

# **KARNATAK UNIVERSITY DHARWAD**



## **syllabus For Post Graduate Studies in Marine Biology**

**(I to IV Semesters)**

**Under Choice Based Credit System**

**From  
2017-18 onwards**

# ***Regulations Governing M.Sc. Course in Marine Biology***

(I to IV Semesters)

***Under Choice Based Credit System (CBCS)***

***(framed under Section 44(1)(c) of K.S.U. Act, 2000)***

## **1.0 Title**

These Regulations shall be called “Regulations” governing the M.Sc. Course in Marine Biology “Choice Based Credit System” in Karnatak University, Dharwad.

## **2.0 Commencement**

All these Regulations shall come into force on the date of approval by the Chancellor or such other date as the Chancellor may direct.

## **3.0 Definitions**

a. In these Regulations, unless otherwise provided:

“**Academic Council**” means Academic Council of the University constituted according to the *Karnatak State Universities Act, 2000*.

b. “**Board of Studies**” means P.G. Board of Studies of the University, Adhoc/Combined and Steering Committees of International Diploma Programmes in the discipline/subjects concerned.

c. “**Compulsory Course**” means fundamental paper, which the student admitted to a particular Post-Graduate Programme, should successfully complete to receive the Post Graduate Degree in the concerned subject.

d. “**Course Weightage**” means number of credits assigned to a particular course.

e. “**Credit**” means the unit by which the course work is measured. One Credit means one hour of teaching work or two hours of practical work per week. As regards the marks for the courses, 1 credit is equal to 25 marks, 2 credits are equal to 50 marks, 3 credits are equal to 75 marks and 4 credits are equal to 100 marks.

f. “**Cumulative Grade point Average (CGPA)**” refers to the Cumulative Grade Point Averages weighted across all the semesters and is carried forward from first semester to subsequent semesters.

g. “**Degree**” means Post-Graduate Degree.

h. “**Grade**” is an index to indicate the performance of a student in the selected course. These grades are arrived at by converting marks scored in each course by the candidate in both Internal Assessment and Semester-end Examinations.

- i. **“Grade Point Average (GPA)”** refers to an indication of the performance of the student in a given semester. GPA is the weighted average of all Grades a student gets in a given semester.
- j. **“Open Elective Course”** means a paper offered by a Department to the students of other Departments.
- k. **“Post-Graduate Programme”** means semesterised Master’s Degree Programmes excluding P.G.Diploma.
- l. **“Specialization course”** means advanced paper offered by a Department that a student of that Department can opt as a special course.
- m. **“Student”** means the student admitted to programmes under (k).
- n. **“University”** means Karnatak University, Dharwad.

#### **4.0 Minimum Eligibility for Admission**

A candidate, who has successfully completed Bachelor’s Degree programme in Science or any other Degree programme of this University or of any other University recognized as equivalent thereto by this University, shall be eligible for admission to the Post Graduate Programmes in science provided the candidate also satisfies the conditions like the minimum percentage of marks and other eligibility conditions as prescribed by the University from time to time. Admissions shall be as per Government of Karnatak reservation policy and the directions issued in this regard from time to time.

#### **5.0 Durations of the Programme**

The Durations of the study for the Post-Graduate programme shall extended over a period of two (three in case of MCA) consecutive academic years, each academic year comprising two semesters, and each semester comprising sixteen weeks with a minimum of ninety working days. However, the students, who discontinue the programme after one or more semesters due to extraordinary circumstances, are allowed and complete the programme with due approval from the Registrar. Candidate shall not register for any other regular course other than Diploma and Certificate courses being offered on the campus during the durations of P.G. Programme.

#### **6.0 Medium of Instruction and Evaluation**

The medium of instruction shall be English. However, the students may write the examinations in Kannada if so provided by the concerned Board of Studies.

#### **7.0 Programme Structure**

**7.1** The students of Post-Graduate programme shall study the courses as may be approved by the concerned Board of Studies. Faculty and the Academic Council of the University from time to time subject to minimum and maximum credits as outlined in these regulations.

7.2 There shall be three categories of courses namely, Compulsory Courses, Specialization courses and Open Elective Courses.

7.3 Each programme shall have a set of Compulsory Courses, as stipulated in the regulations governing the concerned programme that a student must complete to get the concerned degree.

7.4 In those programmes that offer specialization courses, the students shall choose the prescribed number of Specialization Courses offered within the Department.

7.5 Each Department shall offer Open Elective courses for students of other Departments. The students of a Department shall choose Open Elective courses from among those prescribed by the University and selected by the Department from time to time. P.G. Centres and affiliated colleges can offer those Open Electives Courses which are approved of prescribed by their Parent Department of the University. Such Open Elective courses shall be taught by qualified teachers approved by the University.

7.6 The credits for each of the Compulsory Courses may vary from 2 to 4: for Specialization Course, from 2 to 4 and for Open Elective Course, from 2 to 4, wherever project work/field work/practical are involved in the course, the credits may extend to 6 or as otherwise provided by concerned programme.

7.7 The minimum credits for P.G. Programme shall be 92. In the case of MCA, the minimum number of credits shall be 158 and in case of M.Sc. Computer Science the minimum credits are 116.

7.8 The students shall undertake project/field work during the programme as compulsory course or in lieu of Specialization Course or Open Elective Course if so specified by concerned Board of Studies.

7.9 The ratio between Compulsory, Specialization and Open Elective may differ from department to department

7.10 The detailed programme structure for Faculty of Science & Technology shall be as prescribed and shown in Annexure-I, Annexure-Ia & Annexure-Ib

7.11 The Open Elective Courses generally will have practical component, unless otherwise specified by the respective Board of Studies. The number of students admitted to the course shall commensurate with the availability of infrastructure.

## **8.0 Attendance**

8.1 Each course shall be taken as a unit for the purpose of calculating the attendance.

8.2 Each student shall sign the attendance register maintained by the Department for each course for every hour/unit of teaching /practical. The course teachers shall submit the monthly

attendance report to the Chairperson of the Department who shall notify the same on the notice board of the Department during the second week of the subsequent month.

**8.3** Marks shall be awarded to the student for attendance as specified in the regulations concerning evaluation.

**8.4** A student shall be considered to have satisfied the required attendance for each course if he/she has attended not less than 75% of the total number of instructional hours during the semester.

**8.5** There is no provision for condoning shortage of attendance.

**8.6** The students who do not satisfy the prescribed requirement of attendance shall not be eligible for the ensuing examination. Such candidates may seek admission a fresh to the given semester.

**8.7** Such of the candidates who have participated in State/National level Sports, NSS, NCC, Cultural activities and other related activities as stipulated under the existing regulations shall be considered for giving attendance for actual number of days utilized in such activities (including travel days) subject to the production of certificates from the relevant authorities within two weeks after the event.

## **9.0 Examination**

**9.1** There shall be an examination at the end of the each semester. The odd semester examinations shall be conducted by the respective Departments/P.G. Centres/Colleges. The even semester examinations shall be conducted by the University.

**9.1.1** Unless otherwise provided, there shall be semester-end examination of 3 hours duration for 75/100 marks; 1.5 hours for 50 marks and 2/4 hours for 35/75 marks for practical examination.

**9.1.2** Every student shall register for each semester-end examinations as per the University Notification by submitting duly completed application form through the proper channel and shall also pay the fees prescribed.

**9.1.3** The Office of the Registrar (Evaluation) shall allot the Register Number to the candidate at 1st semester-end examination. That will be the Register Number of the candidate for all subsequent appearances at semester-end examinations.

**9.1.4** The Answer scripts shall be in the safe custody of the University for a maximum period of six months from the date of announcement of results. These shall be disposed off after six months.

**9.1.5** The programme under CBCS is a fully carry-over system. A candidate reappearing for either the odd or even semester examinations shall be permitted to take examinations as and when they are conducted (even semester examination in even semester and odd semester examination in odd semester).

**9.1.6** Candidates who have failed, remained absent or opted for improvement in any course/ courses shall appear for such course/courses in the two immediate successive examinations that are conducted. However, in the case of the candidates appearing for improvement of their marks, the marks secured in the previous examination shall be retained, if the same is higher.

**9.1.7** Candidates who desire to challenge the marks awarded to them, in the even semester-end examinations, may do so by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days from the announcement of results.

## **9.2 Odd Semester Examination**

**9.2.1** There shall be a Board of Examiners to set, scrutinize and approve question papers.

**9.2.2** The BOE shall scrutinize the question papers submitted in two sets by the paper setters and submit the same to the office of the Registrar (Evaluation)

**9.2.3** The office of the Registrar Evaluation shall dispatch the question papers to the Departments/P.G. Centers/Colleges who shall conduct the Examinations according to the Schedule announced by the University.

**9.2.4** The Chairperson of the Department/Administrator of the P.G. Centre/Principal of the College shall appoint one of their full time course teachers as Post Graduate Programme (PGP) Coordinator who shall conduct the examinations and arrange for evaluation of answer scripts.

**9.2.5** Answer scripts shall be valued by the examiners appointed by the University. However, in those centers where an examiner for a particular course is not available, then the answer scripts of that course shall be dispatched to the office of the Registrar (Evaluation) who shall arrange for valuation of the same.

**9.2.6** There shall be single valuation. The examiners (Internal or External) shall value the answer scripts and shall indicate the marks awarded to each question on the answer script.

**9.2.7** The Marks List, a copy of the Examination Attendance Sheet and the sealed bundles of the answer scripts shall be dispatched by PGP Coordinator to the Registrar (Evaluation)'s Office at the conclusion of the valuation at the respective centers.

**9.2.8** The Office of the Registrar Evaluation shall process and announce the results.

## **9.3 Even Semester Examination**

**9.3.1** There shall be a Board of Examiners to set, scrutinize and approve question papers.

**9.3.2** As far as practicable, it will be ensured that 50% of the paper setters and examiners are from other Universities/Research Institutes.

**9.3.3** Each answer script of the semester-end examination (theory and project report) shall be assessed by two examiners (one internal and another external). The marks awarded to that answer script shall be average of these two evaluations. If the difference in marks between two evaluations exceeds 20% of the maximum marks, such a script shall be assessed by a third examiner. The marks allotted by the third examiner shall be averages with nearer award of the two evaluations.

Provided that in case of the number of answer scripts to referred to the third examiner in a course exceeds of 5 or 20% of the total number of scripts, at the even semester-end examinations, such answer scripts shall be valued by the Board of Examiners on the date to be notified by the Chairperson of the Board of Examiners and the marks awarded by the Board shall be final.

**9.3.4** Wherever dissertation/project work is prescribed in the even semesters of a programme, the same shall be evaluated by both internal and external examiners. The evaluation shall be as prescribed by the concerned Board of Studies.

**9.3.5** In Case of programmes with practical examination details of maximum marks, credits or duration may vary from Department to Department as specified by the concerned Board of Studies.

## **9.4 Evaluation**

**9.4.1** Each Course shall have two evaluation components- Internal Assessment (IA) and the Semester End Exams.

**9.4.2** The IA Component in a course shall carry 25% / 30% /50% and the Semester End Examination shall carry 75% /70% /50% respectively, as the case may be. Courses having 25% & 30% / 50% marks as internal assessment shall have 3 / 5 marks allotted to attendance. However, in case of project work, the distribution of marks for Internal Assessment and Examination shall be left to the discretion of the concerned BOS.

**9.4.3** Marks for attendance shall be awarded to the students according to the following table.

For courses carrying 25% of marks for IA, the attendance marks shall be

<b>Attendance (in percentage)</b>	<b>Marks</b>
Above 90	3
Above 80 and up to 90	2
Above 75 and up to 80	1

**9.4.4** Internal Assessment (IA) shall be based on written tests, practical and seminars. However, the number of IA components per course per semester shall not be less than two.

**9.4.5** The IA marks list shall be notified on the Department Notice Board as and when the individual IA components are completed and the consolidated list shall be submitted to the

Office of the Registrar Evaluation before the commencement of semester-end examination, or as directed by the University.

**9.4.6** The tests shall be written in a separately designated book supplied by the University which shall be open for inspection by the students after evaluation.

**9.4.7** There is no provision for seeking improvement of Internal Assessment marks.

**9.4.8** The IA records, pertaining to Semester Examination, shall be preserved by the Department/Centers/Colleges for a period of one year from the date of semester examination. These records may be called by the University or body constituted by the University as and when deemed necessary.

**9.4.9** The dissertation /project work viva-voce shall be conducted by an internal and external examiner.

## **10.0 Maximum duration for completion of the Programme**

**10.1** A candidate admitted to a post graduate programme shall complete it within a period which is double the duration of the programme from the date of admission.

**10.2** Whenever the syllabus is revised, the candidate reappearing shall be allowed for the examinations only according to the new syllabus.

## **11.0 Declaration of Results**

**11.1** The minimum for a pass in each course shall be 40% of the total marks including both IA and the semester-end examinations. Further, the candidate shall obtain at least 40% of the marks in the semester-end examination. There is no minimum for the IA marks.

**11.2** Candidates shall secure a minimum of 50% in aggregate in all courses of a programme in each semester to successfully complete the programme.

**11.3** Candidates shall earn the prescribed number of credits for the programme to qualify for the PG Degree.

**11.4** For the purpose of announcing the results, the aggregate of the marks secured by a candidate in all the semester examinations shall be taken into account. However, Ranks shall not be awarded in case of the candidate has not successfully completed each of the semesters in first attempt or has not completed the programme in stipulated time (vide Regulation 5) or had applied for improvement of results.

## **12.0 Marks, Credit Points, Grade points, Grades and Grade Point Average**

**12.1** The grade points and the grade letters to candidates in each course shall be awarded as follows:



Percentage of marks	Grade points	Grade Letter
75 and above, up to 100.00 %	7.50 to 10.00	A
60 and above but less than 75%	6.00 and above but less than 07.5	B
50 and above but less than 60%	5.00 and above but less than 6.0	C
40 and above but less than 50%	4.00 and above but less than 5.00	D
Less than 40%	Less than 4.00	F

**12.2 Credit Point (CP):** The Credit Point for each course shall be calculated by multiplying the grade obtained by the credit of the course.

**12.3** The award of Grade Point Average (GPA) for any student is based on the performance in the whole semester. The student is awarded Grade Point Average for each semester based on the Total Credit Points obtained and the total number of credits opted for. The GPA is calculated by dividing the total credit points earned by the student in all the courses by the total number of credits of those courses of the semester.

**12.4** The Cumulative Grade Point Average (CGPA) shall be calculated by dividing the total number of credit points in all the semesters by the total number of credits in all the semesters. The CGPA to date shall calculated by dividing the total number of credit points in all the semesters to date by the total number of credits in all the semesters to date.

CGPA for the I Semester= Sum of the CP of the I Semester+Sum of the credits of the I Semester

CGPA for the II Semester= Sum of the CP of the Sem +Sum of the CP of II Sem +Sum of the Credits of the I Semester+II Semester

CGPA for the III and IV Semester shall be computed accordingly.

**12.5** The Grade Card at each semester examination shall indicate the courses opted by the student, the credit for the course chosen by the student, the credit points obtained in each course, the grade letter and the grade point average. No. class shall be awarded for each semester and the same would only be awarded at the end of all the semesters based on Cumulative Grade point Average.

**12.6** Class shall be awarded to the successful candidates based on the Cumulative Grade Point Average (CGPA) as specified below.

Cumulative Grade Point Average (CGPA)	Class to be awarded
7.5 to 10.0	First Class with Distinction
6.0 and above but below 7.5	First Class
5.0 and above but below 6.0	Second Class

### 13. Miscellaneous:

a) Notwithstanding anything contained in these regulations, the semester system at Post-Graduate level is hereby repeated.

- b)** The provisions of any order, Rules or Regulations in force shall be inapplicable to the extent of its inconsistency with these Regulations.
- c)** The University shall issue such order, instructions, procedures and prescribe such format as it may deem fit to implement the provisions of this Regulations.
- d)** The procedural details may be given by the University from time to time.
- e)** Any unforeseen problems/difficulties may be resolved by the Vice Chancellor, whose decision in the matter shall be final.

### Annexure-I

The Programme structure of the Master of Science Degree shall be as follows:

Semester	No. of compulsory & Specialization courses (credits/course)	Total credits for compulsory & Specialization courses	No. of open elective course (credits/course)	Total credits of open elective course	Total credits for the semester
Sem. I	Th:04(04)=16 Pra/Th*:02(04)=08	24	----	--	24
Sem.II	Th:03(04)=12 Pra/Th*:03(02)=06	18	Th:01(04)=04	04	22
Sem.III	Th:03(04)=12 Pra/Th*:03(02)=06	18	Th:01(04)=04	04	22
Sem.IV	Th:03/04** (04) =12/16 Pra/Th*:3/4**(02) =06/08 D# 01(06)=06	24		--	24
Total	Th 13(04)= 52 Pra /Th 12/13(02)=24/26 D1(06) =06	84	Th: (04)=08	08	92

Note: Except for I & IV Semester, the concerned Department shall offer one each of open elective theory and practical course or two \*open elective Theory courses for students of other science departments.

\*Only for Mathematics; \*\* for Mathematics and Statistics; # except Mathematics & Statistics Abbreviations: Th=Theory; Pra=Practical; D=Dissertation;

**GRADE CARD**

Programme: M.Sc. ( )

Name of the Candidate:..... Semester: IV

Seat No: Month &amp; Year:

Course	Course Code	Credit	IA Marks	Theory/ Practical	Max	Marks obtained	Semester Grade point	Credit Points		
Max			Obt		Max			Obt		
<b>Compulsory Courses</b>										
Course-I	XXCT 4.1	04	25	15	75	45	100	60	6.00	24.00
Course-II	XXCT 4.2	04	25	15	75	59	100	74	7.40	29.60
Course-III	XXCT 4.3	04	25	15	75	28	100	43	4.30	17.20
Course-IV	XXCT 4.4	02	15	06	35	34	50	40	8.00	16.00
Course-V	XXCT 4.5	02	15	06	35	34	50	40	8.00	16.00
Course-VI	XXCT 4.6	02	15	06	35	34	50	40	8.00	16.00
Course-VII	XXCD# 4.7 Or	06	25	20	125	100	150	120	8.00	48.00 <i>Or</i>
Course-VI	XXCT* 4.7	04	25	15	75	28	100	43	4.30	17.20
Course-VIII	XXCP+/CTψ 4.8	02	15	05	35	35	50	40	8.00	16.00
Total		24			600			200.00/185.00		

XX refers to course abbreviations, 4.1 refers to IV semester course 1; e.g. CHI CT

1.1=chemistry

Inorganic compulsory theory 1.1

# Except for Mathematics and Statistics; \* For Statistics and mathematics; + Only for Statistics;

Ψ Only for Mathematics

$$\text{GPA for IV Semester} = \frac{\text{CP (IV Sem)}}{\text{Credits (IV Sem)}} = \frac{200}{24.00} = 8.33$$

$$\text{GPA for I semester} = \frac{\text{CP (I sem)}}{\text{Credits (I sem)}}$$

$$\text{CGPA for I semester} = \text{GPA for I semester}$$

$$\text{CGPA for II Sem} = \frac{\text{CP (I sem)} + \text{CP (II sem)}}{\text{Credits (I sem)} + \text{Credits (II sem)}}$$

$$\text{CGPA for III Sem} = \frac{\text{CP (I sem)} + \text{CP (II sem)} + \text{CP (III sem)}}{\text{Credits (I sem)} + \text{Credits (II sem)} + \text{Credits (III sem)}}$$

$$\text{CGPA for the programme} = \frac{\text{CP (I sem)} + \text{CP (II sem)} + \text{CP (III sem)} + \text{CP (IV)}}{\text{Credits (I sem)} + \text{Credits (II sem)} + \text{Credits (IIIsem)} + \text{Credits (IV sem)}}$$

(\*CP: Credit point)

The Post Graduate Department of Studies and Research in Marine Biology was established in Karwar Post Graduate Centre of the Karnatak University in the year 1975. The department is known for its academic excellence and extension activities (through FGB- Fishermen Guidance Bureau) in coastal regions. The Department is supported by coordinated grants from UGC, DBT, DST, BRNS, MoEF, MoES and INCOIS.

The Department offers three courses in Marine Biology viz. M.Sc., M.Phil. and Ph.D.

The Department also offers skill development course under National Skill Qualification Framework (NSQF) supported by Agriculture Skill Council of India (ASCI).

### **M.Sc. Programme in Marine Biology under Choice Based Credit System (CBCS) w.e.f. 2017-2018.**

**1.1 Duration:** Two years with four semesters, each of 16 week duration.

**1.2 Eligibility for admission:** B.Sc. graduates in life science subjects from Karnatak University or any other recognized Universities with 45% aggregate marks are eligible for admission to M.Sc. Marine Biology course. Relaxation is for SC/ST/Cat-I students as per University norms.

**1.3 Intake:** 30 students for the first semester that includes seats under enhanced fee. Other rules for admission for intake of students may change from time to time as per university notification.

**2. Attendance:** Every student must have at least 75% attendance in each semester for eligibility to appear for semester and examination.

**3. Medium of instruction:** the medium of instruction shall be English.

**4. Course Structure:** The student desirous for a M.Sc. degree in Marine Biology shall complete 92 credits, 84 credits in Marine biology and 8 credits in other subjects. Department also offers 4 credits each for elective papers in II and III semester for students from other subjects. Given below are the details about credits for each paper/practical/dissertation work and number of teaching hours for the four semesters along with marks allocation for students offering M.Sc. Marine Biology or Elective paper in Marine Biology.

**SEMESTER I:**  
***Compulsory Papers***

	<b>Theory</b>	<b>Hrs/Wk</b>	<b>Credits</b>	<b>Practical</b>	<b>Hrs/Wk</b>	<b>Credits</b>
MBCT 1.1	Biosystematics & Biology of Non-Chordates	4	4	MBCP 1.5	4	2
MBCT 1.2	Genetics and Molecular Cell Biology	4	4	MBCP 1.6	4	2
MBCT 1.3	Oceanography	4	4	MBCP 1.7	4	2
MBCT 1.4	Marine Ecology and Pollution	4	4	MBCP 1.8	4	2
			16	+	8=24	

**SEMESTER II:**  
***Compulsory Papers***

	<b>Theory</b>	<b>Hrs/Wk</b>	<b>Credits</b>	<b>Practical</b>	<b>Hrs/Wk</b>	<b>Credits</b>
MBCT 2.1	Biology of Chordata, Reproductive & Developmental Biology	4	4	ZCP 2.4	4	2
MBCT 2.2	Environmental Biology and Planktonology	4	4	ZCP 2.5	4	2
MBCT 2.3	Aquaculture	4	4	ZCP 2.6	4	2
OEC	-	4	4			
			16	+	6=22	

**SEMESTER III:**  
***Compulsory Papers***

	<b>Theory</b>	<b>Hrs/Wk</b>	<b>Credits</b>	<b>Practical</b>	<b>Hrs/Wk</b>	<b>Credits</b>
MBCT 3.1	Fishery harvest and post harvest technology	4	4	ZCP 3.4	4	2

MBCT 3.2	Animal Physiology, Endocrinology & Biochemistry	4	4	ZCP 3.5	4	2
MBCT 3.3	Mariculture	4	4	ZCP 3.6	4	2
OEC	-	4	4		-	
	Project Work (Commences)	4	-			
		16		+		6=22

**SEMESTER IV:  
Compulsory Papers**

	Theory	Hrs/Wk	Credits	Practical	Hrs/Wk	Credits
MBCT 4.1	Fishery Resources and Management	4	4	ZCP 4.4	4	2
MBCT 4.2	Marine Biotechnology	4	4	ZCP 4.5	4	2
MBCT 4.3	Fishery Economics and Management	4	4	ZCP 4.6	4	2
MBD 4.7	Dissertation	4	6			
		18		+		6=24

**Total Credits: 58 (Theory +Dissertation)+26 (Practical)+8(OEC)=92**

- Note:**
1. There Shall be 25 Marks as internal assessment (IA) for each theory paper and 10 marks as IA for each Practical.
  2. There shall be 75 marks for each theory paper and 40 marks for each practical final examination at the end of each semester.
  3. The Dissertation work carries 150 marks (IA-25 marks; Dissertation -75 marks; Viva-Voce-50marks)

**Scheme of Examinations:**

- i) The examination will be conducted at the end of the each semester
- ii) Each theory course will be have a question paper of 3 hours of duration and maximum marks of 75. Each practical course will have examination of 4 hours duration and maximum marks of 40



## **QUESTION PAPER PATTERN:**

### **A) THEORY**

There shall be a total of 15 questions. In section I, out of 4 questions any 2 questions to be answered, each question carrying 15 marks. In section II, out of 5 questions any 3 questions to be answered, each question carrying 10 marks. In section III, out of 5 questions answer any 3 questions each carrying 15 marks.

### **B) PRACTICALS**

The marks allotted for practical is 50, out of which 10 is for internal and 40 is for semester final.

### **C) PROJECT EVALUATION:**

1. Internal assessment	: 25 marks
2. Evaluation of dissertation	: 75 marks
3. Viva-voce	: 50 marks
Total	:150 marks

### **Award of Gold medals:**

The following gold medals will be awarded to the students for standing highest at the M.Sc. Marine Biology Examination.

- Late. Shri Gurulingappa HakkaPakki Gold Medal.

### **Co-curricular Activities:**

Seminars, assignments and group discussions will be conducted periodically. Field visits, cruise, study tours and Institutional/industrial visits are conducted. However, these activities do not carry any marks.

## **PROGRAMME SPECIFIC OUTCOMES (PSOS)**

By completing Post graduation course in Marine Biology, students are expected to have achieved the following knowledge, skills and capabilities.

- This programme offers a global platform to involve in academic, research and entrepreneurship capacities through knowledge intensive, innovative thinking, problem solving skills.
- The programme provides understanding of basic and advanced concept of theoretical and practical skills in building the sustainability.
- The course provides independent project/dissertation research, develops computational, analysis and interpretation skills by evaluating qualitative and quantitative data and one can be independent researcher.
- This course provides greater platform for competitive and qualification exams such as UGC-NET, CSIR NET in Life science and Earth science, ICAR, SET, GATE, GRE, as well administrative and academic peers.

<b>Paper Code and Name</b>	<b>Paper: MBCT 1.1. Biosystematics &amp; Biology of Non-Chordates</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will learn the Animal kingdom classification and basics of taxonomy of non-chordates.
CO 2	Students will understand how morphological change due to change in environment helps drive evolution over a long period of time.

<b>PARTICULARS</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I: Principles of taxonomy</b> Scope of taxonomy. Species concept, Theories of biological classification, Taxonomic hierarchy. Central theme of International Code of Zoological Nomenclature. Modern trends in taxonomy.	<b>8hrs.</b>
<b>Unit II: General classification of non-chordata.</b> Classification upto order and systematic position of - Protozoa, Porifera, Cnideria, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata.	<b>10hrs.</b>
<b>Unit III: Minor phyla.</b> General organization and systematic position of minor phyla - Ctenophora, Nemertinea, Chaetognatha, Entoprocta, Rotifera, Kinorhyncha, Phoronida, Brachiopoda.	<b>10hrs.</b>
<b>Unit IV: Morphology, locomotion, feeding and digestion among invertebrates</b> Structural modifications and adaptations for locomotion, food and feeding. Structural variations in digestive system.	<b>6hrs.</b>
<b>Unit V: Respirations, circulation and excretions among invertebrates</b> Structure involved in respiration, respiratory pigments. Evolution of respiratory strategies. Role of body fluid. Types of circulations. Circulatory mechanism. Excretory organs and excretion.	<b>8hrs.</b>
<b>Unit VI: Nervous system, sense organs and reproduction among invertebrates</b> Cephalization. Development and evolution of nervous system. Sense organs. Reproductive patterns. Reproduction and metamorphosis. Larvae and their evolutionary significance.	<b>6 hrs.</b>
<b>REFERENCES</b>	
1. Barnes R.D. (1968). Invertebrate Zoology. W.B. Saunders Co., Philadelphia, London and Toronto,	

2. Brown, Jr., F.A (1950). Selected Invertebrates Types, Jhon Wiley & Sons, New York.
3. Clark, R. B. (1964). Dynamics in Metazoan Evolution. Oxford: Clarendon Press.
4. Hyman, L.H. (1967). The Invertebrates, Vol. I – VI, Mc Graw-Hill, N. Y.
5. Mayr, E. (1963): Animal Species and Evolution. Harward Universtity Press Cambridge
6. Kotpal R.L. (2015-16) 10 edition *Minor Phyla* – Rastogi Publication ISBN . 978-93-5078-025-1
7. Verma P.S. (2008) *A manual of practical zoology, Invertebrates*, Ramnagar, New Delhi. ISBN 81-219-0829-9
8. Kotpal R.L (2016-17) 11<sup>th</sup> edition, *Modern text book of Zoology Invertebrates (Animal Diversity -1)*, Rastogi Publicatiion ,Meerut; ISBN 978-93-5078-040-4
9. Kotpal R.L (2001-06) , *Zoology Phylum 1-8,Protozoa to Echinodermata*, Rastogi Publication Meerut, ISBN 81-7133-534-9
10. Taylor, J.W (1894-1907): Monograph of the land and freshwater Mollusca of the British Isles.4 Vols. Leeds.

<b>Paper Code and Name</b>	<b>MBCT 1.2: Genetics and Molecular Cell Biology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Students will understand the basic concept of cell and its components with their functions in details and acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
CO 2	Students will have adequate understanding and knowledge in Genetics & Cell biology and related aspects making them to take up advanced research in the field of Aquatic and terrestrial organisms studies such as cancer biology, Neurobiology, Physiology etc.

<b>PARTICULARS</b>	<b>Teaching Hours (Max. 50)</b>
<p><b>Unit I: Mendelian genetics</b></p> <p>An overview of Mendelian Genetics. Phenomenon of dominance and its applications in animals. Mechanisms of dominance. Law of segregations. Law of independent assortment.</p>	<b>4hrs.</b>
<p><b>Unit II: Linkage and crossing over</b></p> <p>Sutton view on Linkage, Morgan's view on linkage. Chromosome theory of linkage, complete &amp; incomplete linkage, significance of linkage. Types of crossing over. Somatic and germinal crossing over. Mechanism of crossing over. Synapsis, Kinds of crossing over. Significance of crossing over. Sex linked inheritance. Multiple alleles. Structure of Genes.</p>	<b>6hrs.</b>
<p><b>Unit III: Chemical nature of genetic material</b></p> <p>DNA structure and its replication. One gene one polypeptide concept. Genetic control of protein synthesis. Regulation of gene expression in prokaryotes and eukaryotes. Genetic engineering. Gene mutations. Chromosomal mutations. Practical application of mutation. Polyploidy in animals and their application.</p>	<b>8hrs.</b>
<p><b>Unit IV: Introduction and history of cell biology</b></p> <p>Techniques in cell biology- Microscopy, Focal length, Angular aperture of lens and Resolving power of the microscope. Light microscopy, Phase-contrast microscope, Dark field microscope, Fluorescence microscopy, Scanning Electron Microscope (SEM) and Scanning Transmission Electron Microscopy (STEM). Staining- Chemical basis of staining, simple staining and differential staining.</p>	<b>10hrs.</b>

<p><b>Unit V: Separation techniques</b></p> <p>Chromatography- Different phases of chromatography, Adsorption chromatography, Thin layer chromatography and partition chromatography.</p> <p>Centrifugation- Differential, Gradient, Zonal centrifugation and Equilibrium density centrifugation. Electrophoresis-mechanism of Electrophoresis.</p>	<p><b>8hrs.</b></p>
<p><b>Unit VI: Membrane biology</b></p> <p>Fluid mosaic model of plasma membrane. Transport across biomembrane- Passive transport, Active transport, Endocytosis and Exocytosis. Structure and functions of cell organelle. Bioenergetics, Protein import to mitochondria.</p>	<p><b>6 hrs</b></p>
<p><b>Unit VII : Cell division and cell cycle</b></p> <p>Cell division- Amitosis, Mitosis and Meiosis. Cell cycle- phases of cell cycle and molecular events of cell cycle. Cytoskeleton- structure and role in cell architecture, Structure of cilium and flagellum. Cellular aging, Cell death mechanisms- necrosis and apoptosis.</p>	<p><b>4 hrs</b></p>
<p><b>Unit VIII: Cancer biology</b></p> <p>Cancer: Benign and Malignant tumours. Types of cancer- carcinomas, sarcomas, lymphomas, leukemias and mixed type. Properties of cancer cells, treatment for cancer.</p>	<p><b>2 hrs</b></p>
<p><b>REFERENCES</b></p>	
<ol style="list-style-type: none"> <li>1. Agarval V.K. and Verma P.S (1997) 1<sup>st</sup> edition, <i>concept of Genetics, Human Genetics and Eugenic</i> 03 255 , pp240</li> <li>2. Agarval V.K. and Verma P.S (1997) 1<sup>st</sup> edition ,<i>concept of Molecular Biology</i> 03 255 pp160</li> <li>3. Berg.P (1991), <i>Reverse Genetics: Its origin and prospects Biotechnology</i> 9: 342-344</li> <li>4. De Robertis (1965): <i>Cell Biology</i>, W.B. Saunders Company, London.</li> <li>5. Gupta P.K (2016-17) 1<sup>st</sup> edition, <i>Molecular Biology and Technology</i> and text books for University students, Rastogi Publication Meerut, ISBN 978-93-5078-050-3</li> <li>6. Gupta P.K (2004),<i>Biotechnology and Genomics</i>, Rastogi Publication Meerut, India, pp1-796</li> <li>7. Gupta P.K,<i>Genetics</i> , Rastogi Publication, Meerut,India</li> <li>8. Gupta P.K (2016-17)8<sup>th</sup> edition, <i>Cytology, Genetics and Evolution</i>, A textbook for undergraduate students, Rastogi Publication, Meerut, ISBN 978-93-5078-136-4</li> <li>9. Joshi. P (2007) <i>Genetics Engineering and its Application</i>, Published by Agrobios, Jodhpur, ISBN 81-7754-197-8</li> <li>10. Mari muttu. R (2008) <i>Microscopy and Microtechnicals</i> - MJP, Chennai</li> <li>11. Sharma N.S (2005)1<sup>st</sup> edition, <i>Molecular Structure of Genes and Chromosomes</i>, Published by International Scientific Publishing Academy, New Delhi, ISBN 81-8293-020-0</li> <li>12. Satpathy G.C (2001) <i>Developmental and Modern Biology</i> , Kalpaz, Delhi; ISBN 81-7835-053-X</li> <li>13. V.K. and Verma P.S (1997) 1<sup>st</sup> edition, <i>concept of cell Biology</i> 03 250, pp336</li> </ol>	

<b>Paper Code and Name</b>	<b>MBCT 1.3: Oceanography</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper,	
CO 1	student will have better understanding of marine and its related biological process and cycles
CO 2	Students will be able to demonstrate how the oceans are connected to and drive major Earth processes, such as atmospheric and oceanic circulation, climate and weather, plate tectonics, and sustainability of human and marine populations

<b>PARTICULARS</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I</b> Origin of oceans, Continental drift and plate tectonics. History and various disciplines of oceanography- Definitions, dimensions and limits. Institutions related to oceanography. Oceanographic expeditions.	<b>8hrs.</b>
<b>Unit II</b> Waves, tides and tsunamis. Upwelling and sinking. General circulation and currents pattern in the world oceans of Atlantic, Pacific and Indian Ocean. Monsoon currents.	<b>6hrs.</b>
<b>Unit III</b> General submarine topography & oceanographic features - classification of sea floor. Origin and evolution of continental shelf, slope, ridges, trenches, canyons. Topography of Antarctic, Arctic, Atlantic, Indian and Pacific oceans. Features of Arabian sea and Bay of Bengal.	<b>8hrs.</b>
<b>Unit IV</b> Marine Sediment – classification, constituents, distribution and significance of marine sediments. Mudflats, their formation and importance. Principles of bio-geochemistry. Particulate suspended matter.	<b>2hrs.</b>
<b>Unit V</b> Physical properties of sea water and sea ice. Freezing point and factors affecting freezing point of sea water. Distribution and significance of salinity, temperature and density. Heat budget of the ocean. T.S diagram and water masses.	<b>4hrs.</b>

<p><b>Unit VI</b></p> <p>Chemical composition of sea water, Constancy of composition and factors influencing composition. Major and minor constituents. pH. Distribution of pH in marine environment, redox potential, selected radioactive isotopes and stable isotopes organic compounds, dissolved gases, process regulating the composition. Trace metals and their biological role</p>	<p><b>10 hrs</b></p>
<p><b>Unit VII</b></p> <p>Oxygen cycle-Sources, concentration, distribution and factors affecting the distribution of oxygen. Carbon dioxide cycle- sources, concentration, distribution and factors affecting the distribution of carbon dioxide. Nitrogen cycle, phosphorus cycle and silicon cycle. Factors affecting the distribution of nutrient elements. Vertical distribution of nutrient elements in the world ocean.</p>	<p><b>10 hrs</b></p>
<p><b>REFERENCES</b></p>	
<ol style="list-style-type: none"> <li>1. Albert Defant (1961) Volume II; <i>Physical Oceanography</i></li> <li>2. Allen E. Herbert, James R. Kramer; <i>Nutrients in Natural waters</i>; A Wiley- Interscience Publication</li> <li>3. Diwan A.P and Arora D.K; <i>Oceanography Environment</i>, Anmol Publications, New Delhi</li> <li>4. Dean F. Martin; (1970) Volume 2, <i>Marine Chemistry</i>, Marcel Dekker, INC., New York</li> <li>5. Gerhard Neumann and Willard J. Pierson (1994). <i>Principal of Physical Oceanography</i>; United states of America</li> <li>6. Harold Barnes (1968). <i>Oceanography and Marine Biology</i>, Vol-1,The Marine Station, Millport, Scotland</li> <li>7. Keen M.J (1968). <i>An Introduction to Marine Geology</i>, Hazell Watson and Vincy Ltd, Great Britain</li> <li>8. R. Davis, J.R. (1977). <i>The principles of Oceanography</i>. Addison-Wesley Publishing Company.</li> <li>9. H. V.SVERDRUP (1961). <i>The Oceans Their Physics, Chemistry, and Biology</i>.</li> <li>10. William S; <i>An Introduction to Physical Oceanography</i>, London</li> <li>11. Werner Stumm and James J. Morgan;(1970). <i>Aquatic Chemistry</i>, Wiley- Interscience ; A Division of John Wiley and sons, Inc-United States of America</li> <li>12. Wallace S. Broecker (1974). <i>Chemical Oceanography</i> by Harcourt Brace Jovanovich, Inc; United States of America.</li> </ol>	



<b>Paper Code and Name</b>	<b>MBCT 1.4: Marine Ecology and Pollution</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will understand the evolutionary and functional basis of Marine ecology.
CO 2	Students will understand the Marine environmental pollution with the insights Govt. Acts on environmental conservation.

<b>PARTICULARS</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I:</b> Ecology and its concepts. Importance of study, major subdivisions of the world oceans. Salient features of Karwar coastal waters.  Ecological media, substratum and habitat. Role of abiotic factors- light, temperature, water movements, etc.	<b>8 hrs</b>
<b>Unit II:</b> Biotic factors- Nutrition, competition, predator, prey-predator relationship, Leibigs law of the minimum. Animal associations-intraspecific and interspecific relationships, Ecological succession.	<b>5 hrs</b>
<b>Unit III:</b> Lunar periodicity, biological clock, foodweb and trophic relationships, elementary and functional concepts of an ecosystem.	<b>5 hrs</b>
<b>Unit IV:</b> Energy in ecosystem, Energy flow. Marine Borers-Crustacean and molluscan borers, Marine fouling, methods of prevention of fouling and wood borers.	<b>7 hrs</b>
<b>Unit V:</b> Pollution- Surface, ground water and marine pollution. Agricultural pollution- Insecticides, pesticides, and their effects on aquatic environment. Heavy metal pollution- Sources, causes and impact on terrestrial and aquatic habitats. Solid wastes- type, sources effects and management.	<b>8 hrs</b>
<b>Unit VI:</b>	<b>5 hrs</b>

Bioaccumulation, biotransformation and biomagnification. Bioindicator organisms; Greenhouse effect and global warming. Ozone depletion. Acid rain and its impact. Ecotoxicology-types of toxicity, principles, dose-response.	
<b>Unit VII:</b> Environmental impact assessment- Basic concepts and principles of EIA; Pollution control programs and management of hazardous substances. Application of remote sensing in pollution management.	<b>5 hrs</b>
<b>Unit VIII:</b> Pollution Acts, Constitutional rights and administrative acts for pollution control and management.	<b>5 hrs</b>
<b>REFERENCES</b>	
<ol style="list-style-type: none"> <li>1. Agarwal V.K and Verma P.S (1997) <i>Concept of Ecology, Environment Biology</i>, 03 257 1/e, pp272</li> <li>2. Datta Munshi . J and Datta Munshi .J.S (1995) 1<sup>st</sup> edition, <i>Fundamentals of Fresh water Biology</i>, Narendra Publication, Delhi.</li> <li>3. G. Karleskint &amp; R Turner (2012). Introduction to Marine Biology. Unleash –Inc. ISBN: 978-1133364467.</li> <li>4. Michael H &amp; Peter C (2009). Marine Biology. Apex media. ISBN – 978-0073524160.</li> <li>5. Nasar . S. A. K and Datta Munshi J (1975) Studies on Primary Production of Fresh water Pond. Japanese J. Ecol, 25(1;21-23)</li> <li>6. Rana S.V.S (2012) 1<sup>st</sup> edition( 4<sup>th</sup> reprint) <i>Environment Studies</i>, Rastogi Publication, Meerut ISBN 81-7133-728-7</li> <li>7. Rana S.V.S (2010)<i>Environment Studies</i>, Rastogi Publication, Meerut ISBN 81-7133-728-7</li> <li>8. Trivedy R.K (1995)Vol 1, <i>Encyclopedia of Environmental Pollution and control</i> ,ISBN 81-86421-00-9.</li> </ol>	

<b>Paper Code and Name</b>	<b>MBCP 1.5: PRACTICAL- Biosystematics &amp; Biology of Non-Chordates</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will be trained in animal identification, classification, dissections, mountings and animal biology as a tool for applied and advanced R&D.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Identification and systematic positions of Invertebrates.</li> <li>2. Mounting -Mouth parts and appendages of prawn and crab.</li> <li>3. Nephridium and parapodium of Neries.</li> <li>4. Spicules of sponges and Sea Cucumber.</li> <li>5. Radula of molluscs. Pedicellaria and Aristotle's lantern of sea urchin</li> <li>6. Dissections- Digestive, Nervous and Reproductive systems of Neries, Prawn, Crab, Perna, Sepia.</li> <li>7. Water vascular system of Starfish,</li> <li>8. Study of larval stages of invertebrates and preparation of stained mountings.</li> </ol> <p style="text-align: center;"><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>MBCP 1.6 Practical - Genetics and Molecular Cell Biology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will be trained in genetics and cytological techniques and its related instrumentation which will aspire them to upgrade their analytical and modular research techniques.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Study of Prokaryotic and Eukaryotic cells</li> <li>2. Preparation of fixatives, stains and other reagents</li> <li>3. Microtomy- Preparation and mounting of histological slides using fish tissues.</li> <li>4. Chromosome preparations and Cell cycle study</li> <li>5. Onion root tips (Mitosis).</li> <li>6. Testis / Rheo bud (Meiosis)</li> <li>7. Study of Polytene chromosomes in Chironomus/ Drosophila larva.</li> <li>8. Study of tissues- Temporary mounting of epithelial, nervous, muscular, connective and cartilage tissues.</li> </ol> <p style="text-align: center;"><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>MBCP 1.7: PRACTICAL - Oceanography</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will be trained to use the modern instruments insitu and applied research and its applications in sea water sampling and preservation.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Study of general oceanographic instruments-Physical, chemical &amp; biological study of water samples.</li> <li>2. Estimation of Salinity of sea water using Mohr Knudsen method.</li> <li>3. Estimation of CO<sub>2</sub> in sea water.</li> <li>4. Estimation of Dissolved oxygen in sea water using Winkler's method.</li> <li>5. Estimation of Calcium. Estimation of nutrients- Nitrates, Phosphates and Silicates.</li> <li>6. Measurement of pH and temperature.</li> <li>7. Measurement of light intensity and suspended load.</li> <li>8. Sediment analysis- Sand, silt, clay and organic matter.</li> <li>9. Measurements of wave parameters.</li> <li>10. Beach profiling. Study of erosion and accretion.</li> <li>11. Identification and classification of cloud types.</li> <li>12. Operation of meteorological equipments.</li> <li>13. Remote sensing and its application in oceanography</li> </ol> <p style="text-align: center;"><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>MBCP 1.8: PRACTICAL - Marine Ecology and Pollution</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will be exposed to different realms of marine ecosystem to study in-situ followed by laboratory analysis.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Collection and study of boring and fouling communities.</li> <li>2. Ecological adaptations – Estuary, Rocky shore and Sandy shore. Pelagic and benthic adaptations.</li> <li>3. Collection and preservation of samples Sampling methods: Manual, automatic and sorbent sampling, Collection of water, sediment and biological samples.</li> <li>4. Sample storage and preservation techniques</li> <li>5. Estimation of metals from water and sediment samples.</li> <li>6. Preparation of stock solution for Ecotoxicological studies.</li> <li>7. Basic requirement of aquatic toxicological studies.</li> <li>8. Crustacean and fin fish bioassays.</li> </ol> <p style="text-align: center;"><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>MBCT 2.1: Biology of Chordata, Reproductive &amp; Developmental Biology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	The study of Chordates classifications upgrades student's basic and advanced knowledge.
CO 2	Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I: Protochordata and Cyclostomes:</b> Origin of Chordata. Classification and general organization. Development, life cycle and affinities of Urochordata, Cephalochordata and Cyclostomata.	<b>8 hrs</b>
<b>Unit II: Pisces</b> Classification, External morphology, Evolution and adaptive radiation in fishes. Scales, Air-bladder and Sense organs in fishes. Age and growth in fishes, Food and feeding in fishes Reproduction in fishes, migration in fishes. Poisonous fishes.	<b>10 hrs</b>
<b>Unit III: Amphibia, reptilia, aves and mammals</b> Classification, origin and evolution, Biology and Adaptive radiation, Turtle taxonomy and conservation in India. Migrations in Birds and Echolocation in Mammals.	<b>10 hrs</b>
<b>Unit IV: Comparative anatomy:</b> Integuments and its derivatives in vertebrates. Evolution and Differentiations of aortic arches, heart, brain, respiratory, limbs, Kidney and urinogenital systems.	<b>6 hrs</b>
<b>Unit V: Reproductive modes &amp; structure of gametes:</b> Sexual, asexual, parthenogenesis. Oviparity, viviparity and ovo-viviparity. Types of Regeneration. Structure and types of sperms and eggs. Sequence and events of fertilization, prevention of polyspermy.	<b>4 hrs</b>

<p><b>Unit VI: Developmental biology:</b> Introduction, Cleavage patterns, regulation and morphogenic movements. Fate of Germ layers, placenta in mammals.</p>	<p><b>2 hrs</b></p>
<p><b>Unit VII: Cell differentiations and organogenesis</b> Differentiation of neural tube, antero posterior and dorso ventral axis, differentiations of erythrocytes, myogenesis.</p>	<p><b>8 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Agarwal V. K and Verma P.S, (1997). Chordate Embryology, 10/e Rep pp683</li> <li>2. Kotpal R. L (2016-17) 4<sup>th</sup> edition, <i>Modern textbook of Zoology, Vertebrates</i>( Animal Diversity2) Rastogi Publication, ISBN978-93-5078-095-4</li> <li>3. Jordan E.L and Verma P.S, <i>Chordate Zoology and Animal Physiology</i>, pp1163</li> <li>4. Lal S. S; (2016-17) 2<sup>nd</sup> edition, Vol 3, <i>Practical Zoology</i>, Rastogi Publication, Meerut, India</li> <li>5. Verma P. S and V.K (2000) <i>Chordata Embryology, Developmental Biology of Non-Chordates and Chordates</i>, S. Chand and Company Publication, ISBN 81-219-0261-4.</li> <li>6. Venkataram K, Raghunathan . C, Sreeraj C R and Raghuraman R (2012). Guide to Dangerous and Venomous Marine Animals of India; 1-98. Director, Zool. Surv.India, Kolkata</li> </ol>	



<b>Paper Code and Name</b>	<b>MBCT 2.2: Environmental Biology and Planktonology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	understand a detailed account of environmental aspects and planktonology as specialization to improve basics and fundamental knowledge.
CO 2	Insights in to the environment and its disciplines stimulate the interest among the students.

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I:</b> Plankton- Historical background, classification of planktonic organisms, systematic studies. Major groups of plankton in the sea. Phyto- zooplankton interrelationship.	<b>5 hrs</b>
<b>Unit II:</b> Distribution - geographical, vertical and seasonal. Plankton indicators. Vertical migration of plankton. Geographical variations in planktonic community with respect to environmental variables.	<b>5 hrs</b>
<b>Unit III:</b> Biology of diatoms and copepods. Primary production. Factors affecting primary production. Methods of estimation of primary production. Relationship between hydrography and primary production.	<b>5 hrs</b>
<b>Unit IV:</b> Plankton and Fisheries. Collection methods, preservation and Analysis of plankton. Red tide. Luminescent plankton. Plankton of Karwar waters.	<b>5 hrs</b>

<p><b>Unit V:</b></p> <p>Nekton- taxonomic groups, horizontal and vertical distribution, factors affecting distribution. Benthos- benthic communities, the epifauna, infauna, general characteristics and adaptations. Littoral zones: rocky, sandy, muddy shores characteristics, adaptations, composition. Zonation in the intertidal zones and factors affecting zonation. Estuarine ecology- classification, physico- chemical characteristics, fauna and flora, economic importance. Kali estuary.</p>	<p><b>8 hrs</b></p>
<p><b>Unit VI:</b></p> <p>Mangroves- Distribution, conditions, adaptations, fauna and flora, significance. Salt marshes- characteristics, composition, distribution. Coral reefs- characteristics, distribution, types, composition and economical importance.</p>	<p><b>5 hrs</b></p>
<p><b>Unit VII:</b></p> <p>Pelagic zone- classification, life composition, distribution, variation, significance. Deep sea- life conditions in deep sea, abyssal and hadal zones, faunal composition.</p>	<p><b>5 hrs</b></p>
<p><b>Unit VIII:</b></p> <p>Conservation of ecosystems, resources. Renewable and non- renewable resources. Wildlife conservation- Definition, importance of wild life, Coastal Regulation Zone rules, Biological diversity act. Loss of biological diversity, source and conservation strategies. Bio reserves and biospheres, wildlife sanctuaries, national parks, marine parks, projects, hotspots, protected areas, endangered species. Application of remote sensing in biodiversity conservation. Environmental education and awareness.</p>	<p><b>10 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Abijit Mitra, Kakoli Banerjee, Bhattacharyya. D.P, 2006 Inroduction to Marine Phytoplanktons , Narendra Publication, New Delhi. ISBN 81-85375-13-5</li> <li>2. Ananda Rao T and Suresh P. V, Costal Ecosystem of Karnataka State, India, Mangrooves, Karnataka Association for Advancement of Sciences Bangalore</li> <li>3. Gopal . B; 2001, Marine Ecosystem, Kalpaz Publication , Delhi, ISBN 81-7835-059-9</li> <li>4. Kathiresan K, Bingham B.L; 2001, Biology of Mangrooves and Mangroove ecosystems, Advances in Marine Biology, 40;81-251</li> <li>5. Sharma P.D (2013) <i>Environmental Biology and Toxicology</i> , 3<sup>rd</sup> revised edition, Rastogi Publication, Meerut, ISBN 13:978-81-7133-964-8</li> <li>6. Sharma P.D (2015-16) <i>Ecology and Environment</i> ,A textbook for University Students 12<sup>rd</sup> edition, Rastogi Publication, Meerut, ISBN 978-91-5078-068-8</li> <li>7. Selvam V. L, Gnanappazham, Naramuniyammal. M, Ravichandran K.K and Karunagaran V.M, 2002 Atlas of Mangrove Wetlands of India: Part 1 M.S Swaminathan Research Foundation</li> <li>8. Venkataraman .K , Rajkumar . R, Satyanarayana C. H, Raghunathan C and Venkatraman C; 2012 Marine Ecosystem and Marine Protected areas of India, Zoological Survey of India, Chennia, Kolkata ISBN 978-81-8171-312-4</li> </ol>	

<b>Paper Code and Name</b>	<b>MBCT 2.3: Aquaculture</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper,	
CO 1	Students will understand the aquaculture systems
CO 2	Students will understand the various aspects of biology and culture technique of fishes and allied products.

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I:</b> History of aquaculture. General principles underlying the practice of aquaculture. Scope and importance of aquaculture in India.	<b>5 hrs</b>
<b>Unit II :</b> Food and feeding in culturable species. Nutritional requirements, principles of feed formulation, proximal composition of different feed. Feed conversion efficiencies of culturing organisms.	<b>5 hrs</b>
<b>Unit III:</b> Culture systems: Culture in irrigation systems. Paddy fields, sewage disposals, race ways. Monoculture, polyculture. Integrated farming. Bottom and off bottom culture. Rope culture, raft culture, pen culture. Sea ranching.	<b>8 hrs</b>
<b>Unit IV:</b> Construction of fish farm- selection of fish farm site. Topography survey. Ecological survey, water quality, tidal range, layout design. Design of farm physical structures and construction. Equipments and facilities for fish farm operation and management.	<b>5 hrs</b>

<p><b>Unit V:</b></p> <p>Farm management- Physical and chemical properties of soil and their impact on construction and maintenance of ponds. Development cost of fish farms. Water characteristics- salinity, pH, dissolved oxygen, temperature, nutrients etc. Eradication of predators. Pond preparation. Transport of seeds. Pond management and feeding. Harvesting and marketing. Criteria for selection of species. Problems in rearing.</p>	<p><b>12 hrs</b></p>
<p><b>Unit VI:</b></p> <p>Carp culture- Breeding and seed production in fin fishes. Natural seed resources, collection, transportation. Brood stock management. Induced breeding. Fin fish hatchery management.</p>	<p><b>8 hrs</b></p>
<p><b>Unit VII:</b></p> <p>Macrobrachium (scampi) culture. Salmon and catfish culture. Crop manipulation. Fin fish diseases; Health, hygiene and quarantine measures in fishes.</p>	<p><b>5 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Coche A. G, Muir . I F and Laughlin . T, (2000). <i>Simple Methods of Aquaculture, Management of Fresh water Fish Culture, Ponds and water Practices</i> , FAO, Bangkok</li> <li>2. Chakrabarti N M, (1998) <i>Biology , Culture and Production of Indian Major Carps -A review</i> , ISBN 81-85375-51-8</li> <li>3. Dr. Yadav B. N; (2006) <i>Fish and Fisheries</i>, Daya Publishing House, Delhi ISBN 81-705-1715-1</li> <li>4. Dr. Arumugam . N, Murugan T, Johnson J.R and Ram R.P, 2010, <i>Applied Zoology</i>, Saras Publication, Kanyakumari Dist.</li> <li>5. FAO Training Series, <i>Simple Methods for Aquaculture Series</i>, Vol 4, 1981, Water for fresh water Fish Culture, ISBN 92-5-101112, pp111</li> <li>6. Pal R N and Ghosh, 1915, <i>Aquaculture extension Manual</i>, New series no.9, Central Inland Fisheries Research Institute, Barrackpora, West Bengal ,India</li> <li>7. Upadhyay A.S (1987) <i>Few Improved designs of water inlet/ out let structures of semi-intensive Aquaculture</i> forums unpublishes paper presented in 1<sup>st</sup> Indian Fisheries forum Mangalore India 17pp</li> </ol>	

<b>Paper Code and Name</b>	<b>ZCP 2.4: PRACTICAL - Biology of Chordata, Reproductive &amp; Developmental Biology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will be trained in animal identification, classification, dissections, mountings and animal biology.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Identification and classification of Chordates. Dissection of eye muscles, Digestive, Circulatory, reproductive system, Brain, cranial nerves of Sharks.</li> <li>2. Mounting of Ampullae of Lorenzini in Shark</li> <li>3. Assessment of age and growth using Placoid scales, Cycloid scales, Ctenoid scales.</li> <li>4. Study of development stages of fish and amphioxus.</li> <li>5. Preparation of whole mount of embryo and larvae of fish.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>ZCP 2.5: Practicals - Environmental Biology and Planktonology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Students will be exposed to different realms of marine ecosystem to study in-situ followed by laboratory analysis

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Methods of collection of plankton, preservation techniques in plankton study and Analysis. Identification of phyto and zooplankton.</li> <li>2. Evaluation of standing stock. Diel variation in plankton in estuary/bay</li> <li>3. Estimation of primary production by light and dark bottle method.</li> <li>4. Chlorophyll estimation.</li> <li>5. Preparation of whole mounts of planktons.</li> <li>6. Identification and adaptations of Nekton and benthos.</li> <li>7. Collection and identification of economically important Sea weeds and their adaptation.</li> <li>8. Visit to intertidal regions- Rocky shores, Sandy shores, mud flats, mangrove and estuaries.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>ZCP 2.6: PRACTICALS - Aquaculture</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will acquire lab and field based hands on skills and enable them to upgrade the current trends of Aquaculture and its management aspects.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Collection and identification of culturable organisms.</li> <li>2. Study of Design, layout of aquaculture farm.</li> <li>3. Culture pond preparation and its management.</li> <li>4. Water and soil quality analysis of aquaculture pond.</li> <li>5. Study biology of Culturable fishes.</li> <li>6. Study of food and feeding in culturable fishes.</li> <li>7. Determination of maturity stages in fishes.</li> <li>8. Fish seeds collection and analysis.</li> <li>9. Identification egg, larva, fry and fingerlings of fishes.</li> <li>10. Induce Breeding experiments in fish.</li> <li>11. Dissection and display of pituitary gland and preparation of extract.</li> <li>12. Artificial fish feed preparation.</li> <li>13. Common fish diseases and its management.</li> <li>14. Visit to freshwater fish hatchery to study hatchery management.</li> </ol> <p style="text-align: center;"><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>MBCT 3.1: Fishery Harvest and Post Harvest Technology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Identify and witness the operational process of various fish catching methods.
CO 2	Students will learn the post-harvest technology and subsequent value addition national and international standards

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<p><b>Unit I:</b></p> <p>Introduction, History &amp; Evolution of fishing gears and crafts. Fishing methods- Surrounding nets, Seine nets, Trawls, Lift nets, Falling nets, Gill nets &amp; Entangling nets, Traps, Hook &amp; lines and Traditional Fishing gears of India.</p> <p>Fish finder- working principles, fishing without gear. Fishing gears and crafts of Uttara Kannada. Care and maintenance of gears- sterilization, tannin &amp; coal tar and heat treatments. Maintenance of fishing vessels- docking the vessel in a dry dock. Hull preparation and painting. Life saving appliances- life boat, life buoy, life jacket, life raft.</p>	<b>10 hrs</b>
<p><b>Unit II:</b></p> <p>Gear accessories: Floats- properties, low-density floats- wood, cork, thermocol, sponge plastic and rubber floats. High-density floats- glass, aluminum, steel, fiberglass floats. Buoy- light buoy, radio buoy and dahn buoy. Sinkers and kites. Properties of natural and synthetic fibers. Types of craft building materials. International Standard Statistical Classification of fishing Gears (ISSCG).</p>	<b>6 hrs</b>



<p><b>Unit III:</b></p> <p>Handling of fish and shrimps onboard the fishing vessel- cleaning, sorting &amp; evisceration, water supply, fish holds &amp; containers and personal hygiene; Quality of water, ice and refrigerated seawater for seafood processing; Water- physical, chemical and bacteriological examination of water.</p> <p>Freezing of fish- Principles and mechanism of freezing and canning of fish; Principles and steps involved in canning; Curing- sun drying, salt curing, smoking of fish and radiation.</p>	<p><b>13 hrs</b></p>
<p><b>Unit IV:</b></p> <p>Biochemical Composition of fish- protein, fat, fish oils, minerals, vitamins, etc. Post- mortem changes in fish. Spoilage of fish- Bacterial, Enzymatic and Biochemical spoilage. Quality Control- Intrinsic and Extrinsic qualities.</p>	<p><b>7 hrs</b></p>
<p><b>Unit V:</b></p> <p>The structure of Bacteria- flagella, pili, glycocalyx, cell wall, cell membrane, cytoplasm &amp; spore. Bacterial growth- requisite for bacterial growth. Bacteriology of fish and shellfish.</p>	<p><b>6 hrs</b></p>
<p><b>Unit VI:</b></p> <p>HACCP Concept in Seafood processing. National and International Quality standards for fish and fishery products. Packing and transportation of fresh and processed sea foods.</p>	<p><b>6 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Balachandran K.K (2001) <i>Post Harvest Technology of fish and fish products</i>, ISBN 81-7035-237-1.</li> <li>2. Bonnell A.D (1994) <i>Quality Assurance in seafood processing</i>, Publishing in Great Britain ISBN 0-442-00879-1.</li> <li>3. Golikatte Mahesh. (2009). Hall G.M (2009) <i>Fish Processing Technology</i>, BAP Publication, New Delhi.</li> <li>4. Jyoti M.K and Sharma.A (2006). <i>Fish aid to collection ,preservation and Identification</i>, Daya publishing house, Delhi.</li> <li>5. Ninawe A. &amp; Sand Rathnakumar .K (2008) <i>Fish Processing Technology and Product development</i> Narendra publishing house, Delhi. ISBN 81-85-375-895.</li> <li>6. Ronald A, Corlett.Jr (1998). <i>HACCP Users Manual</i>, Aspen Publishers, ISBN 0-8342-1200-5</li> <li>7. Winton A.L and Winton K.B (1997) <i>Fish and Fish Products</i>.</li> <li>8. Winton A.L and Winton K.B (2000) <i>Fish and Fish Products</i>, Jodhpur, India. ISBN 81-7754-029-7.</li> </ol>	

<b>Paper Code and Name</b>	<b>MBCT 3.2: Animal Physiology, Endocrinology &amp; Biochemistry</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Realize that very similar physiological mechanisms are used in very diverse organisms.
CO 2	Students will understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I: Nutrition</b> Nutritive requirements, Food value, Digestion and absorption in animals.	<b>2 hrs</b>
<b>Unit II: Circulation &amp; Respiration</b> Blood. Composition and functions of blood. Fluid transport. The closed and open circulatory systems. Vertebrates' circulatory mechanism. Integumentary, branchial, and pulmonary respiration. Respiratory pigments. Oxygen/ Carbon dioxide transport. Anaerobic respiration in animals.	<b>9 hrs</b>
<b>Unit III: Excretion and Osmoregulation</b> Basic aspects of the disposition of ammonia and nitrogen. Major nitrogenous end products. Inter relations between habitat and excretion. Ionic and osmotic regulation in animals.	<b>5 hrs</b>
<b>Unit IV: Sense organs and thermoregulation</b> Chemoreceptions, Mechanoreceptions. Thermoreceptions and Photoreception. Propagation of nerve impulses. Cardiac, skeletal and smooth muscles. Mechanism of muscle contraction. Effect of temperature changes and acclimatization. Regulation of body temperature in birds and mammals. Aestivation and hibernation.	<b>7 hrs</b>
<b>Unit V: Endocrinology &amp; Immunology:</b> Comparative anatomy of endocrine glands. Structure, biosynthesis and biological actions of hormones. Structure and functions of hormone systems of crustaceans and fishes. Overview of immune system. Cells and organs of immune system. Antigen & Antibody and its interactions. T- Cell, B-Cell and Cytokines. Vaccines.	<b>7 hrs</b>

<p><b>Unit VI: Biochemistry</b></p> <p>Principles of Biochemistry. Chemistry of Carbohydrates, Lipids, Protein, Nucleic acids and Vitamins. Classifications of Enzymes. Mechanism of action of enzymes. Kinetics of enzyme catalyzed reaction activation, Enzyme inhibition, Co-enzymes, Metalloenzymes, Iso-enzymes. Metabolism of Protein and Lipids.</p>	<p><b>18 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Gupta S.N (2015-16) <i>Concepts of Biochemistry</i>, Rastogi Publication, Meerut, ISBN 978-93-5078-092-3.</li> <li>2. Goyal, Sastry (2015-16) 6<sup>th</sup> Edition, <i>Animal Physiology</i>, Rastogi publication, Meerut. ISBN 978-81-7133-864-1.</li> <li>3. Sastry K.V (2016-17) 2<sup>nd</sup> Edition, <i>Animal Physiology and Biochemistry</i>, Rastogi publication, Meerut.</li> <li>4. Sastry K.V (2008). 1<sup>st</sup> Edition, <i>Animal Physiology And Biochemistry</i>, Rastogi publication, Meerut.</li> </ol> <p>David Nelson &amp; M. Cox (2004). <i>Lehninger the Principles of Biochemistry</i> 4<sup>th</sup> Ed.</p>	

<b>Paper Code and Name</b>	<b>MBCT 3.3: Mariculture</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students learn various culture techniques and field exposure
CO 2	Hands on training on mariculture management and accountability

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I:</b> Brackish water aquaculture- Shrimp culture. Biology of cultivable Shrimps. Culture practices- Extensive, semi intensive and intensive culture. Aquaculture impact on environment. Paddy cum shrimp culture. Tidal range and pond construction.	<b>8 hrs</b>
<b>Unit II:</b> Culture of milk fish, mullets, tilapia, seabass, cobia and mud crabs. Cage culture practices & prospectus.	<b>8 hrs</b>
<b>Unit III:</b> Recent advances in coastal aquaculture and open sea mariculture. Mussel culture. Pearl oyster culture. Sea cucumber, sea weed, oyster, clam and eel culture.	<b>8 hrs</b>
<b>Unit IV:</b> Hatchery management for shrimp and molluscan seed production. Technique, collection, transportation and breeding of spawners. Induced maturation by eye stalk ablation. Larval rearing technique. Live feed culture: Algal culture and artemia culture, cladoceran and rotifer culture for hatchery production of seeds. Packing and marketing. Induced breeding in molluscs, spat settlement and collection.	<b>10 hrs</b>
<b>Unit V:</b> Nutrition, food and feeding- Nutritional requirements of different species of shell fish and their life history stages. Principle of feed formulation, proximate composition of different shrimp feeds.	<b>5 hrs</b>

<p><b>Unit VI:</b></p> <p>Pathology- Problems of diseases and parasites in brackish water culture. Common diseases of cultivable shell fishes. Bacterial, fungal and viral diseases.;. Ecto and endoparasites of shell fishes. Protozoan and helminthic diseases. Prophylaxis, diagnosis and therapeutic measures, Molecular disease diagnostics.</p>	<p><b>5 hrs</b></p>
<p><b>Unit VII:</b></p> <p>Aquaculture management: Aquaculture authority Act, aquaculture authority guidelines. Effluent treatment system in aquaculture, MPEDA – NACA guidelines for shrimp health management; HACCP in aquaculture; Aqua club concept.</p>	<p><b>4 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Agarwal .S.C,(1994),A handbook of fish farming,Narendra publishing house ,Delhi.ISBN81-85375-32-1H.</li> <li>2. Biswas.K.P,(1992),Prevention and Control of fish and Prawn Disease,Narendra Publishing House,Delhi</li> <li>3. Coche,A.G,(1985),Simple methods for Aquaculture-Soil and Fresh water,Fish culture – FAOPublication(6),FAO,Rome.</li> <li>4. Gilda,Lio-PO,(1991),Diseases ofPond Cultured Shrimps with Emphasis on Prevention Strategies.Aquaculture Dept.South East Asian Fisheries Dev.Centre,Phillippines.</li> <li>5. Simple Methods for Aquaculture Series-Vol-6,Soil and fresh water fish Culture,(1986),pp174,ISBN92-5-101355-1.</li> <li>6. Simple Methods for Aquaculture Series-Vol-21/2,Management of fresh water fish Culture .ponds and water practices,(1996),pp233,ISBN92-5-102873-7.</li> <li>7. Silas.E.G,(1912),Breeding and Rearing of Marine Prawns,Central Marine Fisheries Resaearch Institute,Cochin.</li> <li>8. Upadhyay.A.S,(1994),Investement opportunities in shrimp farming,pp 12.</li> </ol> <p>Philipose K.K.(2012). Open Sea Cage Culture. CMFRI Publications.</p>	

<b>Paper Code and Name</b>	<b>ZCP 3.4: PRACTICALS- Fishery harvest and post harvest technology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Identify and witness the operational process of various fish catching methods and quality analysis of seafoods

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Identification of netting materials. Identification of gear accessories.</li> <li>2. Construction of Cabled netting yarn. Parts of fishing vessels. Preparation of knots, hitches and bends. Net making.</li> <li>3. Study of hull shapes and positions. Study of operation of beach seine (Yendi). Study of typical backbone assembly.</li> <li>4. Operation and demonstration of fishing methods-Trawling, Purse seining, Gill netting and other traditional fishing methods. Study of Navigational charts.</li> <li>5. Study of sign of flags. Engine parts, GPS, Echo-Sounder etc.</li> <li>6. Study of Navigational equipments- Sextant, Azimuth mirror, Pyrotechniques, Navigational chart, Magnetic compass and Pelorus.</li> <li>7. Visit to fishing places, Ship yard and Marine Research Institutes.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>ZCP 3.5: Practicals - Animal Physiology, Endocrinology &amp; Biochemistry</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students learn vertebrate blood collection and analysis technique and other macro molecules analysis as a technical tool

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Study of Blood groups. Haemoglobin content, haemolysis, blood coagulation, RBC, WBC and differential counts in any vertebrate representative. Fish blood collection and analysis.</li> <li>2. Preparation of Solutions: Percentage solutions, Molar solutions, Normal solutions, Dilution of Stock solutions. Buffer solution preparation and pH adjustments.</li> <li>3. Qualitative and quantitative Estimations - Carbohydrates, Protein, and Lipid from animal source.</li> <li>4. Constituents of normal and abnormal urine.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>ZCP 3.6: Practicals - Mariculture</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Hands on training on mariculture management and accountability

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Study of Brackish water pond design, layout and Tidal range.</li> <li>2. Equipment and facility used in mariculture.</li> <li>3. Open sea cage culture tools.</li> <li>4. Identification of marine culturable finfish's and shellfish.</li> <li>5. Study biology of Shrimps and marine culturable fish</li> <li>6. Food and feeding studies in finfish &amp; shell fishes.</li> <li>7. Induced breeding of molluscans.</li> <li>8. Identification of larval stages of culturable species and rearing.</li> <li>9. Spat collection technique.</li> <li>10. Live feed culture.</li> <li>11. Artificial shrimp feed preparation.</li> <li>12. Disease diagnosis and therapy. Molecular disease diagnostics in aquaculture.</li> <li>13. Visit to a shrimp hatchery.</li> <li>14. Visit to a aquaculture farm.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	



<b>Paper Code and Name</b>	<b>MBCT 4.1: Fishery Resources and Management</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	understand fisheries biodiversity and its management.
CO 2	have insights of the present status of fisheries as upgraded knowledge.

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I:</b> History of fishery resources. Survey of fishery resources of the world. Present status and future prospectus of fishing industry. Application of Remote sensing in fishery survey.	<b>5 hrs</b>
<b>Unit II:</b> Pelagic fishery resources of India. Oil sardine, lesser sardine and Indian mackerel. Estuarine fishery, milk fish, pearl spot, mullets. Chilka & pulicate lake fisheries. Cochin back waters. Aganashini & Kali estuarine fisheries  Demersal Fishery resources of India- Bombay duck, tunas, bill fish, sword fish and seer fish.	<b>15 hrs</b>
<b>Unit III:</b> Flying fish, ribbon fish, white baits, perch, elasmobranchs, cat fish, pamfrets, sciaenids. Silver bellies, thread fins, flat fishes, carangids, seaweeds, corals, sponges, echinoderms  Shell fishery of India: Molluscan-bivalves, gastropods and cephalopods (cuttle fish, squids & octopus)	<b>10 hrs</b>
<b>Unit IV:</b> Fishery byproducts- fish meal, fish body oil, Fish Protein Concentration (FPC), Pearl essence, fish glue, fish guano, fish ensilage.	<b>4 hrs</b>
<b>Unit V:</b> Value added fish products-fish sausages, fish wafers, soup powder, fish pickles, clam pickle and squid rings. Ornamental and industrial fishes.	<b>4 hrs</b>

<p><b>Unit VI:</b></p> <p>Fishery products and byproducts: Shark liver oil, shark fins, Fish maws and Isinglass, chitosan, ambergris, beche-de-mers. Seaweed products- agar, algin, iodine, edible sea weeds and sea weed products, fertilizers. Chemical products from sea waters - Extraction and uses of salt, magnesium, magnesium sulphate, bromine, heavy waters. Drugs from the marine organisms.</p>	<p><b>10 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Jhingran V.G, <i>Fish and Fisheries of India, Central inland Fisheries Institute, Barrackpore</i></li> <li>2. John E B, John HR , Willium O M, Aquaculture , <i>The Farming and Husbandry of Fresh Water and Marine Organisms</i></li> <li>3. Mohan Joseph and Jaya Prakash A. A(eds 2003), <i>Status of exploited Marine Fisheries Resources of India</i>, CMFRI, Kochin, India</li> <li>4. Sundaraj V, Srikrishnadhas B, 2000, <i>Cultivable Aquatic Organisms</i>, Narandra Publication House, ISBN 81-85375-61-5-PB</li> <li>5. Venkataramana K (2007) <i>Marine Ecosystem of India</i>, Indian journal of Environmental and Education, 7(2) 7-26</li> <li>6. Venkataraman K and Wafar M (2005)<i>Coastal and Marine Biodiversity of India</i>, Indian Journal of Marine sciences , 24(1):57-75</li> <li>7. Venkataram K, Raghunathan . C, Sreeraj C. R and Raghuraman R, 2012 <i>Marine Biodiversity in India ;Zool. Surv.India Division</i>, ISBN 978-81—8171-307-0.</li> </ol>	

<b>Paper Code and Name</b>	<b>MBCT 4.2: Marine Biotechnology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Learn the theoretical basis of Biotechnological technique, its principle of working and its correct application
CO 2	Analyze the contribution of marine microbes in water treatment, solid waste management, bioremediation and phytoremediation.

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I: An Overview of Biotechnology</b> Origin. History of Biotechnology. Definition. Biotechnology is an interdisciplinary activity, Scope and importance of Biotechnology, Biotechnology in India.	<b>5 hrs</b>
<b>Unit II: Cell and Tissue Culture Technology</b> Requirement for animal cell and tissue culture. Substrates for cell growth. Culture media. Sources of cell. Techniques of obtaining cells by disaggregation's of tissue. Culture procedures - storage, preservation and retrieval of culture. Large scale culture of cell lines. Applications of cell culture products.	<b>12 hrs</b>
<b>Unit III: Environmental Biotechnology</b> Introduction of Biotechnology for pollution abatement. Use of Genetically Engineered organisms for removal of specific pollutants. GEM for oil spill, GEM for degrading pesticides and GEM for sequestering heavy metals.	<b>7 hrs</b>
<b>Unit IV: Biotechnological Bioremediation</b> In situ bioremediation. Ex situ bioremediation. Bioremediation of specific pollutants. Phytoremediations. Methods of Phytoremediation, Biosorption and Bioleaching.	<b>6 hrs</b>
<b>Unit V: Aquaculture Biotechnology</b> Introduction. Transgenic fish, Production of transgenic fish. Technique of transfer of transgene. Microinjection, electroporation, sperm-mediated transfer, Retrivial vectors, biolistics and lipofection. Cryopreservation in Marine organisms. Prospects of aquaculture biotechnology in India.	<b>10 hrs</b>

<p><b>Unit VI: Biotechnological Tools for Disease Diagnostics</b></p> <p>Diagnostics in aquaculture, Enzyme Linked Immuno assay, Dot Immunobinding Assay, Western blotting, Gene cloning, DNA based Diagnostics, Polymerase Chain Reaction, Nucleic acid probes, Recombinant DNA technology. Disease management technologies.</p>	<p><b>8 hrs</b></p>
<p>References</p>	
<ol style="list-style-type: none"> <li>1. Gupta P.K (2015-2016) 1<sup>st</sup>Edition, Molecular Biology and Genetic Engineering, Rastogi Publication, Meerut. ISBN 81-7133-719-8.</li> <li>2. Rajan .S and Selvi R.C (2010) 1<sup>st</sup>Edition, <i>Experimental procedures in Life Sciences</i>, Anjanaa Book House, Chennai. ISBN-978-81-910165-05.</li> <li>3. Ramdas. P (2008) <i>Animal Biotechnology</i>-MJP, Chennai</li> <li>4. White T.J, Arnhein.N and Erlich (1989) <i>The polymerase chain-Trends gene5</i>(185-189)</li> </ol>	

<b>Paper Code and Name</b>	<b>MBCT 4.3: Fishery Economics and Management</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Students will understand the Fishery resources adding valuable foreign exchange to the Indian economy.
CO 2	insight into the trends of fishery economics and national and international status

<b>Particulars</b>	<b>Teaching Hours (Max. 50)</b>
<b>Unit I:</b> Introduction of fishery economics, catch per unit effort, maximum sustainable yield, Economics of different types of marine Fishing Units. Economic evaluation of Mariculture practices. Trends in landings and potential yield from Indian EEZ.	<b>10 hrs</b>
<b>Unit II:</b> Structure of fishing industry & man power requirements. Financial requirements in the fishing industry.	<b>5 hrs</b>
<b>Unit III:</b> Role of banking institutions in the fishing industry. Fishermen co-operatives in Karnataka State & Uttara Kannada District.	<b>5 hrs</b>
<b>Unit IV:</b> Five year plans & fishing industry, Blue revolution. fisheries extension	<b>5 hrs</b>
<b>Unit V:</b> Global fisheries export scenario. Export growth of marine products in India. Socio-economic aspects of fishing industries.	<b>5 hrs</b>
<b>Unit VI:</b> Fisheries management theories and objectives – classical theory of Adam Smith. Biological theory of fisheries Management. The Neo-Classical theory of Economists. Modern theory of fisheries management. Global theory of fisheries management. A holistic theory of fisheries management.	<b>10 hrs</b>

<b>Unit VII:</b> Fisheries Education, Training & National and international organizations. International Law of Marine fisheries	<b>8 hrs</b>
References	
<b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. DattaMunshi and Srivastava (2006) Reprint, <i>Natural history of Fishes and Systematicc of fresh water fishes of India</i>, Narendra publishing house, Delhi ISBN 81-85375-12-7.</li> <li>2. Ninawe A.S and Rathnakumar .K (2008) <i>Fish processing Technology and Product development</i>, Narendra publishing house, Delhi.ISBN 81-85-375-89-5.</li> <li>3. Simon .J, Michel J.K and John D.R (2001) <i>Marine Fisheries Ecology</i></li> <li>4. Shukla J.P (2016-17) <i>Fish and Fisheries</i>, Rastogi publications, Meerut, ISBN978-81-7133-967-9.</li> <li>5. Fish and fisheries of Tropical estuaries - Balbu Stiphen J.M.</li> <li>6. Commercial fishing methods - John C. Sainsbury.</li> <li>7. Fishery management – Rekha R. Goankar              Fishing Chymes – Quarterly Journal</li> </ol>	

<b>Paper Code and Name</b>	<b>ZCP 4.4: Practicals - Fishery Resources and Management</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Hands on training on fish taxonomy and its allied research and development branches, field visits to fish landing center, fish meal plant and processing plant strengthens the applied aspects.

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Identification and classification of commercially important fin fishes of Karwar.</li> <li>2. Morphometric and meristic studies. Length weight relationship.</li> <li>3. Mounting of scales and otoliths.</li> <li>4. Fish market survey and report.</li> <li>5. Visit to fish landing center and report. Visit to ice plants, fish meal plants.</li> <li>6. Visit to fish processing plants.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	

<b>Paper Code and Name</b>	<b>ZCP 4.5: Practicals - Marine Biotechnology</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	Hands on training of various Microbiological and biotechnological techniques

<b>Particulars</b>	<b>4 Hrs/week</b>
<ol style="list-style-type: none"> <li>1. Common Laboratory instruments and tools. Colony characteristics of Bacteria. Preparation of culture media. Preparation of smears and saline.</li> <li>2. Streak plate technique. Staining methods. Effect of pH on the growth of bacteria. Bacterial motility study-hanging drop method.</li> <li>3. Sampling of fish for Total Plate count (TPC). Most probable number (MPN) for coliforms.</li> <li>4. Sterilization techniques -Physical and chemical methods.</li> <li>5. Study of tissue culture technique and equipments. Preparation of Cell culture medium</li> <li>6. Collection and , isolation, and culture of Micro algae</li> <li>7. Enzyme linked immunosorbant Assay (demonstration)</li> <li>8. SDS-PAGE Electrophoresis (demo)</li> <li>9. DNA extraction technique (demo), PCR technique, Agarose Gel Electrophoresis (demo)</li> <li>10. Cryopreservation of Gametes.</li> </ol> <p><i>(New practical component may be added every year)</i></p>	



<b>Paper Code and Name</b>	<b>ZCP 4.6: Practicals - Fishery Economics and Management</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper :	
CO 1	Students will understand commercially important fish commodity, taxonomy of shrimps, crabs and bivalves and its biological aspects.

<b>Particulars</b>	<b>4 Hrs/week</b>
1. Identification and classification of commercially important Shell fishes of Karwar. <ul style="list-style-type: none"> <li>I. Shrimps</li> <li>II. Crabs</li> <li>III. Bivalves</li> </ul> 2. Morphometric and meristic studies. 3. Length weight relationship in shrimps. 4. Mounting of scales and otoliths. 5. Fish market survey and report. 6. Visit to fish landing centre and report. 7. Visit to ice plants, fish meal plants. 8. Visit to fish processing plants.	
<i>(New practical component may be added every year)</i>	

<b>Paper Code and Name</b>	<b>MBD 4.7: Dissertation work</b>
<b>COURSE OUTCOMES (COs)</b>	
After completing this paper, the students will be able to:	
CO 1	During their project tenure, students are assigned to independent research and development activity, field based survey, institutional internship to make them competent qualifying researchers.
CO 2	Literature survey on the topic.
CO 3	Basics of research methodology and design of experiments.
CO 4	Preparation of manuscript for publication.
CO 5	Execution of research work by various techniques