	Lymphoid organ in Rat Demonstration only – Model/ chart/ CD Students have to draw the diagramandwritededetailedaccountofthelymphoidorgansinRatintheobservationnotebook.		
2	Rh and ABOblood grouping		
3	Spotters:a)Stemcells,b)Phagocytes,c)Thymus, d)Bonemarrow,e)Spleen,f)Lymphnode,g)Immunoglobulin		
4	Double immune diffusion and radial immune diffusion(demonstrationonly).		
GENETICS			
1	Experiment to study Mendel’s law using beads		
2	Observation of minimum10 Mendelian characters for self & classtudents.		
3	Observation of Blood group for self & classtudents		
4	Preparation of Pedigreechart for anytwo known visible characters for self.		
5	Spotters - Drosophila Cis-Trans linkage types Gynandromorph Syndromes –Down, Turner,Klinefelter& Cri-du-Chart Bacteriophage E.coli. DNA Base pairs Replication tRNA Proteinsynthesis		

VIII- SEMESTER					
Core	Course Code 548801	APPLICATION OF REMOTE SENSING & GIS	T	Credits: 4	Hours: 4
UNIT -I					
Objective: 1	To attain a foundational knowledge and comprehension of the physical, computational, and perceptual basis for remote sensing.				
Remote sensing Definition-Principles and Concepts-Electromagnetic spectrum Electromagnetic energy interaction in the Atmosphere: Absorption, Transmission and Scattering- Electromagnetic spectrum- Electromagnetic energy interaction in the Earth Surface: Vegetation, Soil and Water.					
Outcome 1	They can characterize the natural features or physical objects on the soil and wetland.			K2	
UNIT -II					
Objective 2	To gain familiarity with a variety of earth science applications of remote sensing.				
Define sensors and Platforms-Types of sensors (Active and Passive)-Types of Platforms (Airborne and Space borne)-Aerial camera-Basic principles of Photogrammetry-Aerial photography missions-Multispectral scanners.					
Outcome 2	Students will gain knowledge about the sensors and platforms-types of sensors.			K2	
UNIT- III					
Objective 3	To gain basic experience in the hands-on application of remote sensing data through visual interpretation and digital image processing exercises.				
Introduction of visual image interpretation- Land use, land cover, Geological, Soil and Wetland mapping-Applications of Agricultural, Forestry, Rangeland, Waterresourceand Urban planning Principles of Land form identification and Evaluation-Multispectral, Thermal, Hyperspectral and Microwave sensing.					
Outcome 3	They will get an idea about remote sensing platforms and remote sensors.			K3	
UNIT-IV					
Objective 4	Analyze and synthesize understanding by identifying and developing a research and application proposal using remote sensing.				
Earth observation system (Low, medium, High and Imaging spectrometry systems) Lansatseries, SPOT, IRS, RESURS, ADEOS, JERS, SPIN, IKONOS, QuikBird, OrbView, EROS, NOAA, GOES, DMSP, Seasat, EOS					
Outcome 4	Students will gain knowledge on GIS technology.			K4	
UNIT-V					
Objective 5	To study the earth observation systems.				
Basic principles & uses of GIS-Application of GIS in Geology and natural Resource management - Components of GIS-Raster and vector data – DEM- Digital Image Classification-Principle of image classification-image classification process (Supervised, Unsupervised)- Problems in image classification					
Outcome 5	Students will understand the Basic principles & uses of GIS- Application.			K4	

Suggested Readings:-

Ikeda, M., & Dobson, F. (1995). *Oceanographic Applications of Remote Sensing*: CRC Press.
 Malczewski, J. (1999). *GIS and Multicriteria Decision Analysis*: John Wiley & Sons Inc.
 Mueller, T., & Sassenrath, G. (2015). *GIS Applications in Agriculture*. CRC Press.
 Richards, J., & Jia, X. (2006). *Remote Sensing Digital Image Analysis (4th ed)*. Springer International Publishing.
 Richards, J., and Jia, X. (1999). *Remote Sensing Digital Image Analysis (3rd ed)*. Springer International

Online resources

<https://eos.com/blog/remote-sensing/#:~:text=Basic%20Principle%20of%20Remote%20Sensing,radiant%20energy%20for%20further%20study.>
http://www.ccpo.odu.edu/SEES/veget/class/Chap_5/5_3.htm
<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2062>
https://www.esa.int/Applications/Observing_the_Earth
<https://www.environmentalscience.org/principles-applications-gis>

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S (3)	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	M(2)	M (2)	M(2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S(3)
CO3	M(2)	M (2)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
W.AV	2.4	2.6	2.4	2.8	3	3	3	2.8	3	2.8

S–Strong(3), M–Medium(2), L–Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M(2)	M(2)	S (3)	S (3)
CO2	S(3)	M(2)	M(2)	S(3)	S (3)
CO3	S(3)	M(2)	M(2)	S(3)	S (3)
CO4	S(3)	S (3)	M(2)	S(3)	M (2)
CO5	S (3)	S (3)	S (3)	S (3)	M (2)
W.AV	3	2.4	2.2	3	2.6

S–Strong(3),M–Medium(2),L–Low(1)

VIII- SEMESTER					
Core	Course Code 548802	EVOLUTION	T	Credits: 4	Hours: 4
UNIT -I					
Objective: 1	To understand the origin of life based on different research.				
Origin of life – Theory of special creation – Cosmozoic theory – Theory of spontaneous generation/abiogenesis: Greek philosophers – Thales, Empedocles and Aristotle concepts – Big Bang theory – A. I. Oparin’s theory – J.B.S. Haldane’s hypothesis – Urey – Miller hypothesis – Coacervation theory.					
Outcome 1	Students able to understand the origin of life based on different research.			K2	
UNIT -II					
Objective 2	To acquire deep knowledge about geological time scale with the evolution of different organisms.				
Geological time scale: Palaeozoic era: Cambrian period, Ordovician period, Silurian period, Devonian period, Mississippian period, Pennsylvanian period and Permian period. Mesozoic era: Triassic period, Jurassic period, Cretaceous period. Cenozoic era – Paleocene epoch, Eocene epoch, Oligocene epoch, Miocene epoch, Pliocene epoch, Pleistocene.					
Outcome 2	Learn about geological time scale with the evolution of different organisms.			K2	
UNIT- III					
Objective 3	To know about Lamarckism and Darwinism and fossilization.				
Lamarckism, Neo Lamarckism, Darwinism, Neo Darwinism and Modern Synthetic Theory Fossil and Fossilization, Living fossils, Dating of Fossils, Mesozoic reptiles.					
Outcome 3	Understand the Lamarckism and Darwinism and fossilization.			K3	
UNIT-IV					
Objective 4	To understand about species concept, mimicry and coloration.				
Species concept, Isolating mechanisms, Mimicry and colouration. Hardy Weinberg Principle: Gene, Gene pool, Gene and genotypic frequencies and factors affecting H.W. Equilibrium. Evolution of man					
Outcome 4	Learn about species concept, mimicry and coloration.			K4	
UNIT-V					
Objective 5	To know about the causes of extinction and Molecular evolution.				
Fossils and fossilization. Extinction – causes. Molecular evolution – molecular clocks - systems of classification: cladistics and phenetics - molecular systematics - gene expression and evolution					
Outcome 5	Familiar about the causes of extinction and Molecular evolution.			K4	
Suggested Readings:-					
Barnes, R. S. K. (1999). Introduction to Marine Ecology: Blackwell Science.					
Bertness, M.D., Gaines, S. D. & Hay, M.K. (2000). Marine Community Ecology: Sinauer Associates. Jeffery, S. Levinton. (2000). Marine Ecology, Biodiversity and Function: Oxford University Press.					
Monroe W. Strickberger. (2000). Evolution. Jones & Bartlett Learning Montagu. (1980). Sociobiology examined. New York: Oxford University Press. Moody P.A. (1978). Introduction to Evolution. New York, Harper.					

Online resources<https://www.britannica.com/science/life/The-origin-of-life><https://www.britannica.com/science/geologic-time><https://www.britannica.com/science/Lamarckism><https://www.britannica.com/science/mimicry>[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_\(Boundless\)/18%3A_Evolution_and_the_Origin_of_Species/18.05%3A_Evidence_of_Evolution/18.5B%3A_Fossil_Formation#:~:text=The%20process%20of%20a%20once,of%20them%20ever%20become%20fossils.](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/18%3A_Evolution_and_the_Origin_of_Species/18.05%3A_Evidence_of_Evolution/18.5B%3A_Fossil_Formation#:~:text=The%20process%20of%20a%20once,of%20them%20ever%20become%20fossils.)**K1-Remember****K2-Understand****K3-Apply****K4-Analyse****K5-Evaluate****K6-Create****Course Outcome VS Programme Outcomes**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	M(2)	S (3)	M(2)	M (2)	M (2)	S (3)	S(3)	S (3)	S (3)	S (3)
CO3	M(2)	S (3)	M(2)	M (2)	S (3)	S (3)	S(3)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)
W.AV	2.4	2.8	2.4	2.6	2.8	3	2.8	3	3	3

S–Strong(3),M-Medium(2),L-Low(1)**Course Outcome VS Programme Specific Outcomes**

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	M(2)	M(2)
CO2	S(3)	S (3)	S(3)	M(2)	M(2)
CO3	S(3)	S (3)	S(3)	M(2)	M(2)
CO4	S(3)	M (2)	S(3)	S (3)	M(2)
CO5	S (3)	M (2)	S (3)	S (3)	S (3)
W.AV	3	2.6	3	2.4	2.2

S–Strong(3),M-Medium(2),L-Low(1)

VIII- SEMESTER					
Core	Course Code 548803	BIOTECHNOLOGY	T	Credits: 4	Hours: 4
UNIT -I					
Objective 1	To understand the techniques involved in gene cloning.				
Gene Cloning: Restriction enzyme and DNA Ligation-Cohesive and blunted ligation, Linkers, adapters, homopolymer tailing; Transformation– Bacteria- Ca ²⁺ mediated, electroporation, lipofection; PEG mediated, gene gun, electroporation, and Mammalian cells microinjection, transfection methods. Primer design; Fidelity of thermostable enzymes; Chemical synthesis of oligonucleotides; PCR and its optimization; Types of PCR – multiplex, nested, reverse transcriptase, realtime PCR, touchdown PCR, hotstart PCR, colony PCR					
Outcome 1	Understand the techniques involved in gene cloning.			K3	
UNIT -II					
Objective 2	To know about the marine microbes and genomics.				
Marine Microbial Genomics: Molecular methods of microbial identification; Microbial community structure analysis; Analysis of genomes of cultured marine microorganisms- new generation sequencing technology; Marine metagenomics; Marine genomics – advances and applications; Advances in genomics- introduction to epigenomics, Proteomics of marine organisms; Applications of marine proteomics; Metatranscriptomics and metaproteomics					
Outcome 2	Students will know about the marine microbes and genomics.			K2/ K3	
UNIT- III					
Objective 3	To understand the proteomics and metatranscriptomics.				
Bioreactor Technology: Introduction to bioreactors – Types of ideal reactors; Design equation for ideal reactors; Mode of operation of bioreactors- fed-batch and continuous culture, immobilized reactors, solid state fermentation –Bioreactor instrumentation and process control.					
Outcome 3	Students will familiarize with proteomics			K3	
UNIT-IV					
Objective 4	To provide students with fundamental strength in analyzing, designing and solving industry related problems and to develop the ability amongst the students to apply modern bioengineering techniques in industry and research.				
Downstream processing: Downstream processing – Strategies to recover and purify fermentation products – Separation of insoluble products by filtration – Centrifugation – Coagulation and flocculation – Cell disruption – Precipitation – Osmosis – Dialysis – Extraction.					
Outcome 4	Students will know the fundamental strength in analyzing, designing and solving industry related problems by applying modern bioengineering techniques.			K3/ K4	
UNIT-V					
Objective 5	To understand the bioactive compounds from marine sources.				
Marine Natural Products: Marine Products: hydrocolloids-agar, agarose, Sarrageenan, alginates, chitosans and chitin. Marine enzymes- Applications of enzyme for fish processing. Marine Lipids application of lipases formodification of fats and oils. Marine flavourants.					
Outcome 5	The students will know the bioactive compounds from marine sources			K4	

Text Books and Reference Books

Bhakuni, D.S. &Rawat, D.S. (2005). *Bioactive Marine Natural Products*. New Delhi, India: Springer and AnamayaPublishers,
 Brown, T.A. (2000). *Essential Molecular Biology: Vol.(1), A Practical Approach*: Oxford University

Online resources

<https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/overview-dna-cloning>
[https://www.cell.com/trends/microbiology/fulltext/S0966-842X\(06\)00153-3](https://www.cell.com/trends/microbiology/fulltext/S0966-842X(06)00153-3)
<https://en.wikipedia.org/wiki/Bioreactor>
https://www.mt.com/in/en/home/applications/L1_AutoChem_Applications/fermentation/downstream-processing-in-biotechnology.html

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S (3)	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	M(2)	M (2)	M(2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S(3)
CO3	M(2)	M (2)	M(2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
W.AV	2.4	2.6	2.4	2.8	3	3	3	2.8	3	2.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M(2)	M(2)	S (3)	S (3)
CO2	S(3)	M(2)	M(2)	S(3)	S (3)
CO3	S(3)	M(2)	M(2)	S(3)	S (3)
CO4	S(3)	S (3)	M(2)	S(3)	M (2)
CO5	S (3)	S (3)	S (3)	S (3)	M (2)
W.AV	3	2.4	2.2	3	2.6

S–Strong(3),M-Medium(2),L-Low(1)

VIII - SEMESTER					
Core	CourseCode : 548804	POST-HARVEST TECHNOLOGY	T	Credits: 4	Hours: 4
UNIT -I					
Objective:	To study the handling and transportation in the post-harvest period				
Handling and transportation – on board and on shore – manufacture, quality and uses of ice for handling, transportation and processing of fish – Refrigerated sea water for fish preservation. Insulated containers for fresh fish transportation.					
Outcome	Student will study the handling and transportation in post-harvest period				K3
UNIT -II					
Objective	To understand post mortem changes in fishes				
Fish processing – post mortem changes–chemical and structural. Chemical changes in lipids, proteins and nucleotides. Changes in pH, bacterial load, sensory changes, texture, taste and odour. Factors affecting quality of fish. Pre- treatment of fish washing, gutting, filleting, beheading, peeling, deveining. Steaming of crab.					
Outcome	Student will understand post mortem changes in fishes				K2
UNIT- III					
Objective	To know the process of freezing				
Methods of freezing. Processing and packaging, Chemical treatment, antioxidants, cryoprotectants and other additives. Temperature and duration of storage in quality and shelflife. Processing of crustaceans, and cephalopods. Sanitation in processing plants and Quality control of fresh and processed fish and fishery products.					
Outcome	The learner will know the process of freezing				K2
UNIT-IV					
Objective	To study the packaging techniques and packaging materials.				
Packaging and packaging materials – Packaging materials; basic films and laminates, their manufacture and identification; resistance of packaging materials; development of protective packaging for fishery products. Packing of fresh and frozen fish–packaging for transport and shipping. packaging standards for domestic and international trade.					
Outcome	The learner will study the packaging techniques packaging materials.				K3
UNIT-V					
Objective	To study the various seafood quality measures				
Seafood quality - Quality assessment in fish and fishery products – Physical, chemical organoleptic and microbiological quality standards. Good manufacturing practices. National and International standards, Codex alimentaris, USFDA and EU regulation for exporttrade					
Outcome	Student will learn various seafood quality procedures				K4

Suggested Readings:-

Baishya, D., Deka, M. (2009). Fish Fermentation. New India Publishing Agency. Cutting, C. L. (1999). Fish Processing and Preservation. Agro Botanica Publishers Desai, R. K. (2009). Fish Management and Aquatic Environment. A.K. Publications. Harnell, J. (1995). Marine Fish Farming for India. Asiatic Publishing House.
 Nettleton, J. A. (1987). Sea Food and Health. Van Nostrand Reinhold.
 Sinha, P. (2011). Fish Processing and Preservation. APH Publishing Corporation

Online resources

<https://www.astralint.com/book/9788170352372/postharvest-technology-of-fish-and-fish-products>
https://www.academia.edu/85964285/Fish_Processing_Technology_Book_ecopy
<https://gala.gre.ac.uk/id/eprint/12796/>
<https://www.barnesandnoble.com/w/advances-in-harvest-and-post-harvest-technology-of-fishes-nm-nambudiri/1123031091>
<https://nifphatt.gov.in/>
<https://advancedscholarsjournals.org/full-articles/fish-post-harvest-technologies.pdf?view=inline>

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	M(2)	S (3)	S (3)
CO2	S (3)	S (3)	M (2)	M (2)	M (2)	S (3)	M (2)	S (3)	M (2)	M (2)
CO3	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)
CO4	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	3	3	2.2	2.8	2.6	3	2.4	2.8	2.8	2.6

S–Strong(3),M-Medium(2),L-Low(1)

CourseOutcomeVSProgrammeSpecificOutcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	M (2)	M(2)
CO2	M (2)	M (2)	S (3)	M (2)	S (3)
CO3	S (3)	M (2)	S (3)	M (2)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	2.8	2.6	3	2.4	2.8

S–Strong(3),M-Medium(2),L-Low(1)

Core	Course Code: 548805	LAB-II - APPLICATION OF REMOTE SENSING AND GIS, EVOLUTION, BIOTECHNOLOGY, POST-HARVEST TECHNOLOGY	P	Credits:4	Hours:8
APPLICATION OF REMOTE SENSING AND GIS					
1.	Preparation of simple Vectormap, Toposheet reading and GPS field survey.				
2.	Visual Interpretation of Geomorphic features from the Satellite image and Aerial photographs.				
3.	Visit to GIS Centre				
EVOLUTION					
1.	Chart and models: Evolution – Different Geological time scale organisms.				
2.	Field study of bivalve and gastropod diversity and computing using PAST online software with discussion.				
BIOTECHNOLOGY					
1.	Plasmid DNA isolation and DNA quantitation.				
2.	Restriction digestion and mapping of DNA.				
3.	Confirmation of DNA by Agarose gel electrophoresis.				
4.	DNA Ligation.				
5.	Transformation of E. coli with standard plasmids, Calculation of transformation efficiency.				
6.	Cloning of genomic DNA in standard plasmid vectors.				
7.	Confirmation of the insert, Miniprep of recombinant plasmid DNA.				
8.	Polymerase Chain reaction.				
9.	RFLP analysis.				
10.	BLAST, NCBI.				
POST-HARVEST TECHNOLOGY					
1.	Observation of fin and shell fish freezing.				
2.	Freezing practices with different fish and shell fish products. Organoleptic quality analysis.				
3.	Canning of fish and shrimp. Observation of can seaming-estimation of salt content in Cured fish.				
4.	Analysis of fish meal-estimation of protein, Lipid and carbohydrates				

IX- SEMESTER					
Core	Course Code: 548901	MARINE MICROBIOLOGY	T	Credits: 4	Hours: 4
UNIT-I					
Objective	To understand the characteristics of marine microscopic organisms such as bacteria, viruses, and fungi.				
Introduction and scope of marine microbiology- Marine microbial habitats: estuaries, mangroves, salt marshes, beach, coastal ecosystems, coral reefs, water column, sediments and extremophiles Diversity of marine microorganism-Archaea, bacteria, cyanobacteria, algae, plankton, fungi, viruses and actinomycetes.					
Outcome	Student will learn characteristics of marine microscopic organisms such as bacteria, viruses, and fungi.			K3	
UNIT-II					
Objective	Know the pattern of growth, development, and other characteristics of microorganisms.				
Ecology of coastal microorganisms sampling equipment- water samplers such as Niskin sampler, Hydro-Bios sampler, sediment samplers such as van Veen grabs and corers, multiple plankton net and hand-held plankton net.					
Outcome	Student will study the pattern of growth, development, and other characteristics of microorganisms.			K4	
UNIT-III					
Objective	To know the microbiological sampling devices and their mechanisms.				
Culture media-Types and preparation of isolation, purification and culture methods for bacteria, algae, actinomycetes and viruses, identification of microbes. Staining methods for different microbes. Control of microorganisms: physical and chemical methods. Microbial identification system Fatty acid analysis genomic sequencing using microbial identification system and 16S rRNA sequence homology.					
Outcome	Student will be familiarized with microbiological sampling devices and their mechanisms.			K3	
UNIT-IV					
Objective	Understand the biogeochemical cycle in the marine environment,				
Role of microorganisms - Nutrient cycles- carbon, nitrogen, phosphorous and sulphur cycles in the Coastal under different environments including mangroves.					
Outcome	Student will study the biogeochemical cycle in the marine environment			K4	
UNIT-V					
Objective	To study the industrial application of microorganisms.				
Industrial microbiology-Fermentation-production of Single cell protein (SCP)from algae and bacteria-product quality and safety. Production of mushroom, probiotics, distilled beverages, exopolysaccharides, biofuels and vinegars.					
Outcome	Student will study the industrial application of microorganisms.			K4	
Suggested Readings:-					
Arora,D. R., &BhartiArora. (2007). Practical Microbiology (2nd ed.). CBS.					
Casida, L.E.J.R. (2019). Industrial Microbiology. New Age International Private Limited.					
Reed, G. (2004). Prescott & Dunn's Industrial Microbiology (4th ed.). CBS Publishers & Distributors.					
Insam, Heribert.,&Rangger, Andrea. (1997). Microbial Communities. Springer-Verlag Berlin					
Michael, T.,Madigan, John, M.,Martinko, Kelly, S.,Bender, Daniel, H.,Buckley.,& David A. Stahl. (2017). Brock Biology of Microorganisms, (14thed). Pearson Education.					
oanne Willey, Linda Sherwood.,& Christopher J. Woolverton. (2017). Prescott's Microbiology (10thed).					
Pelczar, Jr., & Michael. (2001). Microbiology (5thed). McGraw Hill Education.					
Pradipta K. Mohapatra. (2008). Textbook of Environmental Microbiology. I K International Publishing					

Online resources

<https://www.ncbi.nlm.nih.gov/books/NBK559439/>

<https://www.ocean-connect.org/science/marine-microbiology/>

<https://www.evergreen.edu/catalog/offering/marine-microbiology-43586>

<https://www.routledge.com/Marine-Microbiology-Ecology--Applications/Munn-Munn-Munn/p/book/9780367183561>

<https://www.wiley.com/en-us/Marine+Microbiology%3A+Bioactive+Compounds+and+Biotechnological+Applications-p-9783527665273>

<https://www.wiley.com/en-us/Marine+Microbiology%3A+Bioactive+Compounds+and+Biotechnological+Applications-p-9783527665273>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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CourseOutcomeVSProgrammeOutcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)
CO2	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)
CO3	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)
W.AV	2.4	2.8	3	3	3	2.8	2.6	3	2.8	2.8

S–Strong(3),M-Medium(2),L-Low(1)

CourseOutcomeVSProgrammeSpecificOutcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	S(3)	S(3)	M(2)
CO2	S(3)	M(2)	S(3)	S(3)	M(2)
CO3	S(3)	M(2)	S(3)	S(3)	M(2)
CO4	M(2)	S(3)	S(3)	S(3)	S(3)
CO5	M(2)	S(3)	S(3)	S(3)	S(3)
W.AV	2.6	2.4	3	3	2.4

S–Strong(3),M-Medium(2),L-Low(1)

IX- SEMESTER					
Core	Course Code: 548902	ENVIRONMENTAL IMPACT ASSESSMENT	T	Credits: 4	Hours: 4
UNIT- I					
Objective	Able to understand about the Environmental Impact Assessment (EIA),				
Introduction - Environmental Impact Assessment (EIA) - types of EIA - rapid EIA - comprehensive EIA - environmental clearance - coastal regulation zone - baseline studies - collection of primary and secondary data.					
Outcome	Students will gain knowledge on marine environment and its importance.			K2	
UNIT-II					
Objective	To understand about environmental clearance, coastal regulation zone, baseline studies and collection of primary and secondary data.				
Design and sample collection - Site selection - precision - size of samples- variability in biotic communities - appropriate spatial and temporal replication - data collection field observation-air quality					
Outcome	The students will gain knowledge on collection of primary and secondary data for environmental Impact Assessment in a particular area.			K2	
UNIT-III					
Objective	Knowledgeable to design, site selection, precision, size of samples and appropriate spatial and temporal replication in data collection and field observation.				
Marine environment – hydrodynamics (tides - tidal ranges - waves - current velocity) water quality - physical (temperature - salinity - total suspended solids - turbidity) - chemical (pH dissolved oxygen - BOD - nutrient analysis - heavy metals) - biological (Fecal coliforms - phytoplankton - zooplankton - benthos) - sediment quality - sand - silt -clay fraction analysis - wet sieving method - total organic carbon organic matter estimation.					
Outcome	They will gain knowledge about the biological indicators management.			K3	
UNIT-IV					
Objective	They will know about the biological indicators.				
Biological indicators - benthic indicators - Marine Biotic Indices - [BENTIX, AMBI, Benthic Quality Index (BQI) - Ecological quality (EcoQ)] - Taxonomic Sufficiency (TS). Prediction of impacts - risk assessment - environmental management - monitoring - preparation of EIA report using computational software. (Field trip data collection – data interpretation).					
Outcome	Students will gain knowledge about Environmental impact assessment studies.			K2	
UNIT-V					
Objective	To Know about marine environment, physical, chemical, biological and sediment logical analysis				
Ecological quality measures - univariate measures (species diversity indices) - multivariate measures (Bray-Curtis similarity - multivariate dispersion indices-principal component analysis-cumulative dominance curves or ABC curves).					
Outcome	To study the species diversity indices			K4	

Suggested Readings:-

Alongi, D. (1998). Coastal Ecosystem Processes. CRC Press LLC. Brown, M. (2010). Ecology (1sted). Apple Academic Press Ltd.
 Diwan, A., & Arora, D. (1995). Marine Ecology (1st ed.). Anmol Publications Pvt. Ltd. Kumar, A., & Singh, L. (2006). Advanced Ecology. Daya Publishing House.
 Kumar, H. (1997). General Ecology. Vikas Publishing House Pvt. Ltd.
 Trivedi, P., & Raj, G. (1992). Marine Ecology and Pollution. Akashdeep Publishing House.

Online Resources

https://en.wikipedia.org/wiki/Environmental_impact_assessment
<https://moef.gov.in/moef/division/environment-divisions/environmental-impact-assessment-eia/introduction/index.html>
https://environment.ec.europa.eu/law-and-governance/environmental-assessments/environmental-impact-assessment_en
<https://www.epa.ie/our-services/monitoring--assessment/assessment/environmental-impact-assessment/>
[https://www.environmental-mainstreaming.org/documents/EM%20Profile%20No%201%20-%20EIA%20\(6%20Oct%2009\).pdf](https://www.environmental-mainstreaming.org/documents/EM%20Profile%20No%201%20-%20EIA%20(6%20Oct%2009).pdf)

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	M(2)
CO2	S (3)	S (3)	S (3)	M(2)	S (3)	S (3)	M (2)	M (2)	S(3)	S (3)
CO3	S (3)	S (3)	S (3)	M(2)	S (3)	S (3)	M (2)	S (3)	S(3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV	3	3	3	2.4	2.8	3	2.6	2.8	2.8	2.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M(2)	S (3)	S (3)	M(2)
CO2	S (3)	M(2)	S(3)	S(3)	M(2)
CO3	S (3)	M(2)	S(3)	S(3)	M(2)
CO4	M (2)	S (3)	S(3)	S(3)	S (3)
CO5	M (2)	S (3)	S (3)	S (3)	S (3)
W.AV	2.6	2.4	3	3	2.4

S–Strong(3),M-Medium(2),L-Low(1)

IX- Semester					
Core	Course Code 548903	RESEARCH METHODS IN MARINE BIOLOGY	T	Credits: 5	Hours: 4
UNIT- I					
Objective	The primary objective is to develop a research orientation among the students and to familiarize them with the fundamentals of research methods.				
Biological literature library search: Abstracting, searching for literature, indexing; manuscript preparation, organization of the paper–the art of writing–presentation of results–tables–graphs–histogram–relevant titles, etc. Internet and e-journals. Computer aided techniques for data analysis, data presentation and slide preparation					
Outcome	Student will learn to develop and understand basic framework of research process, various research designs and techniques.			K4	
UNIT-II					
Objective	The course also aims to introduce the students to the basic concepts used in research.				
Histology: Principles of micro techniques –fixing, embedding, sectioning, staining, differential. Histochemistry: Principles and practice. Methods employed in analysis of proximate composition.					
Outcome	Recognizing the various source of information for literature review and data collection.			K4	
UNIT-III					
Objective	To learn different techniques				
Spectroscopy: Principles of biophysical methods, X-ray diffraction, Spectrofluorometer, flame photometer, UV-visible, atomic absorption and emission spectrophotometers, NMR and Mass spectrometer. Centrifuge: Principles and applications – Ultra centrifuge (velocity, buoyance and density, gradient centrifugation). pH: Buffers – pH meters – ion, selective electrodes.					
Outcome	Student will learn different techniques			K4	
UNIT-IV					
Objective	To know the basics of biostatistics				
Chromatography: Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity. Electrophoresis: Principles and Application of Electrophoresis: Paper, Agarose, PAGE, SDS PAGE and Iso-Electric focusing. Hybridization, sequencing, PCR, DNA finger printing, screening of genome and cDNA libraries.					
Outcome	Student will learn the basics of biostatistics			K4	
UNIT-V					
Objective	To impart education in the foundational methods of academic research.				
Biostatistics: Collection and analysis of biological data - mean, median, mode Standard deviation, Standard error, Coefficient of variation, Student 't' test, Skewness, Kurtosis, Chi - square, Correlation, Regression and ANOVA. Bioinformatics: Internet - Worldwide Web - Search Engines - their functions. Boolean searching - file formats. Biological data bases - sequence and structure - data retrieval - searching sources databases - sequence similarity searches - FASTA and BLAST, CLustalW and Phylip.					
Outcome	Students will understand the ethical dimensions of conducting research.			K4	

Suggested Readings:-

Bajpai, P. K. (2006). Biological Instrumentation and Methodology. New Delhi: S. Chand & Co. Ltd.
 Blum, Deborah., & Mary Knudson. (1997). A field guide for science writers: the official guide of the National Association of Science Writers. New York: Oxford University Press.
 Comir., & Peter Wood Ford. (1979). Writing scientific papers in English, London. Pitman Medical
 Day, R.A. (1994). How to write and publish a scientific paper. London: Cambridge University Press.
 Milton, J.S. (1992). Statistical methods in Biological and Health Sciences. New York: McGraw Hill
 Wilson, & Walker. (2000). Practical biochemistry - principles and techniques. Cambridge University Press.

Online resources

<https://www.britannica.com/science/primary-productivity>
<https://biokimicroki.com/microscope-principle-parts-and-application/>
<https://www.vedantu.com/physics/spectroscopy>
<https://www.bioxspace.com/post/data-analysis-in-biological-research>
<https://libguides.rowan.edu/c.php?g=237523&p=1579142>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create	
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Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	M(2)
CO2	S (3)	S (3)	S (3)	M(2)	S (3)	S (3)	M (2)	M (2)	S(3)	S (3)
CO3	S (3)	S (3)	S (3)	M(2)	S (3)	S (3)	M (2)	S (3)	S(3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV	3	3	3	2.4	2.8	3	2.6	2.8	2.8	2.8

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M(2)	S (3)	S (3)	M(2)
CO2	S (3)	M(2)	S(3)	S(3)	M(2)
CO3	S (3)	M(2)	S(3)	S(3)	M(2)
CO4	M (2)	S (3)	S(3)	S(3)	S (3)
CO5	M (2)	S (3)	S (3)	S (3)	S (3)
W.AV	2.6	2.4	3	3	2.4

S–Strong(3),M-Medium(2),L-Low(1)

IX- SEMESTER					
Core	Course Code: 548904	MARINE BIODIVERSITY AND CONSERVATION	T	Credits: 4	Hours: 4
UNIT- I					
Objective 1	To protect and restore marine and estuarine ecosystems. Control of invasive species, mitigate dry land salinity, Promote ecologically sustainable grazing				
Introduction - Marine Biodiversity - Importance - levels of biodiversity - biodiversity indices. Definition of extinction of marine bio-resources - rate of extinction-causesofextinction-island/intertidalbiogeography-vulnerability to extinction.					
Outcome 1	Students will gain knowledge on scientific information and knowledge regarding the status of marine biodiversity, various values associated with it and the necessity for its conservation.			K2	
UNIT-II					
Objective 2	To study the marine protected areas.				
Conservation - essential concepts for small populations - problems of small population-appliedpopulationbiology-establishmentofnewpopulations-ex- situ conservation strategies - conservation categories of species –legalprotection of species.					
Outcome 2	They will gain knowledge on marine biosphere reserve area and its importance.			K3	
UNIT-III					
Objective 3	To understand the marine biodiversity conservation				
Marineprotectedareas-designingofprotectedareas – managingprotectedareas- restoration ecology.					
Outcome 3	Students will gain national and international approaches to conservation and sustainable development.			K2	
UNIT-IV					
Objective 4	To study the laws of conservation and sustainable development.				
Impediments to marine biodiversity conservation - insufficient scientific informationinadequatetransferofinformation-culturalandbiologicaldiversity- differing benefits and costs harming aquatic life - jurisdictional gaps and overlaps - use of marine environment - immunity from public scrutiny - fragmented decision making.					
Outcome 4	Students will learn about improve scientific knowledge and access to information.			K4	
UNIT-V					
Objective 5	To minimize impacts of climate change on biodiversity, Maintain and record indigenous peoples' ethnobiological knowledge, Improve scientific knowledge and access to information.				
Conservation and sustainable development - traditional societies - Government action local legislation - national laws - National Biodiversity Act and National Biodiversity Authority. International approaches to conservation and sustainable development - On going problems - possible responses - role of conservation biologists.					
Outcome 5	Students will promote conservation of marine biodiversity and its sustainable use.			K4	

Suggested Readings:-

Dasmann, R. F. (1984). Environmental Conservation (5thed). John Wiley & Sons Inc.
 Heywood, V.,& Watson, R. (1995). Global Biodiversity Assessment. Cambridge University Press.
 Kannaiyan,S.,&Venkatraman,K.(2011).MarineBiodiversityinIndia.AssociatedPublishingCompany
 Kumar, S. (2009). Biodiversity, Environment and Sustainable Management (1sted). A. K. Publications. Laladhas, K., Nilayangode, P.,&Oommen, O. (2017). Biodiversity for Sustainable Development. Springer International Publishing.
 Sinha, P. (1998). Biodiversity Depletion: Anmol Publications Pvt. Ltd.

Online Resources:

<https://www.jagranjosh.com/general-knowledge/coastal-zone-management-purpose-objective-and-challenges-1510572939-1>
<https://www.eea.europa.eu/publications/92-826-5409-5/page035new.html>
<https://unacademy.com/content/mppsc/study-material/geography/marine-protected-areas-in-india/>
https://www.academia.edu/47676064/Land_ocean_interactions_in_the_coastal_zone_science_plan
<https://earsc-portal.eu/display/EOWiki/Monitor+coastal+ecosystem>

K1-Remember	K2-Understand	K3-Apply	K4-Analyse	K5-Evaluate	K6-Create
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CourseOutcomeVSProgrammeOutcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M(2)	S (3)	M(2)	M(2)	S (3)	S (3)	S (3)	S (3)	M(2)
CO2	S (3)	S (3)	M (2)	M(2)	S (3)	S (3)	M (2)	M (2)	S(3)	S (3)
CO3	S (3)	S (3)	M (2)	M(2)	S (3)	S (3)	M (2)	S (3)	S(3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S(3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV	3	2.8	2.6	2.4	2.8	3	2.6	2.8	2.8	2.8

S–Strong(3),M-Medium(2),L-Low(1)

CourseOutcomeVSProgrammeSpecificOutcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	S (3)	M(2)
CO2	S (3)	S (3)	S(3)	S (3)	M(2)
CO3	S (3)	S (3)	S(3)	S (3)	M(2)
CO4	M (2)	M (2)	S(3)	M (2)	S (3)
CO5	M (2)	M (2)	S (3)	M (2)	S (3)
W.AV	2.6	2.6	3	2.6	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Core	Course Code: 548905	Lab -III - MARINE MICROBIOLOGY, ENVIRONMENTAL IMPACT ASSESSMENT RESEARCH METHODS IN MARINE BIOLOGY	P	Credits: 4	Hours: 8
MARINE MICROBIOLOGY					
1.	Principles and methods of sterilization.				
2.	Direct microscopic observations of bacterial shape–cocci, rods, chains, fungal spores.				
3.	Preparation of Media: Nutrientbroth, Nutrientagar, plates, slants.				
4.	Pureculture technique: Streak plate, spread plateandpourplatemethods.				
5.	Measurement of size of microbes.				
6.	Motility determination–Hangingdropmethod.				
7.	Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometercount).				
8.	Isolation and purification of cyanobacteria, actinomycetes, fungiandprotozoans.				
9.	Stainingmethods: Simple, Negative, acidfast, Gramstaining, spore, Capsule.				
ENVIRONMENTAL IMPACT ASSESSMENT					
1.	Physico- chemical Parameter:water and Sedimentsample (Temperature,pH, Conductivity, Light Penetration, Total depth DO, BOD, TDS, Salinity, Nutrients and Heavymetals).				
2.	Biological Parameters: Primary productivity, Qualitative and quantitative an alysis of microbes, plankton and benthic communities.				
RESEARCH METHODS IN MARINEBIOLOGY					
1.	Fixation and Preservation of tissue samples				
2.	Staining by hematoxylin and eosin				
3.	Estimation of proteins, carbohydrates and lipids byUV-Vis Spectroscopy				
4.	Separation ofaminoacids, sugars by Paper Chromatography and Thinlayerchromatography				
5.	Cellfractionationandorganelleisolationbycentrifugation				
6.	Protein is olationbyelectrophoresis– NativeandSDSPAGE				
7.	Isolation and purification of macromolecules bycolumn chromatography				
8.	Electrophoreticquality analysis Isolation of DNA and RNA				
9.	Western, Southernandnorthernblotting				
10.	Biostatistics. (Mean, median,mode,standarddeviation). Probability calculation. Hypothesistesting– Level of Significance –Level of Confidence – pValue.				
11.	Basicbio informatics procedures (NCBI and GenBankresources) Retrieval of Nucleic sequences Protein Sequence 3D visualization of proteinmolecules				

Core	Course Code: 548999	DISSERTATION	Credits:15	Hours:30
Objectives	<p>Project Dissertation will be carried out by the student themselves with the interest of the student as well as the interest of the faculty with mutual understanding, expertise and interest. The students continuously evaluated the work carried out day to day for further events. Finally, the faculty will be given instruction how to write the dissertation with different components, topics and the material, text, problems to be addressed in each assignment title. The dissertation will consist of Introduction, Materials and Methods, Results and Discussion, Summary and Conclusion, References/Bibliography. Of course, appropriate statistical tools must be followed for the assessment of data. A proper preparation of graphs, diagrams and flow charts must be included in the dissertation. Appendix may also be taken into consideration if necessary</p>			



DISCIPLINE-SPECIFIC ELECTIVE

S.NO	DSE	TITLES
1	DSE 1	MARINE RESOURCES
2	DSE 1	MARINE POLLUTION AND MANAGEMENT
3	DSE 2	FERMENTATION TECHNOLOGY
4	DSE 2	ORNAMENTAL FISH CULTURE
5	DSE 3	MARINE FARMING
6	DSE 3	MARINE BIOFOULING, PREVENTION AND MANAGEMENT



DSE 1	MARINE RESOURCES	T	Credits: 4	Hours: 4	
Objectives 1	To understand the living and non-living resources in the ocean				
Unit -I	Non-living resources: Ocean resources in the coast, shelf, slope and abyssal - Distribution of various kinds particularly in India ocean- Their forms, grade and potentiality- Coastal aquifer its nature, form, migration – Integrated resource management-Preservation and conservation of non-living resources including water-Renewable & non-renewable resources. Resources originated terrigenous, chemogenous, biogenous, allogenic and antigenic.				
Outcome	Students gain knowledge of living and nonliving marine resources			K2	
Objectives 2	To study about the marine mineral resources				
Unit-II	Marine minerals: Potential in east and west coasts of India-Mineral resources - Mineral enrichment in the Black sea-Marine phosphorites-Placer minerals-Marine sulfides-Manganese nodules and crusts-Methods in the exploration of seafloor minerals deposits-Methods of exploration in manganese nodules, phosphorite and polymetallic sulfides-Sea baulk (non-living resources).				
Outcome	Obtained knowledge of marine mineral resources			K1	
Objectives 3	To learn about the fisheries resources and their management				
Unit-III	Fishery resources management and deep-sea fishery potential Resource potential – Resource estimates- Fish resources of Indian EEZ- Reasons for decline in fish production- Profitable vessel management and requirement –Exploitation of marine fisheries resources and exports- Export management. Living resources: Captures; Sardines, Mackerels, Bombay Duck and Prawn fisheries. Principle methods of exploitation of sea fishes. Indigenous and modern Crafts and Gears.				
Outcome	Students get knowledge about fisheries resources, modern crafts and gears			K3	
Objectives 4	To understand the different types of marine drugs				
Unit-IV	Drugs: Marine drugs– Importance – Sources-Carbohydrate and derivatives-Nitrogenous compounds-Antibiotic compounds from marine animals. Bioactive compound – Sources- Natural function -Ecological and distribution in the marine environment.				
Outcome	Students know about marine drugs, their sources and its importance.			K2	
Objectives 5	To evaluate the different types of toxins from marine animals				
Unit -V	Toxin from marine animals: Type of toxins- Functional properties toxin-Venoms-Venom in marine animals: sea snake, fish and mollusks -Pharmacological and toxicological properties- Marine steroids– Types- Marine cartenoids- Sterols of marine invertebrate.				
Outcome	Students studied about the different types of toxins from marine animals			K3	
Text Books and Reference Books					
Gautam, A. (1998). <i>Conservation & Management of Aquatic Resources</i> . Daya Publishing House.					
Madhu, M., Jakhar, P.,& Adhikary, P. (2013). <i>Natural Resource Conservation</i> . Satish Serial Publishing House.					
Singh, R. (2013). <i>Fishery Resources</i> . Pearl Books Publishing.					
Teleki, P., Dobson, M.,& Moore, R. (1987). <i>Marine Minerals</i> . Reidel Publishing Company.					
Thompson, M., Sarojini, R., &Nagabushanam, R. (1991). <i>Bioactive Compounds from Marine Organisms</i> . Oxford & IBH Publishing Co. Pvt. Ltd.					
Onlineresources					
https://www.studyiq.com/articles/major-ocean-relief-features/ https://extension.psu.edu/renewable-and-nonrenewable-resources https://worldoceanreview.com/en/wor-1/energy/marine-minerals/					
https://medcraveonline.com/JAMB/indian-deep-sea-fisheries---its-prospects-issues-and-challenges.html https://www.encyclopedia.com/media/educational-magazines/marine-toxins					
K1-Knowledge	K2-Understanding	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Mapping-Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	M(2)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO5	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
W.AV	2.6	2.6	2.4	2.2	2.2	2.2	2.0	2.0	2.4	2.2

S–Strong(3),M-Medium(2),L-Low(1)

Mapping-Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	M(2)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	M(2)	S(3)	M(2)	S(3)
CO4	M(2)	S(3)	M(2)	M(2)	S(3)
CO5	S(3)	M(2)	M(2)	S(3)	M(2)
W.AV	2.6	2.4	2.4	2.6	2.6

S–Strong(3), M-Medium(2),L-Low(1)

DSE 1	MARINE POLLUTION AND MANAGEMENT	Credits: 4	Hours: 4	
Objectives	To study major classes of pollutants in the marine environment.			
Unit -I	Marine pollution-definition - role of GESAMP - major pollutant - sources - transport path - dynamics. Toxicology – Lethal and Sub-lethal effects of pollutants to marine organisms bioconcentration, bioaccumulation and biomagnification, methods of toxicity testing, factors influencing toxicity, synergistic and antagonistic effects, role of microcosms & mesocosms.			
Outcome	Gain knowledge of types of pollutants in the marine environment.		K2	
Objectives	To make students to aware of different types of marine pollution			
Unit-II	Sewage pollution - industrial - agricultural - domestic - impact on marine environment - treatment methods. Detergents - composition – interference with eutrophication - ecological impact. Marine debris - plastics - litter - impact in the marine environment.			
Outcome	Acquired knowledge in sources, causes and effects of marine pollution		K1	
Objectives	To compare the heavy metal and pesticide pollution and their impacts on marine organism			
Unit-III	Heavy metal pollution - sources - distribution - fate - analytical approaches. Pesticide pollution - classification - sources - distribution - fate and ecological impacts with special reference to marine fishes, birds and mammals.			
Outcome	Obtained knowledge on metal and pesticide pollution in the marine environment		K1	
Objectives	To explain the sources causes and effects of oil, thermal and radioactive pollution			
Unit-IV	Oil Pollution - composition - sources - biological impacts on fishes, birds and mammals - treatment techniques - bioremediation. Ballast water and bio-invasion. Aquatic noise. Thermal pollution - sources - uses of waste heat. Role of biocides - chlorine - ecological impacts. Radioactive pollution - sources - natural - artificial -biological effects of radiation.			
Outcome	Understanding the sources causes and effects of oil, thermal and radioactive pollution		K2	
Objectives	To express different environmental monitoring methods			
Unit -V	Environmental monitoring methods - critical pollutants - objectives, status, limitations and biological indicators – bioaccumulation – bioconcentration - biomagnification - biotransformation - Mussel watch - water quality assessment. Use of analytical instruments - AAS - ICP - GC.			
Outcome	Students explored the knowledge in environmental pollution monitoring using different kinds of analytical instruments		K3	
Text Books and Reference Books				
Chhatwal, G. (1997). <i>Encyclopaedia of Environmental, Soil and Marine Pollution (1st ed)</i> . Annol Publications Pvt. Ltd.				
Clark, R.B. (1992). <i>Marine pollution (3rd ed)</i> . Clarendron Press Oxford.				
Diwan, A., &Arora, D. (1995). <i>Marine Pollution (1st ed)</i> . Annol Publications Pvt. Ltd.				
Hammer, M. J. (2006). <i>Water and Wastewater Technologies</i> . Prentice Hall of India Pvt. Ltd.				
Swarup, R. (1992). <i>Encyclopaedia of Ecology, Environment and Pollution Control</i> . Mittal Publications.				
Thompson, M., Sarojini, R.,& Nagabushanam, R. (1988). <i>Marine Bio deterioration</i> . Oxford & IBH Publishing				
Online Resources				
https://www.nepa.gov.jm/sites/default/files/2019-12/Marine_Pollution.pdf				
https://www.researchgate.net/publication/325303740_Eutrophication				
https://www.sciencedirect.com/science/article/abs/pii/B9780128050521000243				
https://sites.ualberta.ca/~lfoote/lab_files/CRchap1_2.pdf				
https://egyankosh.ac.in/bitstream/123456789/82821/1/Unit-7.pdf				
https://www.epa.gov/sites/default/files/2015-01/documents/rmpp_6thed_final_lowresopt.pdf				
https://www.researchgate.net/publication/339974686_Sources_of_Heavy_Metals_Pollution				
K1-Knowledge	K2-Understanding	K3-Apply	K4-Analyze	K5-Create

Mapping Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)
CO2	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)
CO3	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)
CO4	M(2)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO5	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	2.4	2.6	2.2	2.6	2.4	2.6	2.4	2.2	2.6	2.4

S–Strong(3),M-Medium(2),L-Low(1)

Mapping Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	M(2)	M(2)
CO2	S(3)	S(3)	M(2)	S(3)	M(2)
CO3	S(3)	M(2)	M(2)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	S(3)	M(2)	S(3)	S(3)
W.AV	2.4	2.6	2.2	2.6	2.4



DSE 2	FERMENTATION TECHNOLOGY	Credits: 4	Hours: 4		
Objectives	To understand the design and function of fermenters				
Unit -I	Fermenter – types and function Fermenters – Basic functions, design and components – asepsis and containment requirements – body construction and temperature control – aeration and agitation systems – sterilization of fermenter, air supply and medium; aseptic inoculation methods – sampling methods, valve systems – a brief idea on monitoring and control devices				
Outcome	Gain knowledge on different types of fermenters and their basic functions	K2			
Objectives	To learn general concepts of industrial microbiological techniques				
Unit-II	General concepts of industrial microbiology Concepts of basic modes of fermentation - Batch, Fed batch and Continuous fermentation. Bioreactor designs. Primary and secondary screening, Strain development strategies. Scale up of fermentation process. Raw material for media preparation. Harvesting and product recovery.				
Outcome	Obtained knowledge on industrial microbiology	K2			
Objectives	To understand the process of downstream techniques				
Unit-III	Downstream processing: Filtration, Cross flow filtration, Flocculation, Whole broth processing, Solvent extraction, Concentration, Centrifugation, Crystallization, Distillation, Adsorption elution, Precipitation and Chromatography				
Outcome	Understanding the different downstream process	K2			
Objectives	To understand the role of enzymes in food industries				
Unit-IV	Application of enzyme: Immobilization of enzymes and microbial cells, Secondary metabolites. Application of enzyme in food industries: enzymes in dairy industries, baking and beverage industries.				
Outcome	Gathering knowledge in applications of enzymes among the food industries	K3			
Objectives	To understand the production of antibiotics and organic acids				
Unit -V	Production of Antibiotics – Penicillin, Enzymes - Amylase. Production of Organic Acids - Acetic acid.				
Outcome	Understanding the knowledge on the organic acids and antibiotics production	K2			
Text Books and Reference Books					
Baishya, D., & Deka, M. (2009). <i>Fish Fermentation</i> . New India Publishing Agency. Cutting, C. L. (1999). <i>Fish Processing and Preservation</i> . Agro Botanica Publishers. Desai, R. K. (2009). <i>Fish Management and Aquatic Environment</i> . A.K. Publications. Harnell, J. (1995). <i>Marine Fish Farming for India</i> . Asiatic Publishing House. Nettleton, J. A. (1987). <i>Sea Food and Health</i> . Van Nostrand Reinhold. Tyagi, N. (2013). <i>Industrial Microbiology and Biotechnology</i> . Agrotech Press.					
Online Resources					
https://ebooks.inflibnet.ac.in/esp15/chapter/fermentation-technology/ https://byjus.com/neet/types-of-fermentation/ https://ebooks.inflibnet.ac.in/ftp1/chapter/food-fermentation/ https://microbenotes.com/fermentation/types-and-procedure/17492#google_vignette					
K1-Knowledge	K2-Understanding	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Mapping-Course Outcome Vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO2	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
CO3	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)
CO5	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	2.4	2.2	2.2	2.4	2.2	2.2	2.2	2.0	2.2	2.2

S-Strong(3),M-Medium(2),L-Low(1)

Mapping-Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	M(2)	M(2)	S(3)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	M(2)	M(2)	S(3)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	S(3)	S(3)	M(2)
W.AV	2.0	2.2	2.2	2.2	2.4

S-Strong(3),M-Medium(2),L-Low(1)

DSE 2	ORNAMENTAL FISH CULTURE	Credits: 4	Hours: 4		
Objectives	To learn about the different types of aquarium and important ornamental organisms				
Unit -I	Introduction to aquarium – types of aquarium – importance of aquarium - Introduction to ornamental aquatic organisms – identification of ornamental fishes – crustaceans - molluscs - ornamental aquatic plants. Status of ornamental fish culture and trade – world and Indian scenario.				
Outcome	Student will learn about the aquarium, different types of ornamental resources		K1/K2		
Objectives	To study about the design and construction of aquarium				
Unit-II	Design and construction aquarium – methods and materials used – setting up of freshwater and marine aquarium - filters and medias used in aquariums – pumps and other equipments – light and its types.				
Outcome	Students will gain knowledge about the construction of aquarium		K2		
Objectives	To learn about the aquarium maintenance and its methods				
Unit-III	Care and maintenance of aquarium - criteria for selection of ornamental fishes - water quality management and methods – probiotics – fish food and its type.				
Outcome	Students acquired knowledge about the aquarium maintenance and its methods		K2		
Objectives	To determine about the ornamental fish diseases and its management practices				
Unit-IV	Diseases of ornamental aquarium fishes - bacterial and fungal diseases – control measures and treatments.				
Outcome	Understanding the aquarium maintenance and its methods		K2		
Objectives	To understand about the brood stock management of ornamental fishes and its economic benefits.				
Unit -V	Brood stock management – breeding of ornamental fishes - Ornamental fish farm and hatchery – design and construction – packaging and transport – economics.				
Outcome	Students will learned the brood stock management of ornamental fishes and its economic benefits.		K3		
Text Books and Reference Books					
<p>Boyd, C., & Tucker, C. (1998). <i>Pond Aquaculture: Water Quality Management</i>. Springer International Publishing.</p> <p>Coche, A. G., & Muir, J. F. (1992). <i>Pond Construction</i>. Daya Publishing House.</p> <p>Dash, M. C., & Patnaik, P. N. (1994). <i>Brackish Water Prawn Culture</i>. Palani Paramount Publications</p> <p>Gupta, S., Mohapatra, B., & Routray, P. (2008). <i>Textbook of Breeding and Hatchery Management of Carps</i>. Narendra Publishing House.</p> <p>Sinha, P. (2011). <i>Fish Processing and Preservation</i>. APHA Publishing Corporation.</p> <p>Thomas, P. C., Rath, S., & Mohapatra, K. D. (2013). <i>Breeding and Seed Production of Finfish and Shellfish</i>. Daya Publishing House.</p>					
Onlineresources					
<p>https://www.jagranjosh.com/general-knowledge/coastal-zone-management-purpose-objective-and-challenges-1510572939-1</p> <p>https://www.eea.europa.eu/publications/92-826-5409-5/page035new.htmlhttps://unacademy.com/content/mppsc/study-material/geography/marine-protected-areas-in-india/https://www.academia.edu/47676064/Land_ocean_interactions_in_the_coastal_zone_science_plan</p> <p>https://earsc-portal.eu/display/EOWiki/Monitor+coastal+ecosystem</p>					
K1-Knowledge	K2-Understanding	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Mapping-Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)
CO2	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO5	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	2.4	2.0	2.2	2.4	2.2	2.2	2.2	2.2	2.2	2.2

S-Strong(3),M-Medium(2),L-Low(1)

Mapping-Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	S(3)	M(2)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	S(3)	S(3)	M(2)	M(2)
W.AV	2.4	2.2	2.2	2.2	2.0

S-Strong(3),M-Medium(2),L-Low(1)

DSE 3	MARINE FARMING	Credits: 4	Hours: 4		
Objectives	To learn about the coastal aquaculture and their importance				
Unit -I	Importance of Coastal aquaculture-Natural Stock-Over fishing-Depletion-Present status-Potentialities and socio economic problems of aquaculture. History, development and present status of mariculture in India and other countries - importance of mariculture.				
Outcome	Students will be learned about the coastal aquaculture and their importance		K1		
Objectives	To understand the farm design and management practices				
Unit-II	Site selection-Technical consideration-Topography-soil Characteristics - water supply- Pond type: Dyke: Inlet, outlet, -Structures, type and design of supply and drainage canals - Farm design, construction, operation and maintenance- Open sea forming: cages, pens - Raft - Raceways practices. Site selection and types of materials used for open sea farming - Design and construction of open sea farming structures and cages.				
Outcome	Enough acquired knowledge about the farm design, maintenance and different farming techniques		K2		
Objectives	To learn about the fin fishes and shell fishes cultivations and harvesting techniques				
Unit-III	An over view of Crustaceans, Fin fishes and Molluscans culture: Present status-Hatchery production: Collection and maintenance of brood stock-induced breeding-mass production of seeds-Types and components of hatchery. Pond management, nursery management-stocking, feeding schedules, water quality management-control of predators, parasites and disease management-harvesting.				
Outcome	Students will gain knowledge on the fin fishes and shell fishes cultivations and harvesting techniques		K3		
Objectives	To comprehend the different cultivable species for mariculture				
Unit-IV	Selection of cultivable species for mariculture, their biology and culture practices of <i>Chanoschanos</i> , <i>Latescalcarifer</i> , <i>Rachycentroncanadum</i> , <i>Mugil cephalus</i> , <i>Epinephelustavina</i> and <i>Etroplusuratensis</i> . - Molluscs: Mussel, Crustaceans: Lobster.				
Outcome	Gain knowledge about the different cultivable species for mariculture		K3		
Objectives	To learn about the Engineering aspects of open sea farming and its economic importance				
Unit -V	Engineering aspects of open sea cages – care and maintenance of open sea cages – various Indian and international companies and institutes involved in construction of open sea cages. Economics of farming. Seaweed culture-Types of culture-Economic importance of seaweeds.Economics of open sea farming - Recent development and future perspective of open sea farming.				
Outcome	Acquired knowledge on the engineering aspects of open sea farming and its economic importance		K2		
Text Books and Reference Books					
Boyd, C., &Tucker, C. (1998). <i>Pond Aquaculture: Water Quality Management</i> . Springer International Publishing.					
Coche, A. G., &Muir, J. F. (1992). <i>Pond Construction</i> . Daya Publishing House.					
Dash, M. C.,& Patnaik, P. N. (1994). <i>Brackish Water Prawn Culture</i> . Palani Paramount Publications.					
Gupta, S., Mohapatra, B., &Routray, P. (2008). <i>Textbook of Breeding and Hatchery Management of Carps</i> . Narendra Publishing House.					
Sinha, P. (2011). <i>Fish Processing and Preservation</i> . APHA Publishing Corporation.					
Thomas, P. C., Rath, S.,& Mohapatra, K. D. (2013). <i>Breeding and Seed Production of Finfish and Shellfish</i> . Daya Publishing House.					
Onlineresources					
http://eprints.cmfri.org.in/10661/1/2.%20Imelda%20Joseph.pdf					
http://eprints.cmfri.org.in/17861/1/AARDO_2023_V%20V%20R%20Suresh.pdf					
https://aquadocs.org/bitstream/handle/1834/35321/fish%20pond.pdf?sequence=1&isAllowed=y					
https://www.austincc.edu/sziser/Biol%201413/LectureNotes/InexamIII/Arthropods-Crustacea.pdf					
https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004061939435276sptrivedi_FISH_DISEASES.pdf					
http://eprints.cmfri.org.in/17152/1/Winter%20School_2023_Mariculture_Aswathy%20N.pdf					
https://www.fao.org/fishery/docs/CDrom/P24/i3530e/root/12.pdf					
K1-Knowledge	K2-Understanding	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Mapping – Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)	S(3)	L(1)	M(2)	M(2)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)	S(3)	L(1)
CO4	M(2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	L(1)	M(2)
CO5	L(1)	M(2)	M(2)	M(2)	M(2)	M(3)	M(2)	M(2)	M(2)	L(1)
W.AV	2.0	2.4	1.8	2.0	2.2	2.4	2.2	1.6	2.0	1.6

S–Strong(3),M-Medium(2),L-Low(1)

Mapping- Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	M(2)	M(2)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	M(2)	M(2)	S(3)	M(2)
W.AV	2.2	2.2	2.4	2.2	2.0

S–Strong(3), M-Medium(2), L-Low(1)

DSE 3	MARINE BIOFOULING, PREVENTION AND MANAGEMENT	Credits: 4	Hours: 4
Objectives	To understand the fundamental knowledge about the corrosion and its types		
Unit -I	Fundamentals of Corrosion: Basic aspects of Corrosion – Types of Corrosion – Mechanisms of Corrosions – Factors influencing corrosion – Corrosion testing and monitoring – Electrochemical methods, surface analysis		
Outcome	Students gain knowledge about the fundamental knowledge about the corrosion and its types		K2
Objectives	To learn about basics of marine biofouling		
Unit-II	Marine Biofouling Basics: Principal fouling organisms - Micro-fouling - Mechanisms of biofilm formation - Properties of a biofilm -Characteristics of the macro-organisms - Factors influencing biofouling growth - Geographical location - Distance from shore – Depth - Temperature and season - Water current and tidal conditions - Water quality - Other factors.		
Outcome	Understanding the basics of marine biofouling		K3
Objectives	To explore the microbial communities in biofouling		
Unit-III	Biofouling Communities: Biofilms – attached macro-fouling communities – mobile communities – Commensals – Parasites and pathogens.Activities of microorganisms as the driving force for biocorrosion - Sulfate-Reducing Bacteria (SRB)- Metal-Reducing Bacteria (MRB)- Metal-Depositing Bacteria (MDB)- Slime-producing bacteria-Acid-Producing Bacteria (APB)- Fungi.		
Outcome	Understanding themicrobial communities in biofouling		K4
Objectives	To evaluate the pathways of biofouling		
Unit-IV	Biofouling as a Pathway: Hull fouling and other ship components – Ports – harbors and marinas - Mariculture – fisheries/fishing and diving equipment – marine debris – Primary and Secondary pathways. Economic losses caused by biocorrosion.		
Outcome	Understanding the pathways of biofouling		K1
Objectives	To learn different management strategies in biofouling		
Unit -V	Biofouling Management: Anti-fouling strategies – anti-fouling systems – Cleaning Programs in the Shipping and aquaculture Industries – Current practice – natural and non-toxic antifoulants – risk analysis – education and training.		
Outcome	Understanding the management strategies in biofouling		K3
Text Books and Reference Books			
Alexander I., & Railkin. (2005). <i>Marine biofouling: Colonization Processes and Defenses</i> . Taylor & Francis e-Library.			
Drane, C.W. (1963). <i>Chapter on natural waters. "Corrosion", Vol. 1</i> . Edited by Shrier: George Newness Limited, London.			
Lynn Jackson. (2008). <i>Marine Biofouling and Invasive species: Guideline for Prevention and Management</i> . Compiled by Lynn Jackson on behalf of The Global Invasive programme and The UNEP Regional Seas Programme.			
Peter Maaß & Peter Peißker. (2011). <i>Handbook of Hot-dip Galvanization</i> , Weinheim:wiley-vch Verlag GmbH & Co. KGaA.			
Volkan Cicek., & Bayan Al-Numan. (2011). <i>Corrosion Chemistry</i> . Co-published by John Wiley & Sons, Inc. Hoboken, New Jersey, and Scrivener Publishing LLC, Salem, Massachusetts.			
Online Resources			
https://safety4sea.com/cm-understanding-marine-biofouling-how-anti-fouling-systems-prevent-growth/			
https://www.imo.org/en/OurWork/Environment/Pages/Biofouling.aspx			
http://www.biosciences-labs.bham.ac.uk/callowj/PDF%20files/iob.pdf			
https://www.frontiersin.org/research-topics/20632/impact-and-management-of-marine-biofouling			
https://link.springer.com/book/10.1007/978-3-540-69796-1			
https://www.routledge.com/Marine-Biofouling-Colonization-Processes-and-Defenses/Railkin/p/book/9780367454418			
https://books.google.com/books/about/Marine_and_Industrial_Biofouling.html?id=olnPUdL6Rt0C			
K1-Knowledge	K2-Understanding	K3-Apply	K4-Analyze
K5-Evaluate	K6-Create		

Mapping - Course Outcome vs Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)
CO2	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)
CO5	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
W.AV	2.2	2.2	2.4	2.0	2.4	2.2	2.2	2.2	2.4	2.2

S–Strong(3),M-Medium(2),L-Low(1)

Mapping - Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	S(3)	M(2)
CO2	M(2)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	S(3)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)
W.AV	2.4	2.2	2.0	2.2	2.2

S–Strong(3), M-Medium(2),L-Low(1)



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