

# **GURU NANAK COLLEGE**

## **(AUTONOMOUS)**

*Guru Nanak Salai, Velachery, Chennai – 600 042*

*Re-accredited at 'A- Grade' by NAAC*

*(Affiliated to the University of Madras)*



## **BACHELOR OF SCIENCE**

### **ADVANCED ZOOLOGY AND BIOTECHNOLOGY**

**(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)**

### **Regulation & Syllabus**

**(For the candidates admitted for the Academic year 2021-22 and thereafter)**

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## **RULES AND REGULATIONS**

**(Effective from the Academic Year 2021-22 and thereafter)**

### **SEMESTER SYSTEM WITH CREDITS**

#### **I. CHOICE BASED CREDIT SYSTEM (CBCS) WITH GRADING**

The College follows the CBCS with Grades under the Semester pattern. Each paper is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted.. This is done after a thorough analysis of the content of each subject paper by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job-oriented courses, Elective courses and Skill based courses as the part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience.

#### **II. ELIGIBILITY FOR ADMISSION**

Candidates admitted to the first year of the UG programme should have passed the higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

##### **For B.Com (Hons) & B.Com (PA):**

Candidates admitted to the first year of the B.Com (Hons.) & B.Com (PA) programme should have passed the higher secondary examinations conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras with 75 % cut-off in Commerce/Business studies, Accountancy, Economics and Business Mathematics/ Mathematics.

##### **For MBA:**

The basic requirement for admission to the MBA Course, is a Bachelor's degree in any discipline with a minimum of 50% marks in aggregate and satisfactory test score in MAT Entrance

Test conducted by AIMA, New Delhi / TANCET for MBA conducted by Government of Tamilnadu / CAT / XAT or any other approved MBA Entrance Tests

**For MCA:**

Only those candidates who have passed B.C.A/B.Sc. in Computer Science or any other equivalent degree OR passed B.Sc/B.Com/BA with Mathematics at 10 + 2 level or at graduation level (with Optional bridge course), provided they have undergone the course under 10+2+3 or 11+1+3 or 11+2+2 pattern and obtained at least 50% of marks (45 % marks in case of candidates belonging to reserved category) in the qualifying examination shall be eligible for admission to the M.C.A. Degree Course.

### **III. DURATION OF THE COURSE**

The UG course is of three years duration with six semesters and the PG course is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students sit for the final End Semester Exam.

### **IV. COURSE OF STUDY**

The main subjects of study for the Bachelor's Degree shall consist of the following:

#### **1. FOUNDATION COURSES**

- a) PART - I : Tamil/ Hindi / Sanskrit/French
- b) PART - II : English

#### **2. CORE COURSES**

- a) PART - III: Consisting of (a) Main subject (b) Allied Subjects (c) Elective subjects related to the main subject of study and project work.
- b) PART - IV
  - i. Those who have not studied Tamil / Hindi up to XII standard and have taken a non-Tamil / non – Hindi language under Part – I, shall opt for Basic Tamil / Basic Hindi in the first two semesters.
  - ii. Those who have studied Tamil up to XII standard, and taken a non -Tamil language under Part – I, shall opt for Advanced Tamil in the first two semesters.
  - iii. Others, who do not come under either of the clauses mentioned above, can choose a Non-Major Elective (NME) in the first two semesters.

iv. Soft Skills (I, II, III & IV Semesters)

v. Environmental Studies (IV Semester)

vi. Value Education (V Semester)

c) PART - V : Compulsory Extension Service

A candidate shall be awarded **one credit** for compulsory extension service.

A student must enroll in NSS / NCC /Sports & Games/ Rotaract/ Youth Red Cross / Citizen Consumer Club / Enviro Club or any other service organization in the College and should put in compulsory minimum attendance of 40 hours, which shall be duly certified by the Principal of the College. If a student lacks 40 hours compulsory minimum attendance in the extension services in any Semester, s/he shall have to compensate the same, during the subsequent Semesters. Literacy and population and educational fieldwork shall be compulsory components in the above extension service activities.

## **V. COURSE STRUCTURE**

The UG course consists of 15-18 Core papers with 3-4 credits for each paper, 3 Elective papers and 4 Allied papers with 5 credits for each paper in addition to 3 Soft Skill papers with three credits each and one skill based subject with three credits. The B.Com (Hons) course has 31 core papers of 4 credits each and project with 8 credits and B.Com (PA) has 29 core papers.

The PG courses (M.A, M.Com, M.Sc and MSW) have 14-17 core papers with 4 credits each , Project Work with 6 credits, 5 elective papers with 3 credits, 2 extra disciplinary papers with 3 credits, Four Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits.

The MBA course has 15 core papers including project work with 4 credits, 6 elective papers with 3 credits, 2 extra disciplinary papers with 3 credits, Four Soft Skill courses with two credits each. Internship as a compulsory component carries 2 credits.

The MCA course has 15 core papers of 2-4 credits, 5 Elective papers of 3 credits, 2 Extra-disciplinary papers of 3 credits and a project work of 17 credits.

Internship training is a compulsory component for all the UG & PG courses.

❖ The details of the course structure are given in the following table:

**CHOICE BASED CREDIT SYSTEM WITH GRADING**

**1. POST GRADUATE DEGREE**

COMPONENTS	M.Sc. Chemistry M.Sc. Mathematics M.Sc. Zoology M.A. Economics M.A. Defence & Strategic Studies			M. COM			M. S.W		
	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits
CORE COURSES INCLUDING PRACTICAL	14-17	4	60-70	15	4	60	17	3-6	65
PROJECT	0-1	6	0 - 6	0	0	0	1	6	6
ELECTIVES	5	3 - 4	10-20	5	3	15	5	3	15
EXTRA DISCIPLINARY COURSES	2	3	6	2	3	6	2	3	6
SKILL	4	2	8	4	2	8	4	2	8
INTERNSHIP	1	2	2	1	2	2	0	0	0
TOTAL			91			91			100

COMPONENTS	M.C.A.			M.B.A.		
	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits
CORE COURSES INCLUDING PRACTICAL	15	2-4	46	13	4	52
PROJECT	1	17	17	1	8	8
ELECTIVES INCLUDING EXTRA DISCIPLINARY COURSES	7	3	21	8	3	24
SKILL	4	2	8	4	2	8
INTERNSHIP	1	2	2	1	2	2
TOTAL			94			94

## **2. UNDERGRADUATE DEGREE**

Under Part IV of the Course, students should register separately for two Non-Major Elective papers, during the First and Second semesters. The marks obtained under Part IV will not be included for classification of the candidate although a pass is mandatory. Students should have obtained the minimum credit under Part V to be eligible to receive the degree.

PART	COMPONENTS	B.Com(Gen.) B.Com (C.S) B.Com(A&F) B.Com(B.M.) B.Com(M.M.) B.Com(ISM) B.B.A. B.C.A B.Sc (IT) B.Com(CA)			B.Sc.(Mat.) B.Sc.(Phy.) B.Sc.(Chem.) B.Sc.(Plant Bio.) B.Sc.(Adv.Zoo) B.Sc.(C.S.) B.Sc.(Viscom) B.Sc (Biotech) B.A.(Eco.) B.A.(Defence), B.A. (English). B.Sc (Data Analytics), B.A Sociology)			B.Com (Honours)			B.Com (Professional Accounting)		
		No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits	No. of Courses	Credit per Course	Total Credits
Part I Foundation Course	Language: (Tamil/ Hindi/ Sanskrit/ French)	2	3	6	4	3	12	2	3	6	2	3	6
Part II Foundation Course	English	2	3	6	4	3	12	2	3	6	2	3	6
Part III	Core Papers	15-18	3-4	72	15-18	3-4	60	31	4	124	29	4-6	123
	Project	-	-	-	-	-	-	1	8	8	-	-	-
	Allied Papers	4	5	20	4	5	20	-	-	-	-	-	-
	Elective Papers	3	5	15	3	5	15	-	-	-	1	4	4
Part IV	Non Major Electives/ Basic Tamil/ Advanced Tamil/Basic Hindi	2	2	4	2	2	4	2	2	4	2	2	4
	Soft Skill	3	3	9	3	3	9	-	-	-	3	2-4	8
	Skill Based Subject	1	3	3	1	3	3	-	-	-	-	-	-
	Environmental Studies	1	2	2	1	2	2	1	2	2	1	2	2
	Value Education	1	2	2	1	2	2	1	2	2	1	2	2
Part-V	Extension Service	1	1	1	1	1	1	1	1	1	1	1	1
	Internship	1	2	2	1	2	2	-	-	14	-	-	14
<b>TOTAL</b>		<b>142</b>			<b>142</b>			<b>167</b>			<b>170</b>		

## **VI. EXAMINATIONS**

Continuous Internal Assessment (CIA) will be for 50 percent and End Semester Examination (ESE) will be for 50 percent.

### ➤ **CONTINUOUS INTERNAL ASSESSMENT (CIA)**

Every semester will have a centralized mid semester examination for each paper. This will be conducted on completion of 45 working days in each semester. A Model exam of three hours' duration will be conducted on completion of 80 working days in each semester.

**The schedule for these tests is as follows:**

<b>C.I.A.Test</b>	<b>Schedule</b>	<b>Syllabus Coverage</b>
<b>I</b>	After <b>45</b> working days of the Semester	50%
<b>II (Model Examination)</b>	After <b>80</b> working days of the Semester	95%

**The components for the CIA (Theory & Practicals) are as follows:**

<b>Internal Components</b>			
<b>Assessment Type</b>	<b>Nature</b>	<b>Maximum Marks</b>	<b>% of Weightage</b>
<b>CIA</b>	Mid Semester Exam	50	10
<b>Model</b>	Model Examination	100	10
	Assignment		10
	Class activity		15
	Attendance		5
<b>Total</b>			<b>50</b>

The class activity relates to a programme of accepted innovative techniques such as seminars, quiz, portfolio creation, MCQ, PowerPoint presentation, objective tests, role play etc. The mode of evaluation of the class activity will be fixed before the commencement of the semester and an approval will be obtained from the Head of the Department. The students will be informed of the various methods of evaluation once the semester begins.

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking.

CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty.



**Marks for attendance will be awarded as per the following:**

<b>Percentage of General Attendance</b>	<b>Marks Awarded</b>
90-100	5
75-89	4
60-74	3
<60	0

➤ **END SEMESTER EXAMINATIONS (ESE)**

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG courses will be held for all papers in November/December and April/May

Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practicals will be notified by the Controller of Examinations in consultation with the Dean (Academics).

A candidate will be permitted to appear for the End Semester examinations for any semester if:

- a) S/he secures not less than 75% of attendance in the working days during the semester.
- b) S/he should have applied for the examination
- c) S/he should have paid the requisite examination fee
- d) Her/His overall conduct has been satisfactory

**The attendance requirements to appear for the ESE are as follows:**

**i. Students must have 75% of attendance in each part of the course of study to appear for the End Semester Examination.**

**ii. Students who have 65% to 74.9% of attendance shall apply for condonation** in the prescribed form along with the prescribed fee after obtaining permission from the Principal. Students cannot claim condonation as a matter of right. Submission of Medical Certificate is normally not accepted to condone shortage of attendance.

**iii. Students who have 50% to 64.9% of attendance will fall under the - Withheld category.** Such students cannot take up the ESE exams. They should apply to the Principal for permission to write the next supplementary examination and pay the requisite fee for this purpose. However, they can appear for the supplementary examinations for the previous semester's paper/s.

iv. Students who have less than 50% of attendance fall under the **Detained category**- They will not be permitted to appear for the examination. They shall redo the semesters after completion of the course and appear for the examination after securing the required percentage of attendance. The decision of the Principal remains final and binding in all respects.

v. Students who do not get the minimum marks to pass in the ESE shall compulsorily re-appear for the paper in the subsequent semester after paying the required fee.

A Student who, for whatever reasons is not able to complete the program within the normal period (N) or the minimum duration prescribed for the programme, may be allowed a two year period beyond the normal period of study to clear the backlog to be qualified for the degree. (Time Span = N +2 years for the completion of programme).

In exceptional cases like major accidents and childbirth an extension of one year may be considered beyond the maximum span of time (Time Span = N + 2 + 1 years for the completion of programme).

If the students fail to complete the course and take the examination within the stipulated time, they will be required to re-register their names and take the examination in the revised regulations/syllabus of the paper in force at the time of their reappearance. Students qualifying during the extended period shall not be eligible for **RANKING**.

➤ **INSTANT EXAMINATION (SPECIAL SUPPLEMENTARY EXAMINATION)**

In order to provide an opportunity to the final year UG and PG students to obtain the degree in the same year and also to facilitate vertical mobility, special supplementary End Semester Examinations will be conducted in about 30 days from the date of publication of results every year for the final semester theory papers and also for the candidates who had failed in **ONLY ONE** theory paper of the previous semesters. Students, who wish to apply for special supplementary End Semester Examinations, can do so within 7 days from the date of publication of results.

**Students involved in Malpractice will not be permitted to appear for Supplementary Examination.**

The details of the ESE are as follows:

External Component			
Assessment type	Comprehensive Test	Maximum mark	% of Weightage
External Exam	3 Hours Examination	100	50
	Grand Total (CIA+ESE)		100

## **VII. CONDUCT OF EXAMINATION**

The Chief Superintendent of Examinations will be the Principal or a person appointed by the Principal. The responsibility of conducting the End Semester Examinations lies with the team led by the Chief Superintendent.

The time-table for examinations will be finalized by the office of the Controller of Examinations and will be displayed well in advance i.e., 20 days prior to the commencement of the examinations.

The Hall tickets for eligible students will be issued 3 days prior to the commencement of examinations. For Subjects like Environmental Studies / Value Education, End Semester Examinations may be conducted either in the on-line mode or in the offline mode along with the regular ESE.

## **VIII. VALUATION**

The valuation of the answer scripts will be undertaken at the central valuation camp led by the Controller of Examinations or the Camp Officer appointed by the Controller of Examinations. Double valuation of answer scripts is adopted for both UG and PG Courses.

## **IX. PUBLICATION OF RESULTS**

The Examination results will be published on the web portal during the third / fourth week of May for the II, IV and VI semester examinations and during the third / fourth week of December for the I, III and V semester examinations

### **A. GUIDELINES FOR OBTAINING PHOTOCOPY OF THE ANSWER SCRIPT**

**Candidates seeking photocopy of the answer scripts are advised to go through these rules and regulations before applying.**

- i. Photocopy is permitted only for Regular theory papers in PART I, II and III.  
**(Supplementary excluded).**
- ii. The student should carefully select the papers for which s/he wishes to obtain the photocopy. A second application will not be accepted for additional papers.

### **B. GUIDELINES FOR APPLYING FOR REVALUATION OF THE ANSWER SCRIPT**

**Candidates seeking revaluation are advised to go through these rules and regulations before applying.**

- i. Revaluation is permitted only for Regular theory papers in PART I, II and III.  
**(Supplementary excluded).**

- ii. The student should carefully select the papers for which s/he wishes to apply for revaluation. A second application will not be accepted for additional papers.
- iii. The application is to be filled in by the candidate in his/her own hand-writing and not by anyone else on his/her behalf.
- iv. Entries made by the candidate are to be verified by the HOD and forwarded to the Principal for endorsement.
- v. The prescribed Fee payment receipt or challan has to be attached along with the Application Form and submitted to the Principal's Office. The candidate will be given an acknowledgement for submission, with date and time.
- vi. The candidate has to be aware that when s/he is applying for revaluation, S/he **SURRENDERS** the original performance and will now accept the revised performance in which there could either be a **CHANGE/ NO CHANGE** in the marks.

#### **X. CLASSIFICATION OF PERFORMANCE – GRADING SYSTEM FOR THE SEMESTER**

A candidate shall be declared to have qualified for the award of the Degree, provided the candidate has successfully completed the Programme requirements and has passed all prescribed subjects of study in the respective semesters.

**Passing Minimum: UG CIA 40% AGGREGATE 40% B.Com (Hons.) and PG CIA 50% ESE 50% AGGREGATE 50% OF THE MAXIMUM OF THE COMPONENT IN THAT PAPER / COURSE**

P: Pass, U: Re-Appeal, WH: Withheld, AAA: Absent, CIA: Continuous Internal Assessment, ESE: End Semester Examination, GPA: Grade Point Average.

CGPA: Cumulative Grade Point Average

#### **POST GRADUATE DEGREE**

**PART – A:** Core, Elective including Extra Disciplinary Elective, Major Project

**PART – B:** Soft Skills, Internship

#### **UNDERGRADUATE DEGREE**

**PART – I :** Tamil / Hindi/Sanskrit/French

**PART – II :** English

**PART – III:** Core, Allied, Elective and Inter Disciplinary Elective

**PART – IV:** Basic/Advanced Tamil / Basic Hindi/ Non-Major Elective, Skill Based Electives, Environmental Studies and Value Education

**PART – V :** Extension Activities

RANGE OF MARKS FOR GRADES UG Also for Certificate / Diploma				RANGE OF MARKS FOR GRADES UG[B.Com.(Hons.) B.Com (PA)], PG and also			
Range of Marks	Grade Points	Letter Grade	Description	Range of Marks	Grade Points	Letter Grade	Description
90 - 100	9.0 - 10.0	O	Outstanding	90 - 100	9.0 - 10.0	O	Outstanding
80 - 89	8.0 - 8.9	D+	Excellent	80 - 89	8.0 - 8.9	D+	Excellent
75 - 79	7.5 - 7.9	D	Distinction	75 - 79	7.5 - 7.9	D	Distinction
70 - 74	7.0 - 7.4	A+	Very Good	70 - 74	7.0 - 7.4	A+	Very Good
60 - 69	6.0 - 6.9	A	Good	60 - 69	6.0 - 6.9	A	Good
50 - 59	5.0 - 5.9	B	Average	50 - 59	5.0 - 5.9	B	Average
40 - 49	4.0 - 4.9	C	Satisfactory	00 - 49	0.0 - 4.9	U	Re-appear
00 - 39	0.0 - 3.9	U	Re-appear	ABSENT	0	AAA	Absent
ABSENT	0	AAA	Absent				

$C_i$  = Credits earned for course  $i$  in any semester

$G_i$  = Grade Point obtained for course  $i$  in any semester

$n$  refers to the semester in which such courses were credited.

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++		First Class with Distinction*		
8.0 and above but below 8.5		D+				
7.5 and above but below 8.0		D				
7.0 and above but below 7.5		A++		First Class		
6.5 and above but below 7.0		A+				
6.0 and above but below 6.5		A				
5.5 and above but below 6.0		B+		Second Class		
5.0 and above but below 5.5		B				
B.Com (Hons.)	UG	B.Com (Hons.), B.Com (PA)	B.Com (Hons.) B.Com (PA)	UG	UG	
0.0 and above but below 5.0	4.5 and above but below 5.0	U	Re-appear	C +	Third Class	
	4.0 and above but below 4.5			C		
	0.0 and above but below 4.0				U	Re-appear

#### ● CGPA Grades:

The candidates who have passed in the first appearance and within the prescribed semester of the UG/PG Programme (Core, Allied and Elective) alone are eligible for classification of results.

## **GRADING SYSTEM**

**For a Semester:**

$$\text{GRADE POINT AVERAGE [GPA]} = \sum_i C_i G_i / \sum_i C_i$$

$\text{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the course}}{\text{Sum of the credits of the courses (passed) in a semester}}$
--

**For the entire programme:**

$$\text{CUMULATIVE GRADE POINT AVERAGE [CGPA]} = \sum_n \sum_i C_{ni} G_{ni} / \sum_n \sum_i C_{ni}$$

$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$
--

(CGPA is calculated only if the candidate has passed in all the courses in the entire programme)

## **XI. CONCESSIONS FOR DIFFERENTLY-ABLED STUDENTS**

### **A. DYSLEXIA STUDENTS**

For students who are mentally challenged/who have a learning disability and mental retardation/ who are slow learners/ who are mentally impaired/ who have learning disorder and seizure disorder/ who are spastic and those who have cerebral Palsy, the following concessions shall be granted:

- i. Part I** Foundation course in Tamil/Hindi/Sanskrit/French **can be exempted**.
- ii. One-third** of the time meant for the paper may be given as **extra time** in the examination.
- iii. Leniency** in overlooking **spelling mistakes**, and
- iv. Amanuensis** for all courses will be provided on request. This will be acceptable only if the request is duly certified by the Medical Board of the Government Hospital/ General Hospital/ District headquarters Hospitals and they shall be declared qualified for the degree if they pass the other examinations prescribed for the degree.

### **B. HEARING, SPEECH IMPAIRED & MENTALLY CHALLENGED**

For students who are hearing and speech impaired/who are mentally challenged, the following concessions shall be granted:

- i. One Language paper** either **Part I** Foundation course Tamil/Hindi/Sanskrit/French or **Part II** English or its equivalent **can be exempted**
- ii. Part IV** Non-Major Elective (NME) or Basic Tamil/Advanced Tamil or Basic Hindi **can be exempted**.

### C. VISUALLY IMPAIRED STUDENTS:

- i. **Exempted** from paying **examination fees**.
- ii. A **scribe** shall be **arranged by the College** and the scribe will be paid as per the College's decision.

### XII. INTERDISCIPLINARY ELECTIVE (IDE)

It has been proposed that the UG students admitted from the academic year 2021 – 22 onwards would take up an Interdisciplinary Elective (IDE) Paper in their **Fifth Semester**.

❖ **The following Departments functioning in Shift I will offer IDE Papers to students only from Shift I:**

S.NO	DEPARTMENT	IDE ( TITLE OF THE PAPER)
1.	B.A Economics	Principles of Insurance and Risk Management
2.	B.A Defence & Strategic Studies	An Introduction to Defence Journalism
3.	B.Sc Mathematics	Numerical Analysis
4.	B.Sc Physics	Introduction to Integrated Electronics
5.	B.Sc Chemistry	Chemistry in Everyday life
6.	B.Sc Plant Biology & Biotechnology	Horticulture & Mushroom Cultivation
7.	B.Sc Advanced Zoology & Biotechnology	Wildlife Conservation
8.	B.Com (General)	Entrepreneurial Development -1
9.	B.Com Corporate Secretaryship	Entrepreneurial Development -2

❖ **The following Departments functioning in Shift II will offer IDE Papers to students only from Shift II:**

S.NO	DEPARTMENT	IDE ( TITLE OF THE PAPER)
1.	B.B.A	Managerial Skill Development
2.	B.C.A	E - Commerce
3.	B.Com (A&F)	Indian Constitution and Human Rights
4.	B.Com (General)	Entrepreneurial Development -3
5.	B.Com (Corp. Sec)	Entrepreneurial Development -4
6.	B.Sc Computer Science	Internet and Its Applications
7.	B.Sc Visual Communication	Understanding Film
8.	B.Com (BM)	Personal Investment Planning
9.	B.Com (MM)	Tourism Management

❖ The following Departments from Shift II, functioning in Shift I timings can only offer IDE Papers to the students functioning within the same Shift I timings:

S.NO	DEPARTMENT	IDE ( TITLE OF THE PAPER)
1.	B.Com (ISM)	Essentials of Office Automation Tools and E- Mail Etiquette
2.	B.A English Literature	English for Competitive Exams
3.	B.Sc Biotechnology	Intellectual Property Rights
4.	B.Sc Information Technology	Web Designing
5.	B.Sc Data Analytics	<ul style="list-style-type: none"> <li>• Interdisciplinary Elective – Digital Logic Fundamentals</li> <li>• Operating Systems</li> <li>• Data Visualization using Tableau</li> <li>• Pentaho/ Looker</li> </ul>
6.	Commerce (PA)	Office Management & Methods
7.	Commerce (CA)	<ul style="list-style-type: none"> <li>• Entrepreneurial Development</li> <li>• Production &amp; Supply Chain Management</li> <li>• Business Information System</li> </ul>
8.	B.A Sociology	Problems of Urban India
9.	B.A Defence & Strategic Studies	An Introduction to Defence Journalism

### **XIII. OPTION TO EARN ADDITIONAL CREDITS**

#### **A. MOOCs (Massive Open Online Courses)**

- The UG students can opt for a minimum of one Course and earn 2 credits, while a maximum of 6 Credits can be earned by completing three courses during their three-year period of study.
- The PG students can opt for a minimum of one Course and earn 2 credits, while a maximum of 4 Credits can be earned by completing two courses during their two-year period of study.
- This is completely optional.

#### **B. CERTIFICATE COURSES**

The Certificate courses are offered by the departments for 30 hours which will enable the students to earn 2 additional credits.

#### **C. ADDITIONAL CREDIT FOR EXTENSION SERVICES**

All the students who have put in additional 40 hours or more apart from the compulsory minimum hours in NSS / NCC / Sports & Games / Rotaract / Youth Red Cross / Citizen Consumer Club / Enviro Club or any other service organization in the College will be eligible to earn an additional credit at the time of completion of their Course. This should be duly certified by the Principal of the College,



#### **XIV. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS**

- i. All candidates should register their names for the first semester examination after admission to the UG / PG courses.
- ii. Candidates shall be permitted to proceed from the first semester up to the final semester irrespective of their failure in any of the semester examinations, subject to the condition that the candidate had registered for all the arrear subjects of earlier semesters along with current semester subjects.

#### **XV. ISSUE OF CERTIFICATES**

A Statement of Marks will be issued to each student who has written the examination.

##### **❖ Consolidated Mark Sheet**

Consolidated mark sheets will be given to final year students along with total credits earned only to those who have passed in all the papers prescribed for the respective degree.

##### **❖ Transcript**

Students who wish to obtain any Transcript for joining courses of study in other Universities in India or abroad or for obtaining scholarships, can obtain these certificates from the office of the Controller of Examinations. A requisition letter duly signed by the Student and forwarded by the Principal along with fee challan is to be submitted to the office of the Controller of Examinations. The Certificate will be provided within 15 working days in a sealed envelope.

##### **❖ Provisional Certificate**

A copy of the results of the successful final year students will be sent to the University of Madras in the prescribed format in July/August and the University will issue a Provisional Certificate through the College. A soft copy can be downloaded from the University of Madras website and a hard copy will be provided by them within 90 days of the issue of the soft copy.

##### **❖ Corrections in the Certificates**

Any corrections like name, date of birth etc., can also be made in the certificate. A letter of request duly signed by the student, HOD and Principal along with the prescribed fee paid challan has to be forwarded to the office of the Controller of Examinations. The details will be updated within 15 working days. The amount once paid will not be refunded under any circumstances.

##### **❖ Duplicate Mark Sheet**

In case of loss of the mark sheet / certificate, a duplicate will be provided after submitting a non-traceable certificate issued from the Police station duly signed by an Inspector or Sub Inspector. A letter of request duly signed by the student, HOD and Principal along with the prescribed fee paid challan is to be forwarded to the office of the Controller of Examinations.

❖ **Duplicate Provisional Certificate / Degree Certificate:**

Students have to apply directly to the University of Madras for duplicate provisional certificate and degree certificate.

❖ **Verification of Qualification**

Agencies which request for verification of educational qualification of students under the autonomous mode of this college and students who opt for higher studies / employment and who require verification of educational qualification shall verify online through the QR code in the consolidated mark sheet after an online payment of fees for the same. They can also apply to the Principal to this effect along with the prescribed fees which has to be forwarded to the Office of the Controller of Examination. The relevant certificate will be issued within 15 working days from the receipt of the forwarded request of the Principal and the Office of the Controller of Examination.

## **XVI. CONVOCATION AND NOTICE**

❖ **Convocation**

Every year after the Convocation is conducted by the University of Madras, the College will hold a Graduation day / Convocation in which the Degree Certificates will be distributed to the students who are present. For others it will be issued by the College Office. Students should collect the same within 30 days of convocation after which a search fee will be charged. **Students are responsible for collecting their Degree certificates from the college office on time.**

❖ **Notice**

Candidates, who have completed the duration of the course and left the College, can get information regarding Supplementary Examinations, issue of examination application forms, certificates and application for Graduation day through the college website and general notice board. Regular students will however be informed of the examinations by circulation, in addition to the modes mentioned above.

**No student will receive individual communication.**

## **XVII. PROCEDURE FOR SUBMISSION OF SYLLABUS**

- i. Each department will finalize the syllabus.
- ii. Finalization could mean a minor change in the existing syllabus or a revamp of the entire syllabus.
- iii. The department will submit the changes to the Board of Studies. After the approval of the syllabus in the BOS, the concerned department will submit the minutes along with the modified syllabus book / sheet (five copies) to the Dean's office within ten days of the BOS meeting.
- iv. A Soft copy of the batch-wise syllabus approved by the BOS in PDF format should be sent to the Dean's mail ID within ten days of the BOS meeting.

## COURSE STRUCTURE 2021-22 Batch onwards

### B.SC ADVANCED ZOOLOGY AND BIOTECHNOLOGY

Sem.	Part	Course Component	Subject Name	Cdt.	Hrs.	Marks		
						CIA	ESE	TOT
I	I	Language	Tamil I	3	6	50	50	100
	II	English	English I	3	4	50	50	100
	III	Core I	Animal Diversity I - Invertebrata	4	6	50	50	100
		Core II	<b>Practical I</b> – Invertebrata and Chordata	-	2			*
		Allied I	Botany I	3	6	50	50	100
			<b>Allied Practical:</b> Allied Botany Practical	-	2			*
	IV	1.NME/ Basic Tamil/ Basic Hindi/Adv. Tamil	Aquaculture	2	2	50	50	100
		2.Skill Based Subjects	Soft Skill I	3	2	50	50	100
Total				18	30			600
II	I	Language	Tamil II	3	6	50	50	100
	II	English	English II	3	4	50	50	100
	III	Core III	Animal Diversity II – Chordata	4	6	50	50	100
		Core II	<b>Practical I</b> – Invertebrata and Chordata	4	2	50	50	100
		Allied II	Botany II	3	6	50	50	100
			<b>Allied Practical:</b> Allied Botany Practical	4	2	50	50	100
	IV	1.NME/ Basic Tamil/ Basic Hindi/ Adv. Tamil	Occupational Zoology (Sericulture, Vermiculture and Poultry Farming)	2	2	50	50	100
		2.Skill Based Subjects	Soft Skill II	3	2	50	50	100
Total				26	30			800
III	I	Language	Tamil III	3	6	50	50	100
	II	English	English III	3	4	50	50	100
	III	Core IV	Cell and Molecular Biology	4	6	50	50	100
		Core V	<b>Practical II</b> – Cell Biology & Genetics	-	2	50	50	100
		Allied III	Chemistry I	3	6	50	50	100
			<b>Allied Practical:</b> Allied Chemistry Practical	-	2			*
	IV	1. Skill Based Subjects	Soft Skill III	3	2	50	50	100
		2.EVS	Environmental Science	-	2			*
Total				16	30			600

**COURSE STRUCTURE 2021-22 Batch onwards**  
**B.SC ADVANCED ZOOLOGY AND BIOTECHNOLOGY**

Sem.	Part	Course Component	Subject Name	Cdt.	Hrs.	Marks	Sem.	Part
						CIA		
IV	I	Language	Tamil IV	3	6	50	50	100
	II	English	English IV	3	4	50	50	100
	III	Core VI	Genetics and Evolution	4	6	50	50	100
		Core V	Practical II – Cell Biology, Genetics and Evolution	4	2	50	50	100
		Allied IV	Chemistry II	3	6	50	50	100
			Allied Practical: Allied Chemistry Practical	4	2	50	50	100
	IV	1. Skill Based Subjects	Soft Skill IV	3	2	50	50	100
		2.EVS	Environmental Science	2	2	50	50	100
Total				26	30			800
V	III	Core VII	Developmental Biology and Immunology	4	4	50	50	100
		Core VIII	Biotechnology and Nanotechnology	4	4	50	50	100
		Core IX	Animal Physiology and Biochemistry	4	4	50	50	100
		Core X	Biostatistics and Computer Applications with R Programming for Life Sciences	4	4	50	50	100
		Core XI	Practical – III Animal Physiology, Biochemistry, Developmental Biology and Immunology	-	4	50	50	100
		Core XII	Practical IV – Environmental Biology, Biotechnology and Microbiology	-	4	50	50	100
		Elective I (IDE)	Wildlife Conservation	5	5	50	50	100
	IV	Value Education	Value Education	2	1	50	50	100
		Internship		2				
Total				25	30			800
VI	III	Core XIII	Environmental Biology and Environmental Biotechnology	3	4	50	50	100
		Core XIV	Genetic Engineering and Recombinant DNA Technology	4	4	50	50	100
		Core XV	Applied Microbiology	4	4	50	50	100
		Core XI	Practical – III Animal Physiology, Biochemistry, Developmental Biology and Immunology	4	4	50	50	100
		Core XII	Practical IV – Environmental Biology, Biotechnology & Microbiology	4	4	50	50	100
		Elective - II	Clinical Laboratory Technique	5	5	50	50	100
		Elective III	Economic Entomology and Pest Management	5	5	50	50	100
		Project	Group Project	3	-	50	50	100
	V	Extension Activities		1	-			-
Total				33	30			800
Grand Total				144	180			4400

**GURU NANAK COLLEGE (AUTONOMOUS), CHENNAI – 42.**

**Subject Name**

**Subject Code**

**MAX. MARKS: 100**

**TIME: 3 HRS.**

**SECTION - A (10 X 3 = 30 MARKS)**

**(Answer Any TEN Questions)**

**SET - I**

**Define/Explain the following**

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

**SECTION - B (5 X 6 = 30 MARKS)**

**(Answer Any FIVE Questions)**

- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.

**SECTION - C (4 X 10 = 40 MARKS)**

**(Answer Any FOUR Questions)**

- 20.
- 21.
- 22.
- 23.
- 24.
- 25.

# Semester I

## CORE I: ANIMAL DIVERSITY I – INVERTEBRATA

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: I</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 6</b>

### Course Objectives:

- To appreciate the biodiversity of invertebrates in living in diversified habitats
- To comprehend the systematics, taxonomy and structural organization of the animal kingdom
- To familiarize the characteristic features of each phylum and to categorize up to order
- To critically analyse the morphological, anatomical and physiological features of various invertebrate animals
- To impart knowledge on the evolutionary relationship of different invertebrates through their structural and functional similarities
- To understand the economic importance of invertebrates and their role in the ecosystem
- To build analytical, teamwork and communication skills through experiential learning

### UNIT I

**15 hours**

Introduction to Animal kingdom and basis of classification - Principles of taxonomic characteristic and nomenclature

**Phylum Protozoa:** General Characteristics and classification upto order

**Type Study:** *Plasmodium*

**General Topics:** Nutrition in Protozoa, Locomotion in Protozoa, Protozoan diseases in humans

### UNIT II

**18 hours**

**Phylum Porifera:** General Characteristics and classification upto order

**Type Study:** *Sycon*

**General Topics:** Canal System of Sponges, Skeletal system in sponges, Economic importance of Porifera

**Phylum Coelenterata:** General Characteristics and classification upto order

**Type Study:** *Obelia* and *Aurelia*

**General Topics:** Economic importance of corals and coral reef, Polymorphism, Nematocyst and Evolutionary significance

### UNIT III

**18 hours**

**Phylum Platyhelminthes:** General Characteristics and classification upto order

**Type Study:** *Taenia solium* and *Fasciola hepatica*

**Phylum Nematodes:** General Characteristics and classification upto order

**Type Study:** *Ascaris*

**General Topics:** Parasitic adaptation in Helminthes, Nematode parasites in humans

## UNIT IV

21 hours

**Phylum Annelida** - General Characteristics and classification upto order

**Type Study:** *Pheretima*

**General Topics:** Metamerism in Annelida, Excretory organ in Annelida, Economic importance of Annelids

**Phylum Arthropoda:** General Characteristics and classification upto order

**Type study:** *Penaeus monodon / indicus*

**General Topics:** Crustacean Larval form and its significance, *Peripatus* and its affinities, Mouth parts in insects, Respiratory organ in Arthropods, Social life in insects

**Phylum Mollusca:** General Characteristics and classification upto order

**Type Study:** *Pila*

**General Topics:** Foot in Mollusca, Torsion in Mollusca and Economic importance of Mollusca

## UNIT V

18 hours

**Phylum Echinodermata:** General Characteristics and classification upto order

**Type Study:** *Asterias*

**General Topics:** Water Vascular system, Larval forms

Comparative account on functional anatomy of feeding, nervous and reproduction in invertebrates

### Reference Books:

1. Dhami, P.S. and Dhami, J.K., (1979). Invertebrates, 5th ed., R. Chand Publisher.
2. Kotpal, R.L., (2005). Invertebrates, Rastogi Publications, Meerut.
3. Jordan, E.L. and Verma, P.S. (2009). *Invertebrate Zoology* S. 14Th Edition Chand &Co. New Delhi
4. Ekambaranatha Ayyar, M and Ananthakrishnan, T.N. (1993). Outlines of Zoology, Vol. I, Part I and II, Viswanathan and Co. Madras.
5. Parker, T.J. and Haswell, W.A., (1990). Text book of Zoology, Invertebrates, Vol. I edited by Marshall, A.J. and Williams, W.D., CBS Publication & Dist., Delhi.
6. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
7. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis. III Edition, Blackwell Science
8. Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers
9. Chaudhry, S., (2003). Fundamental Invertebrate Zoology, S.Vikas & Co. Fatehpura, Jalandhar,
10. T.C. Majpuria. (1990). Invertebrate Zoology, Pradeep Pub. Kitab Mahal.
11. Pechenik, J. A. (2015). Biology of the Invertebrates. VII Edition, McGraw-Hill Education



## ALLIED ZOOLOGY – I

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: I</b>	<b>CREDITS: 3</b>	<b>NO.OF HOURS PER WEEK: 6</b>

### Course Objective:

- To understand the systematics and structural organization of the animal kingdom
- To familiarize the characteristic features of each phylum and to understand the structural and functional aspects of invertebrate species
- To gain knowledge on the general characteristic features and classification of chordates
- To acquire knowledge on the structural and physiological features of different groups of animals under the phylum chordata

### UNIT I

**20 Hours**

**Introduction:** Invertebrata - General characters and classification

**Protozoa** – Type study: *Plasmodium vivax*

**Porifera** – Type study: *Scypha* (Sycon)

**Coelenterata** – Type study: *Obelia geniculata*

**Platyhelminthes** - Type study: *Taenia solium*

**Nematoda** – Type study: *Ascaris*

### UNIT II

**20 Hours**

**Annelida** – Type study: Leech

**Arthropoda** – Type study: Prawn

**Mollusca** – Type study: *Unio* (External morphology and Respiratory system)

**Echinodermata** – Type study: Starfish (External morphology and Water vascular system)

### UNIT III

**20 Hours**

**Chordata** – General characters and Classification

**Prochordates** – *Amphioxus* – Structure

**Vertebrates** - Pisces- Type study: Shark

### UNIT IV

**15 Hours**

**Amphibia**- Type study: Frog (External morphology, Digestive system, Circulatory System and Reproductive system)

**Reptilia** – Type study: Calotes (External morphology, Digestive system, Circulatory System and Reproductive system)

### UNIT V

**15 Hours**

**Aves** - Type study: Pigeon (External morphology and Respiratory system)

**Mammalia** - Type study: Rabbit (External morphology and Circulatory system)

## **Reference Books:**

### **Invertebrata**

1. P.S. Dhama and J.K. Dhama – Invertebrate Zoology – S. Chand and Co. New Delhi.
2. Kotpal, R.L., (2005). Invertebrates, Rastogi Publications, Meerut.
3. Ekambaranatha Ayyar, M and Ananthakrishnan, T.N. (1993). Outlines of Zoology, Vol. I, Part I and II, Viswanathan and Co. Madras.
4. Parker, T.J. and Haswell, W.A., (1990). Text book of Zoology, Invertebrates, Vol. I edited by Marshall, A.J. and Williams, W.D., CBS Publication & Dist., Delhi.
5. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
6. Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers
7. T.C. Majpuria. (1990). Invertebrate Zoology, Pradeep Pub. Kitab Mahal.

### **Chordata**

8. Dhama, P.S., Dhama, J.K., (1982). Chordate Zoology, Dinesh Publishers, Jalandhar.
9. Kotpal, R.L., (2005). Text Book of Zoology- Vertebrates, CBS Publishers, Delhi.
10. Jordan EL and Verma. PS., (2002). Chordate Zoology, S. Chand Publication
11. Ekambaranath Iyer. (2000). A Manual of Zoology. Vol. II S. Viswanathan and Co.
12. Bhamrah, H.S. and Juneja, K., (1990). An introduction to fishes, Anmol Publications, New Delhi
13. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vol. II- Vertebrates. Latest edition, CBS Publishers, Delhi edited by Late A.J. Marshall & Williams, W.D.
14. Dodson, E.O., (1976). A Text Book of Zoology, CBS Publishers & Distributors, Delhi.

## **NON-MAJOR ELECTIVE I: AQUACULTURE**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: I</b>	<b>CREDITS: 2</b>	<b>NO.OF HOURS PER WEEK: 2</b>

### **Course Objective:**

- To acquire knowledge in the physico-chemical analysis of water and their impact on aquatic systems
- To understand the importance of aquaculture practice and different types of aquaculture practices in India with special reference to exotic and major carps
- To introduce the various techniques involved in the construction of fish ponds and their management
- To give an insight into the importance of integrated fish farming methods
- To provide a basic idea about the importance of live feed in culture systems and also composition of supplementary feed
- To Identify and categorize the fish and shrimp diseases in the Aquaculture
- To impart knowledge and technical skills to understand the rapidly changing field of modern Aquaculture

### **UNIT I**

**6 Hours**

History of Aquaculture – Purpose and importance of Aquaculture – Physical and chemical characteristics features of water bodies (Freshwater, Brackish water and Marine water) – Types of culture systems (Traditional, Intensive, Semi-intensive and Extensive), Pond, Cage, RAS

### **UNIT II**

**6 Hours**

Selection criteria for cultivable species – Site selection for fish farming – Construction of fish and Prawn / Shrimp culture ponds – Types of fish ponds (breeding pond, hatchery unit, brooders pond, nursery pond, stocking pond and rearing pond) – Maintenance and management of different ponds - Feeds for cultivable species – Natural, Supplementary and Artificial feeds

Post-harvest technology – Organic farming

### **UNIT III**

**6 Hours**

Types of culture – Cage Culture, Pen culture - Monoculture, Monosex culture and Poly culture – Integrated fish farming (Paddy cum fish culture, Paddy cum prawn culture and Duck cum pig cum fish culture) – Induced breeding in Indian major carps - Biofloc fish farming

### **UNIT IV**

**6 Hours**

Culture of Air-breathing fishes (Mullet and Cat fish) - Sewage fed fish culture – Culture of Pearl oyster and Edible oyster

## **UNIT V**

**6 Hours**

Culture of Marine and Freshwater Prawns /Shrimps – Present status of shrimp farming in India - Common fish diseases (Bacterial, Fungal, Viral and Parasitic Diseases) – Prevention and treatment – Fishing technology (Crafts and Gears) – Preservation and processing of fish and prawn – Agencies involved in Aquaculture – CAA, NFDB, ICAR, MPEDA, RGCA

### **Activity - Field Visit and Submission of Report**

1. Visit to Aquaculture farm / industry

### **Reference Books:**

1. R. Santhanam, N. Sukumaran and Natarajan, - A manual of fresh water aquaculture, Oxford and IBH Publishing Co Pvt. Ltd., Mumbai.
2. B.N. Yadav, - Fish and fisheries, Daya Publishing House, Delhi.
3. Mathew Landan, (1991). Introduction to aquaculture, John Wiley and Sons Inc..
4. V.R.P. Sinha, (1993). Acompendium of aquaculture Technologies for developing countries, Oxford and IBH Publishing Company PVT. Ltd.
5. V.G. Jhingran, (1991). Fish and fisheries of India, Hindustan Publishing Corporation, Delhi.
6. T.V.R. Pillay – Aquaculture principles and practices, Fishing new Books, Blackwell Science Ltd., Oxford.
7. Shanmugam, K. (1990). Fishery Biology and Aquaculture, Hindustan Pub. Corporation, New Delhi.
8. C.V. Kurian and Sebastein – Prawn and Prawn fisheries of India, Hindustan Publishing House, New Delhi.
9. Elvire Balugal, A. (1984). Aquaculture systems and practices – A selected Review, Daya Publishing House, New Delhi.

# Semester II

### CORE III: ANIMAL DIVERSITY II – CHORDATA

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: II</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 6</b>

#### Course Objectives:

- To understand the diversity of chordates and its interaction with the environment
- To understand the characteristic features of each class and to categorize upto order
- To comprehend the morphological, anatomical, physiological features of the chordate groups
- To appreciate the affinities in life forms and functions among various groups of animals in Phylum Chordata
- To impart knowledge on the evolutionary relationships between different subphylum and classes.
- To learn the economic importance of few representative organisms from different groups of chordates
- To enhance collaborative learning and to develop communication skills and analytical skills through experiments, assignments, discussions and projects.

#### UNIT I

**20 Hours**

General characteristic and outline classification of Phylum Chordata - Origin of Chordata

**Protochordates:** General characters and Classification upto order

**Hemichordata:** *Balanoglossus*

**Urochordata:** *Herdmania*

**Cephalochordata:** *Amphioxus*

**General Topics:** Affinities of Urochordata and Cephalochordata - Retrogressive metamorphosis in Urochordata

#### UNIT II

**15 Hours**

**Agnatha:** General characters and classification

**Type Study:** *Petromyzon*

**Pisces:** General characters and classification upto order

**Types Study:** *Scoliodon*

**General Topics:** Accessory respiratory organs in fishes, Types of fins, Migration in fishes, Parental care in fishes

#### UNIT III

**20 Hours**

**Amphibian:** Origin of Tetrapoda - General characters and classification upto order

**Type Study:** *Rana*

**General Topic:** Parental care in Amphibians

**Reptilia** - General characters and classification upto order

**Type Study:** *Calotes*

**General Topics:** Poison apparatus and biting mechanism in snakes, poisonous and non – poisonous snakes, Mesozoic reptiles

#### UNIT IV

20 Hours

**Aves** - General characters and classification upto order

**Type Study:** *Columba livia*

**General Topics** - *Archaeopteryx*, Flight adaptation and Migration in birds, Palates in birds

**Mammals:** General characters and classification upto order

**Type Study:** *Oryctolagus*

**General Topics:** Dentition in mammals, Adaptive radiation in mammals

#### UNIT V

15 Hours

Comparative anatomy of the vertebrate heart and brain, Jaws suspension in vertebrates, Distribution of vertebrates in different realms

#### Reference Books:

1. Dhama, P.S., Dhama, J.K., (1982). Chordate Zoology, Dinesh Publishers, Jalandhar.
2. Kotpal, R.L., (200). Text Book of Zoology- Vertebrates, CBS Publishers, Delhi.
3. E L Jordan and P.S. Verma., (2002). Chordate Zoology, S. Chand Publication
4. Ekambaranath Iyer. (2000). A Manual of Zoology. Vol. II S. Viswanathan and Co.
5. Bhamrah, H.S. and Juneja, K., (1990). An introduction to fishes, Anmol Publications, New Delhi Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vol. II- Vertebrates. Latest edition, CBS Publishers, Delhi edited by Late A.J. Marshall & Williams, W.D.
6. Dodson, E.O., (1976). A Text Book of Zoology, CBS Publishers & Distributors, Delhi.
7. Young, J. Z. (2004). The Life of Vertebrates. III Edition, Oxford university press.
8. Parker T.J. and Haswell W.A. (1972). Textbook of Zoology Vertebrates. VII Ed., Volume II
9. Pough H. (2018). Vertebrate life X Edition, Pearson International.
10. Darlington P.J. (1966). The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
11. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
12. William S. Beck, Karel, F., Liem and George Gaylord Simpson. (2000). Life: An introduction to biology. Harper Collins Publishers, New York.

## CORE II: PRACTICAL I - INVERTEBRATA AND CHORDATA

<b>SUBJECT CODE:</b>	<b>PRACTICAL</b>	<b>MARKS: 100</b>
<b>SEMESTER: II</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 2</b>

### **I. Dissection**

#### **A. Cockroach**

1. Morphological characters
2. Digestive system
3. Nervous system

#### **B. Prawn / Shrimp**

4. Morphological characters
5. Identification of Prawn and Shrimp species
6. Digestive system
7. Nervous system

#### **C. Any Bony Fish:**

8. Morphological characters
9. Digestive system

### **II. Mounting**

1. Mouth parts of Cockroach
2. Mouth parts of Mosquito
3. Mouth parts of Bedbug
4. Mouth parts of House fly
5. Honeybee sting apparatus
6. Prawn: Appendages
7. Earthworm- Body setae and Penial setae
8. Scales - Ctenoid, Placoid, Cycloid
9. Types of fins – Homocercal, Heterocercal, Diphyrcercal

### **III – Spotters**

#### **A- Classify giving reasons up to order:**

1. *Paramecium*
2. *Scypha*
3. *Obelia*
4. *Taenia Solium*
5. *Ascaris*
6. *Neanthes*
7. *Penaeus*
8. *Asterias*
9. *Balanoglossus*



10. *Amphioxus*
11. *Scoliodon sorrakowah*
12. *Rana hexadactyla*
13. *Calotes versicolor*
14. *Columba livia*
15. *Oryctolagus cuniculus*

**B- Draw labelled sketches:**

16. *Obelia medusa*
17. *Nereis* T.S.
18. *Bipinnaria larva*
19. *Amphioxus* T.S
20. *Quill feather*

**C- Comment on Biological significance:**

21. *Entamoeba*
22. *Paramecium* – Conjugation
23. *Plasmodium*
24. *Physalia*
25. *Ascaris*
26. *Heteronereis*
27. *Peripatus*
28. *Nauplius larva*
29. *Rotifers*
30. *Copepods*
31. *Artemia*
32. *Sacculina* on crab
33. *Sea anemone* on *Hermit crab*
34. *Vipera russelli* (Russel's viper)
35. *Pteropus*

**D – Relate structure and function:**

36. Sponge – Spicules
37. Sponge – Gemmule
38. *Taenia* – Scolex
39. *Neanthes* – Parapodium
40. *Penaeus* – Petasma
41. Starfish - Tube foot
42. Snake- Poison apparatus
43. *Quill feather*

## **E. Osteology / Palate in Birds / Dentition**

### **Osteology - Frog**

44. Skull and lower jaw
45. Vertebral column
46. Pectoral girdle
47. Pelvic girdle
48. Forelimb
49. Hind limb

### **Palate in Birds**

50. Pigeon – Palate
51. Crow – Palate
52. Duck – Palate

### **Dentition**

53. Rabbit – Dentition
54. Dog – Dentition

## **IV. Experiments / Field Visit / Study Tour**

1. Observation of Protista in pond water sample
2. Collection, Identification and Morphometric study of fishes from various habitat
3. Project report - Social behaviour of any insect, Animal behaviour
4. Report on field visit for studying the adaptation of animals (Study tour)

## ALLIED ZOOLOGY – II

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: II</b>	<b>CREDITS: 3</b>	<b>NO.OF HOURS PER WEEK: 6</b>

### Course Objective:

- To acquire knowledge on the structure and functions of cellular organelles
- To gain the knowledge about development of all the vertebrates from an egg to an embryo.
- To understand the structural and physiological features of various organ systems in the human body
- To acquire knowledge on the etiology of common physiological diseases, syndromes and disorders
- To educate the students about the basic environmental phenomena and enable them to understand the adaptations of the animals to their environment
- To understand the fundamental processes of evolutionary changes in man

### UNIT I

**15 Hours**

**Cell Biology:** Structure of animal cell - Mitochondria - Nucleus and nucleolus - Golgi bodies - Cell cycle and cell division – Ageing of cell

**Genetics:** Laws of Mendelism - Molecular structure of Genes - Gene concept - Gene function - X and Y – linked inheritance - Karyotype study - Pedigree analysis - Syndromes: Autosomal (Down's syndrome and Edward's syndromes) - Sex chromosomal (Turners syndrome and Klinefelter's syndrome) - Genetic disorders (Sickle cell anemia, Phenyl ketonuria and Cleft lip) - Genetic counselling

### UNIT II

**20 Hours**

**Developmental Biology:** Gametogenesis – Fertilization - Types and pattern of cleavage – Blastulation – Gastrulation in chick: Morphogenetic movements (Epiboly and emboly) - Organizers and Embryonic induction (Brief account) - Applied Aspects of Developmental Biology: Stem cells – *In vitro* fertilization (IVF)

**Biotechnology:** Scope and application of biotechnology - Cloning experiments in animals and man - Bioethics

### UNIT III

**20 Hours**

**Human Physiology:** History and scope of physiology - Principles of Homeostasis - Digestion and Absorption of Carbohydrates, Proteins and Fats

Excretion: Structure and functions of kidney and nephron - Physiology of urine formation - Kidney failure, Dialysis and Transplantation

Circulation: Structure of heart - Origin and conduction of heart beat - Cardiac cycle - Composition and functions of blood - Blood pressure and Pulse pressure - Heart diseases: Ischemia, Myocardial infarction, Rheumatic Heart Disease, Stroke

Endocrine glands: Hormones - Feedback mechanism - Structure, biological action and disorders of Pituitary gland, Thyroid gland, Islets of Langerhans, Adrenal gland and Sex organs

#### **UNIT IV**

**20 Hours**

**Ecology:** Definition and Principles - Ecosystem: Definition and components of ecosystem (Abiotic factors and Biotic factors) - Primary and secondary production - Food chain - Food web - Trophic levels - Energy flow - Ecological pyramids - Animal relationships (Symbiosis, Commensalism, Mutualism, Antagonism, Predation, Parasitism and Competition)

#### **UNIT V**

**15 Hours**

**Evolution:** Lamarkism and Neo-Lamarckism - Darwinism and Neo-Darwinism - Speciation, mimicry and coloration – Fossils - Evolution of man

#### **Reference Books:**

1. Verma, P.S. and V.K. Agarwal, 2010 Reprint, Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology, S. Chand & Co., New Delhi – 110 055.
2. Sambasiviah, I, Kamalakara Rao, A.P. Augustine Chellapa, S (1983). Text book of Animal Physiology, S. Chand & Co, New Delhi.
3. Verma P.S., Agarwal V.K. and Tyagi, B.S. (1995). Text book of Animal Physiology. S. Chand & Co.
4. Rastogi. S.C. (1977). Essentials of Animal Physiology. New Age International (P) Ltd., Publisher
5. Verma, P.S. and Agarwal, V.K. (1983). Animal Ecology, S. Chand & Co, New Delhi.
6. Verma, P.S. and Agarwal, V.K. and Tyagi, B.S. (1991). Chordate Embryology S. Chand & Co, New Delhi.
7. Rastogi, V.B. and Jayaraj, M.S. (2000). Text book of Genetics, Kedarnath Ramnath Publishers, Meerut.
8. T.S.Gopalakrishnan, Itta Sambasivaiah and A.P.Kamalakararao, 1984 Principles of organic Evolution, Pearl publications, Chennai.
9. DeRobertis, EDP, De Robertis,E.M.F. Cell Biology and Molecular Biology. Eighth Edition. W.B. Saunders Co., Philadelphia, 1995.

## ALLIED ZOOLOGY – PRACTICAL

<b>SUBJECT CODE:</b>	<b>PRACTICAL</b>	<b>MARKS: 100</b>
<b>SEMESTER: II</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 2</b>

### **I. Dissection:**

#### **Cockroach**

1. Digestive System
2. Nervous System

#### **Fish (Any bony fish)**

3. Digestive system

### **II. Mounting:**

4. Mouth parts of cockroach
5. Mouth parts of Mosquito
6. Prawn: Appendages
7. Placoid Scale
8. Ctenoid scale

### **III. Spotters**

#### **Invertebrata**

9. *Plasmodium*
10. *Sycon*
11. *Obelia geniculata*
12. *Taenia solium* (Entire)
13. *Taenia solium* (Transverse section)
14. Leech (Entire)
15. Leech (Transverse section)
16. Fresh water mussel

#### **Chordata**

17. *Amphioxus*
18. Shark (Placoid scale)
19. Pigeon (Feathers)
20. Rabbit

#### **Cell Biology**

21. Mitosis (any one stage)
22. Meiosis (any one stage)

#### **Genetics**

23. Human karyotype (Normal and Abnormal)

#### **Developmental Biology**

24. T.S. of Mammalian Testis
25. T.S. of Mammalian ovary

#### **Animal Physiology**

26. Sphygmomanometer

#### **Ecology**

27. Animal Relationship – Sea anemone on hermit crab, Ascaris

**NON-MAJOR ELECTIVE II: OCCUPATIONAL ZOOLOGY  
(SERICULTURE, VERMICULTURE AND POULTRY FARMING)**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: II</b>	<b>CREDITS: 2</b>	<b>NO.OF HOURS PER WEEK: 2</b>

**Course Objectives:**

- To develop entrepreneurial skills necessary for self-employment in the field of sericulture, vermiculture and poultry farming
- To identify various species of silkworms, earthworm and breeds of poultry
- To gain knowledge on the techniques involved in sericulture, vermiculture and poultry farming
- To empower women by inculcating entrepreneurship skills

**UNIT I**

**7 Hours**

**Sericulture**

Definition - History and present status - Silk industry and its importance – Brief account on morphology and life history of silkworm, varieties of silkworm – Rearing technique, Mulberry cultivation – Diseases and Pest of Silkworm – Processing of cocoon – Reeling and Marketing of Silk

**UNIT II**

**3 Hours**

Entrepreneurship in sericulture: Prospectus of Sericulture in India - Sericulture industry in different states - Employment opportunities in mulberry and non-mulberry sericulture sector - Economics in small scale and large-scale silk worm rearing - Scope for women entrepreneurs in sericulture sector

**UNIT III**

**7 Hours**

**Vermiculture**

Introduction - Ecological classification of Earthworms - Species of Earthworms used for vermiculture - Reproduction & life cycle - Role of Earthworm in solid waste management - Preparation of vermibed - Maintenance & monitoring - Preparation of vermicompost - Preparation of vermiwash

**UNIT IV**

**3 Hours**

Eco-science Research Foundation method - Karuna's method - Kale's method - Advantages of Vermicomposting - Prospects of vermiculture as self - employment venture.

**UNIT V**

**10 Hours**

**Poultry Farming**

Poultry breeds - American, Asiatic, Mediterranean, English and Indigenous breeds - Poultry breeding and poultry products - Rearing of chicks, growers, layers, broilers, turkeys and quails - Diseases of poultry

Backyard Poultry Farming in India: Management - Women in backyard poultry farming

### **Activity - Field Visit and Submission of Report**

- Visit to Sericulture Institute / Centres in India
- Preparation of vermiculture / visit to vermiculture unit
- Visit to Poultry Farm

### **Reference Books:**

1. Somani, L.L. (2008). Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
2. Talashilkar and Dosani, (2005). Earthworm in Agriculture. Agrobios (India), Jodhpur.
3. Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.
4. Gopalakrishnan C.A and G.Murley Mohan Lal (1997). Livestock and Poultry enterprises for rural development, Vikash, New Delhi.
5. Gnanamani M.R., (1998). Modern aspects of commercial poultry keeping, Giri.
6. Banarjee G.C., (1992) Poultry, Oxford and IBH, New Delhi.
7. Chauhan H.V.S. and S.Roy, (1996). Poultry diseases, diagnosis and treatment New Age International
8. Jull, Marley. A Poultry Husbandary, Tata Mc Graw Hill, New Delhi.
9. John William S. (2003). Poultry for sustainable Food Production and livelihood. Loyola Publication, Chennai
10. Mack O.North., Commercial chicken Production Manual.
11. Thomas. Singh (1982). Farm animals Management and Poultry Production. Vikas Sastry, Publishing House, New Delhi, 639 pp.
12. Harbans Singh and Eari N.Moore (1982). Livestock and Poultry Production, Prentice Hall of India, New Delhi.
13. M.Seetha Lekshmy and R.Santhi (2012). Vermiculture, Saras Publication
14. Gupta B.K. (2003). Vermicomposting for sustainable agriculture, Agrobios (India), Jodhpur
15. Venkitaraman, P.R, (1983) Text book of Economic zoology (Sudharsana Publ. Kochi) Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.
16. Shukla G.S, & Updhyay V.B, (2005). Economic Zoology, Rastogi Publ. Meerut. Pradip.V.Jabde, Text book of applied zoology.

# Semester III



## CORE IV – CELL AND MOLECULAR BIOLOGY

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: III</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 6</b>

### Course Objectives:

- To understand the structures and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- To critically analyse the structure and functions of cell organelles involved in cellular processes
- To understand the importance of cell cycle and cell division and their regulation
- To comprehend the process of cell signalling and its role in cellular functions
- To understand the basic concepts and mechanisms involved in molecular biology
- To impart knowledge on cancer biology and stem cell therapy
- To appreciate the advancement made in the field of cell biology

### UNIT I

**20 Hours**

History of Cell biology - Cell theory – Comparison of Prokaryotic cell and Eukaryotic cell – Ultra structure of animal cell

**Plasma membrane:** Different models of plasma membrane - Trilaminar model, Bimolecular leaflet model, Lattice model, Micellar model, Fluid mosaic model, Membrane transport (active, passive and facilitated) – Cell signalling – Structure and function of tight junctions - adherens junctions and gap junctions. Cytoplasm – Composition and function

### UNIT II

**15 Hours**

#### Cell organelles

**Endoplasmic Reticulum:** Morphology - Chemical composition - Morphological differentiation and functions.

**Golgi complex:** Morphology - Chemical composition - Relationship with other cell components and its function with special reference to cell secretion.

**Microbodies:** Structure - Chemical composition - Functions and origin of Peroxisomes and Glyoxysomes.

**Mitochondria:** Morphology including vital examination - Light and ultramicroscopic structures - Structural variations with regard to functions - Chemical composition - Role in cell physiology - Mitochondria as semi - autonomous organoids.

**Ribosomes:** Structure and biogenesis (Prokaryotes and Eukaryotes)

### UNIT III

**20 Hours**

**Nucleus and Nucleolus:** Structure and function – Structure of chromosome – Euchromatin and heterochromatin – Giant chromosome (polytene and lamp brush) - Cell cycle and cell stages – Cell division and their significance – Ageing of cell – Apoptosis – Cell signalling and regulation through GPCR and role of secondary messenger – CMP and Protein kinase

**Centrioles:** Basal bodies – Cilia – Flagella – Microtubules - Amoeboid movement

**Lysosomes:** Morphology – Chemistry - Polymorphism in relation to cytolysis and cell autophagy.

#### **UNIT IV**

**20 Hours**

**Molecular Biology** – Nucleic acid – Structure of DNA and RNA (rRNA, tRNA, mRNA) – DNA replication - Repair and recombination: Unit of replication – enzymes involved in replication, Replication origin and replication fork – DNA damage and repair mechanism – DNA transcription and translation

#### **UNIT V**

**15 Hours**

**Advanced studies in molecular technology:** Cancer Biology – Characteristics of cancer cell, carcinogens – Oncogenes - Tumour suppressor gene - Cancer and cell cycle - Virus induced cancer - Metastasis – Stem cell therapy

**Tools and Techniques: Microscope:** Principles of Microscopy – Components and application of Compound Microscope - Cytological study of living Cell, Microtechniques (Fixation, stain, staining methods, vital staining) – Cytochemical techniques – Cell Fractionation – Homogenization and Centrifugation – Isolation of cellular components

#### **Reference Books:**

1. Verma P.S., Agarwal V.K. (2010). Molecular Biology. S Chand Publication.
2. De Robertis, EDP, De Robertis, E.M.F. (1995). Cell Biology and Molecular Biology. Eighth Edition. W.B. Saunders Co., Philadelphia.
3. Powar, C.B., Cell Biology, Himalaya Publishing House, Bombay.
4. Alberts, B. Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. Molecular Biology of the Cell Garland Publ. Inc., New York.
5. Darnell, J., Lodish, JH. & Baltimore, D. Molecular Cell Biology, Oxford & IBH Publishing Co., New Delhi.
6. S C Rastogi. (2019). Cell Biology, New Age International (P) Ltd., Publishers.
7. Gerald Karp, Janet Iwasa, Wallace Marshall. (2018). Karp's Cell Biology. John Wiley & Sons; 8th Edition, Global.
8. L. Veerakumari. (2019). Bioinstrumentation. MJP Publisher.
9. S.C. Rastogi. (2010). Cell and Molecular Biology, New Age Publishers; Third edition.
10. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associates.
11. Bruce Albert, Bray Dennis, Lewis Julian, Raff Martin, Robert Keith and Watson James. (2008) Molecular Biology of the Cell. V Edition, Garland publishing Inc., New York and London.
12. Kleinsmith, L. J. & Kish, V. M. (1995). Principles of Cell and Molecular Biology. 2e, Harper Collins. College Pubs

# Semester IV

## CORE VI: GENETICS AND EVOLUTION

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: IV</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 6</b>

### Course Objectives:

- To understand the basic concept of genetics and determine the phenotypic and genotypic character using Mendelism experiment
- To enable the students to distinguish between maternal effect, sex-linked and cytoplasmic modes of inheritance.
- To understand the structure and function of genetic materials with the help of experimental proof
- To analyse the probability of a particular genotype given independent segregation and random union of gametes between two individuals
- To enable the students to look at a pedigree chart and discern the most likely mode of inheritance
- To give a knowledge of current developments and trends in applying genetics to medicine
- To understand the theory of natural selection by Darwinism and Lamarckism
- To evaluate the data-based evidence that describes evolutionary changes in the genetic makeup of a population over time

### UNIT I

**20 Hours**

History and Scope of Genetics - Mendelism: Mendel's Experiments, Backcross or testcross, phenotype and Genotype – Monohybrid cross - Dihybrid cross, Trihybrid and Polyhybrid crosses – Interaction of genes – Epistasis - Incomplete Dominance and Co-dominance – Complementary factors (*Lathyrus odoratus*) - Supplementary factors (Maize) - Inhibitory and lethal factors - Multiple alleles (in *Drosophila*, coat colour in rabbit, blood group inheritance in man) - Erythroblastosis Foetalis

### UNIT II

**20 Hours**

**Linkage:** Morgan's Experiment -Theories of linkages - Factors affecting linkage – Sex linked inheritance in *Drosophila* and man

**Crossing over:** Types – Mechanism - Cytological evidence - Significance and factors affecting crossing over – Chromosome mapping

**Sex determination:** Basis of sex determination (Genetic and environmental) - Sex determination in *Drosophila* and Man – Mechanism of dosage compensation – Sex linked characters – Sex limited genes - Cytoplasmic inheritance: Kappa particles in *Paramecium*, CO<sub>2</sub> sensitivity in *Drosophila* and milk factor in mice

**Nuclear and extra-nuclear inheritance** – Antibiotic resistance in *Chlamydomonas*, mitochondrial mutation in *Saccharomyces* and human disorder– Infective hereditary in *Paramecium* – Maternal effect – Shell coiling in snail

### **UNIT III**

**15 Hours**

**Genetic Material: DNA** – Double helix structure of DNA – DNA as a genetic material – experimental proof – Transformation – Transduction – Conjugation – Recombination – Sexduction - **RNA**: Structure and function

**Gene and gene concept** - Fine structure of gene – Cistron, Muton and Recon – Regulation of gene expression – Operon concept – Lac operon – Genetic code

**Mutation** – Molecular basis of mutation – Gene mutation – Chromosomal aberration – Mutagenesis

### **UNIT IV**

**20 Hours**

#### **Population and Applied Genetics**

Hardy Weinberg law – Gene frequency and factors affecting gene frequency – Sex linked gene in human – Animal breeding - Inbreeding and out breeding, Heterosis - Hybrid vigour, Eugenics, Euphenics and Euthenics

Pedigree analysis – Human karyotyping and variations – Probability – Application in genetics - Inheritance disorder in man – metabolic disorder – Genetic counselling

### **UNIT V**

**15 Hours**

#### **Origin of life**

History of Evolution – Significance of evolutionary biology – Theories on origin of life – support of Oparins hypothesis – Urey Miller experiment - Biogenesis and Abiogenesis - Fossilization - Dating of Fossil – Living and Extinct Fossils – Phylogenetic evolution.

#### **Principles and Nature of Evolution**

Lamarckism and Neo-Lamarckism – Darwinism and Neo-Darwinism – Mutation Theory - Mimicry & Colouration – Batesian and Mullerian - Convergent, Divergent and Parallel Evolution – Co-evolution - Adaptive radiation in mammals - Isolating mechanisms – Different types – Species concept – Definition and origin of species – Allopatric and Sympatric speciation – Genetic drift – Founder's Principle – Genetic load - Geological time scale – Mass Extinction - Evolution of horse and man

#### **Reference Books:**

##### **Genetics**

1. Goodenough U. Genetics. IIIrd Edition, Washington University, Saunders College Publishing.
2. Swanson, O.P., Timothy Herz and William, J. Young: Cytogenetics -The chromosome in division, inheritance and evolution, Prentice Hall.
3. Gardner, B.S., & Smustad, D.P. Principles of Genetics, John Wiley & Sons. 6th Ed.
4. Winchester, A.M. Genetics-A survey of the Principles of Heredity, Oxford & IBH Publishing Co., New Delhi.
5. Gupta, P K. Genetics, Rastogi Publishers, Meerut.
6. Gupta, P K. Cytology Genetics, and Molecular Biology; Rastogi Publishers, Meerut.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons In.
8. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cumming

9. Pierce B. A. (2012). Genetics-A Conceptual Approach. IV Edition. W. H. Freeman and Company
10. Russell, P. J. (2009). Genetics- A Molecular Approach. IIIrd Edition. Benjamin Cummings
11. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetics Analysis. IX Edition. W. H. Freeman and Co.

## **Evolution**

1. Verma, P.S. and V.K. Agarwal (2002). Concept of Evolution, S. Chand & Co., Ram Nagar, New Delhi
2. Stirton, R.A., Time, life and man, C.B.S. Publishers & Distribution, Delhi.
3. Colbert, E.H., Evolution of Vertebrates, C.B.S. Publishers & Distribution, Delhi.
4. Dobzhansky, T., Genetics and the origin of species. Columbia, Univ. Press, New York.
5. Mayr, E., Systematics and the origin of species, Columbia Univ. Press, New York.
6. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H.(2007). Evolution. Cold Spring Harbour Laboratory Press.
7. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
8. Bendall, D. S. (ed.) (1983). Evolution from Molecules to Man. Cambridge University Press, U.K.
9. Bull J.J and Wichman H.A. (2001). Applied Evolution. Annu. Rev. Ecol. Syst. 32:183-217.
10. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
11. Chattopadhyay Sajib. (2002). Life Origin, Evolution and Adaptation. Books and Allied (P) Ltd. Kolkata, India.
12. Douglas, J. F (1997). Evolutionary Biology. Sinauer Associates.

## CORE V: PRACTICAL II - CELL BIOLOGY, GENETICS AND EVOLUTION

<b>SUBJECT CODE:</b>	<b>PRACTICAL</b>	<b>MARKS: 100</b>
<b>SEMESTER: IV</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 2</b>

### Cell Biology

1. Micrometry – Components and use of microscopes – Light microscope, Camera Lucida, Stage and Ocular micrometer.
2. Blood smear preparation – Differential Count of WBC
3. Counting of RBC and WBC using Hemocytometer (Demonstration)
4. Mounting of Buccal epithelium and observing living cells using vital staining
5. Mitosis in onion root tip squash
6. Meiosis in grasshopper testis squash (Demonstration)
7. Study of prepared slides of histology
  - a. Columnar epithelium
  - b. Ciliated epithelium
  - c. Glandular epithelium
  - d. Connective tissue
  - e. Cartilage T.S.
  - f. Bone T.S.
  - g. Cardiac tissue
  - h. Striated muscle
  - i. Non-striated muscle
  - j. Nervous tissue
  - k. Ovary T.S.
  - l. Testis T.S.

### Genetics

1. Experiments using beads or seeds to study the Mendel's laws and gene interactions
2. Pedigree Analysis
3. Observation of Common Mutants of *Drosophila* (white eye, red eye, normal wing and vestigial wing)
4. Preparation of mount of salivary gland chromosomes of *Chironomus* larva
5. Identification of human blood groups
6. Studies of human Karyotype – Normal (Male and Female), Abnormal (Down Syndrome, Turner and Klinefelter Syndrome)

### Evolution

1. Study of fossils from models/pictures
2. Identify the Scientist and mention their contribution
3. Report on Extinct, Endangered and Vulnerable Species

# Semester V



## CORE VII: DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: V</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

### Course Objectives:

- To acquire the knowledge about development of all the vertebrates from an egg to an embryo
- To outline the overall physiology of fertilization and cleavage
- To gain the information's on the overall organization and functions of the immune system.
- To explain cells, tissues and effector molecules involved in defence mechanisms and to understand types of immunity
- To relate the interactions of antigens, antibodies, complement and other immune components
- To classify the different types of vaccines in disease control and know the principles and applications of immunotechniques

### UNIT I

12 Hours

**Basic Concept of Development:** Origin of germ cells – Gametogenesis - Spermatogenesis and Oogenesis -Types of sperms - Types of eggs and egg membranes - Structure of Sperm and Ovum in mammals.

**Fertilization** – Acrosomal reaction, cortical reaction, physiological, biochemical changes and its significance

### UNIT II

12 Hours

**Cleavage** – Types of cleavage patterns - Controlling factors and laws in cleavage - Blastulation, Gastrulation and Tubulation in frog and chick - Fate maps in frog and chick - Presumptive areas - Organizers and inductors - Extra-embryonic membranes - Placentation in mammals

### UNIT III

12 Hours

**Human Reproduction:** Puberty - Menstrual cycle – Menopause - Pregnancy and its related problems – Artificial Insemination – Cryopreservation – *In vitro* Fertilization (IVF) - Embryo Transfer and its advantages - Test tube baby- Amniocentesis – Super Ovulation - Ethics in Artificial Reproductive Technology (ART) and Embryo manipulation - Infertility in male and female

### UNIT IV

12 Hours

**Overviews of Immune system** – Historical perspectives, Innate and Acquired immunity - Cells of the Immune System - Hematopoiesis and differentiation, B-lymphocytes, T-lymphocytes, Macrophages, Dendritic cells, Natural Killer Cells and Lymphocyte Activated Killer Cells, Eosinophils, Neutrophils and Mast Cells. Organs of the Immune System: Primary and Secondary Lymphoid Organs: Thymus, Bursa of Fabricii, Spleen, Lymph Nodes, Lymphatic System, Mucosa Associated Lymphoid Tissue (MALT) - Complement system.

## UNIT V

12 Hours

**Antigens** – Types, properties - Haptens – Adjuvants – **Vaccines** – Types – Toxoids – Antitoxins – **Immunoglobulins** – Structure, types, and properties – Theories of antibody production – **Complement** - Structure, properties, function and pathway

**Immunotechniques:** Detection of molecules using Antigen-antibody reaction – *In vitro* methods – Agglutination reaction – Agglutination-inhibition - Immunoprecipitation – Complement fixation – Immuno-fluorescence microscopy – ELISA – RIA

### Reference Books:

#### Developmental Biology

1. Verma P.S and Agarwal V.K, (2010). Chordate Embryology, S Chand; Reprint of 1975 first edition.
2. Berry.A.K.(2007). An Introduction to Embryology, Emkay Publications, New, Delhi-51.
3. Arumugam, N. (1988). A Text Book of Embryology. Saras Publication, Nagercoil
4. Rao, C.V. (2006). Immunology. Narosa Publishing House, New Delhi.
5. Kannan, I. (2007). Immunology. MJP Publishers, Chennai.
6. An Introduction to Embryology, Saunders Company.
7. Balinsky, B.I. (1970). *An Introduction to Embryology*. Saunders Press, Phil. 3<sup>rd</sup> Edn.
8. Berril, N.C. (1971). *Developmental Biology*, McGraw Hill, New York.
9. Scott F. Gilbert, (2006). Developmental Biology, Sinauer Associates Inc., U.S.; 8th Revised edition.
10. Jain. P.C. (2007). Elements of Developmental Biology, 6th Edn. Rastogi Publications.
11. Agarwal, V.K. and Usha Guptha, S (1998). Chand's simplified course in zoology, chordate embryology and histology. S. Chand & Co Ltd.
12. Gibbs. (2006). Practical Guide to Developmental Biology. Oxford University Pres
13. Werner. A. Muller. (2008). Developmental Biology. Springer.
14. Wolpert, L. (1998). Principles of Development. Oxford University Press, N. Y.

#### Immunology

1. Kindt, T.J., Goldsby, R. A. and Osborne, B.A. (2007) Kuby Immunology. VI Edition. W.H. Freeman and Co, New York
2. Abbas, K. Abul and Lechtman H. Andrew (2003) Cellular and Molecular Immunology. V Edition, Saunders Publication.
3. Kenneth Murphy and Casey Weaver. Janeway's Immunobiology, IX Edition, Garland Science
4. David, M., Jonathan, B., David, R. B. and Ivan, R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
5. Turner, C.D. and Bagnars, W.B. (1976) General Endocrinology, Saunders Company.
6. Roitt I.M. (2000). Essential Immunology. Blackwell Scientific Publishers
7. Chakravathy, A. K.1996. Immunology, Tata Mc Graw Hill, New Delhi.

## CORE VIII: BIOTECHNOLOGY AND NANOTECHNOLOGY

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: V</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

### Course Objectives:

- To familiarize the students with the basic concepts of biotechnology and its application in various sectors
- To give an insight into the steps involved in gene cloning and its tools used in biotechnology
- To classify the cloning vectors based on its efficiency and the host selection process and identification of recombinant by different methods
- To understand the animal cell culture and its application in various fields
- To prepare the students for interdisciplinary research and educational opportunities to solve problems for the quality of life
- To make the students get a foundational knowledge in nanotechnology and its application
- To prepare the students for comprehensive based training in technical skills in methods of biotechnology

### UNIT I

**5 Hours**

Scope and importance of Biotechnology - Fields of Biotechnology – History of Biotechnology — Global impact of biotechnology in Healthcare, Aquaculture, Agriculture and Environment – Biotechnology in Global and Indian scenario – Applications of Biotechnology

### UNIT II

**20 Hours**

Steps involved in recombinant DNA technology - Tools in Recombinant DNA technology: Enzymes – Nucleases: Exo and Endonuclease, DNase & RNase, DNA ligase, Alkaline Phosphatase, DNA polymerase, Reverse transcriptase, T<sub>4</sub> polynucleotide kinase, Terminal transferase, and Homopolymer tailing.

**Classification of Cloning Vectors:** Based upon copy number, function - Cloning vector - Insertional vector, Replacement vector, Shuttle vector and Expression vector system - Vectors - pBR322, pUC vectors, Ti plasmid vector system - Bacteriophage: Salient feature and vector system -  $\lambda$  WES vectors, Charon vector, M13 vector system, Baculoviral vector system, pBluescript vector and YAC system - Host expression system selection - *E.coli* and *Saccharomyces cerevisiae* - Host system

### UNIT III

**15 Hours**

**Techniques of Genetic Engineering:** DNA isolation - Selection of vector system - Insertion of target DNA - Various transformation techniques of vector system into host system: Transformation, Transduction, Microinjection, Cell fusion, Liposome, Electroporation - Screening and selection of recombinant cells - Selectable markers- Ap<sup>r</sup> gene, Lac Z gene, HGPRT gene - Colony hybridization method and Immunological test – Gene Library construction: Genomic Library and cDNA Library

## UNIT IV

8 Hours

**Animal Biotechnology:** History of animal cell culture – Requirements for animal cell culture – culture media and substrate – Steps involved in animal tissue culture (isolation, disaggregation, establishment of cell culture) – Importance of Transgenic animals (Mice, Cow, Sheep, Hen, Fish, Silkworm) – Overview of tissue engineering - Skin construct for wound healing - Bioethics in animal genetic engineering.

## UNIT V

12 Hours

**Nanotechnology:** Definition – Natural biopolymers - Construction and importance: Chitosan, Collagen, Silk, Keratin, Gelatin and their applications. Types of artificial nanoparticles and their applications - Importance of nanotechnology in the field of medicine (gold, silver and bioceramics - hydroxyapatite, eye lens), medical devices (cell on microchip, Micro array: DNA, RNA and Protein), Biomimicry - Peacock and Butterfly wing effect, Bat, Gecko effect, Termites-hill, Lotus leaf effect - Self-cleaning

### Reference Books:

1. Purohit Mathur, (1999). Biotechnology Fundamental and applications. Botanica Publications.
2. Shah H.A and Tokeer Ahmad, (2011). Principles of nanoscience and nanotechnology. Narosa Publishing House.
3. Dubey, RC., (1993). A Textbook of Biotechnology. S. Chand Publication.
4. Dubey, RC., (2014). Advanced Biotechnology. S. Chand Publication.
5. Brown.TA., (2010). Gene cloning and Introduction. Wiley Blackwell.
6. Brown J.A. (2001) – Genetics – A Molecular approach 3rd edition – Nelson Tornes.
7. Old R. W and S.B. Primrose. (1994). Principles of Gene manipulation – 5<sup>th</sup> edition – Blackwell Scientific publications.
8. John. R. W. Masters (2000). Animal cell culture – A practical approach 3rd Edition. Oxford univ press.
9. Glick B.R. and Jack J. Pasternak, (1994). Molecular biotechnology ASM press.
10. Ramdoss, P., (2009). Animal Biotechnology Recent Concepts and Developments, MJP Publishers.
11. Subbiah Balaji, (2010). Nanotechnology. MJP Publishers.
12. Shanmugam, S., (2011). Nanotechnology. MJP Publishers.
13. Rakesh Rathi, Nanotechnology, S. Chand & Co.
14. Parthasarathy, BK., (2007). Nanotechnology in Life Science Gyan Books.
15. Kumar, (2010). Principles of Nanotechnology, Sci. tech. Publications (India)
16. Murty,BS., Shankar. P., Baldev Raj, B B Rath and James Murday (2013). Textbook of Nanoscience and Nanotechnology

## CORE IX: ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: V</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

### Course Objectives:

- To acquaint the students with basic fundamentals and latest concepts in physiology and biochemistry
- To impart a deep knowledge on the interaction of various organs systems that helps in overall functioning of the body and its related disorders
- To inculcate an awareness among the students on the value of health
- To give an insight into the role of enzymes in physiological and biochemical process.
- To highlight the key concepts in metabolism and provides the students a deep understanding on the metabolic pathways and its regulation
- To prepare students for competitive examination, higher studies and to motivate students to involve in research in the field of physiology and biochemistry
- To create a platform for the students to develop critical thinking, communicative and scientific writing skills and presentations

### UNIT I

**8 Hours**

**Introduction to Physiology:** Definition – History - Branches and scope of physiology - Principles of homeostasis

**Digestion:** Definition and types of digestion - Digestion and absorption of carbohydrates, proteins and lipids in man - Nervous and hormonal control of digestion - Gastro-intestinal disorders: GERD, Gastritis and Ulcer

### UNIT II

**12 Hours**

**Circulation:** Structure of human heart - Blood: composition and functions - Blood clotting mechanism - Theories and disorders of blood clotting - Origin and conduction of heart beat - Cardiac cycle - Heart sounds - Cardiac output and Stroke volume - Regulation of heart beat - Pulse and Blood pressure: Definition and its clinical significance.

ECG – Principle and its significance - Cardiovascular diseases: Arrhythmia, Coronary Artery Diseases (CAD), Myocardial infarction, Heart failure, Cardiomyopathy, Rheumatic Heart disease, Stroke - Angiogram - Angioplasty – ESR

**Respiration:** Structure and functions of respiratory tract and Lungs - Respiratory pigments: Definition, types and its functions - Transport of respiratory gases: oxygen and carbon dioxide transport - Respiratory volumes and capacities - Respiratory quotient

Respiratory disorders: Hypoxia, Hypocapnia and Hypercapnia, Asphyxia, Carbon monoxide poisoning, Bronchitis, Asthma - Physiological effects of smoking - Oxygen therapy and Artificial Respiration

### UNIT III

**8 Hours**

**Excretion:** Excretory products: Definition - Classification of animals based on excretory products - Structure and functional anatomy of human kidney – Nephron - Physiology of

urine formation - Hormonal regulation of excretion - Renal failure - Dialysis - Kidney transplantation

**Osmoregulation:** Osmoregulators and Osmoconformers - Mechanism of Osmoregulation in freshwater and marine fishes and crustaceans

**Thermoregulation:** Temperature regulation in poikilotherms and homeotherms - Physiology of hibernation, aestivation and diapause

## UNIT IV

20 Hours

**Muscle:** Definition, types and properties of muscles - Contractile proteins - Ultrastructure of skeletal muscles - Mechanisms and theories of muscle contraction - Physiological and biochemical changes during muscle contraction - Simple muscle twitch, Muscle fatigue, Tetanus, Rigor mortis

**Neural conduction:** Structure of a neuron and its types - Nerve impulse – Definition, Resting membrane potential, Action potential - Neurotransmitters and its significance - Conduction of nerve impulse - Synaptic transmission, Neuromuscular junctions - Reflex action and Reflex arc

**Endocrine System:** Endocrinology: Endocrine glands – Structure, secretions, functions and disorders of endocrine glands of vertebrates – Pituitary, Thyroid, Parathyroid, Adrenal, Islets of Langerhans.

Hormones: Salient features, Classification and Regulation of their secretion - Modes of hormone action: signal transduction pathway for steroidal and non-steroidal hormones - Homeostasis and Feedback mechanism

**Reproductive Physiology:** Male and female reproductive organs. Physiology of male and female reproductive system.

## UNIT V

12 Hours

**Biochemistry:** Scope and significance of biochemistry

**Enzymes:** Definition, Classification, Nomenclature, Properties, Biological functions - Mechanism of enzyme action: Lock and key hypothesis, Induced fit theory - Enzyme kinetics: Definition, Derivation of Michaelis Menten equation, Line Weaver Burk Plot - Significance of  $K_m$  and  $V_{max}$  - Enzyme inhibition and Regulation - Factors affecting enzyme activity

**Metabolism:** Definition - Catabolism Vs Anabolism - Stages of catabolism, compartmentalization of metabolic pathways - Regulation of metabolism (Brief account)

**Carbohydrate Metabolism:** Glycogenesis, Glycogenolysis, Gluconeogenesis and Glycolysis; Krebs's cycle, Electron Transport Chain, Oxidative phosphorylation - Regulation of carbohydrate metabolism

**Lipid Metabolism:**  $\beta$ -oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms and their regulation - Biosynthesis of palmitic acid, Ketogenesis – Regulation of lipid Metabolism (Brief account)

**Protein Metabolism:** Transamination, Deamination, Transmethylation, Decarboxylation, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids – Regulation of protein metabolism (Brief account)

## **Reference Books:**

### **Physiology**

1. Guyton, A.X. (1986). Text Book of Medical Physiology, 7<sup>th</sup> Edition, Saunders Company.
2. Verma P.S., Agarwal V.K. and Tyagi, B.S. (1995). Text book of Animal Physiology. S. Chand & Co.
3. Rastogi. S.C. (1977). Essentials of Animal Physiology. New Age International (P) Ltd., Publisher
4. Best, J.P. (1985). Best and Taylor's Physiological Basis of Medical Practice (11<sup>th</sup> Edition) William and Wilkins.
5. Ganong, W.F. (2003). Review of Medical Physiology, McGraw Hill, New Delhi.
6. Schmidt-Nielson K. (2002). Animal Physiology. Prentice Hall India Ltd.
7. Hoar, W.S. (1983). General and comparative physiology, Adaptation and Environment (3rd Edition) Cambridge University Press.
8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander 's Human Physiology, XI Edition., McGraw Hill
9. Shenbulingam K and Prema Shenbulingam (1999). Essentials of Medical Physiology. Jaypee Brothers Medical Publishers (P) Ltd.
10. Pat Willmer., Graham Stone and Ian Johnston (2000). Environmental Physiology of Animals. Blackwell Publishing Company.
11. Gerard J. Tortora., Bryan Derrickson (2000). Principles of Anatomy and Physiology. John Wiley & Sons, Inc.
12. Golds Worthy, G.J. Robinson, J. and Mordue, W. (1981). Endocrinology, John Wiley and Sons, New York.

### **Biochemistry**

1. Jain, J.L et.al. (2005). Fundamentals of Biochemistry. S. Chand & Co, New Delhi.
2. Ambika Shanmugam. Fundamentals of Biochemistry for Medical Students. Wolters Kluwer (India) Pvt. Ltd., New Delhi
3. Satyanarayana U., Chakrapani U (1999). Biochemistry. Books and Allied (P) Ltd.
4. Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).
5. Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).
6. Rawn J.D. (1989). Biochemistry (Neil Patterson).
7. Voet D., Voet, J.G. (2004). Biochemistry (John Wiley & Sons).
8. Voet, D., Voet, J.G. and Pratt, C.W. (2008). Fundamentals of Biochemistry: Life at the molecular level (John Wiley & Sons).

## **CORE X - BIOSTATISTICS AND COMPUTER APPLICATIONS WITH R PROGRAMMING FOR LIFE SCIENCES**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: V</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

### **Course Objectives:**

- To acquire knowledge about a variety of statistical methods of use in describing and analyzing biological data
- To understand and use mathematical and statistical theory underlying the application of biostatistical methods
- To understand the nature of variability and helps in deriving general laws from small samples
- To recognize the importance of data collection and its role in determining scope of inference
- To interpret statistical results correctly, effectively and in context
- To understand and critique data-based claims
- To explore and understand how to use the R documentation
- To read structured data into R from various sources
- To understand the different data structures in R

### **UNIT I**

**12 Hours**

Introduction to Biostatistics - Types of data, Collection, Classification and Tabulation of the Primary data, Secondary Data, Discrete data and Continuous data, Diagrammatic and Graphical representation of grouped data - Frequency Distribution (univariate and bivariate) - Cumulative frequency distribution and their graphical representation, Histogram frequency polygon - Concept of central tendency - Measures of dispersion

### **UNIT II**

**12 Hours**

Normal distribution - Simple Correlation - Hypothesis testing- Student's t-test - Chi-square analysis - Regression Analysis - Theories of probability

### **UNIT III**

**12 Hours**

Introduction – R Features – How to run R – Variables – Basic data types – Operators – Data structure – Vectors – Data frames – Lists – Matrices – Arrays, Factors

### **UNIT IV**

**12 Hours**

R Programming Structure – Control statements – Loops – R Functions – Input / Output accessing the keyboard and monitor, reading and writer files - R graphics – R Plot, Line R, Scatter plot R, Pie Charts, R Bars



## UNIT V

**12 Hours**

R Math & Statistical Functions – Built in math functions, Statistical function, Central tendency (Mean, Mode, Median), Hypothesis testing, t-test, Chi-square test – Correlation - Normal Distribution

### Reference Books:

1. P.N. Arora & P.K. Malhotra (1996). Biostatistics (Himalaya Publishing House, Mumbai).
2. Sokal & Rohlf (1973). Introduction to biostatistics (Toppan Co. Japan).
3. W.J. Evens, G.R. Grant (2005). Statistical methods in Bioinformatics: An introduction (Springer).
4. P.K. Sinha (2004). Computer fundamentals (BPB).
5. Suresh K. Basandra (2008). Computers today (Galgotia Publications Pvt. Ltd., New Delhi).
6. “R in Action, Rob Kabacoff, Manning”
7. Statistics with R Programming Sandip Rakshit, McGraw Hill Education
8. R For Dummies- and Rie de Vries, Publisher - John Wiley & Sons
9. Statistical Analysis in Simple Steps Using R , Kiran Pandya, - SAGE Publications Limited
10. Jared P. Lander, R for Everyone, Pearson Education Publisher
11. Paul Teetor, R Cookbook, Oreilly.
12. An Introduction to Statistical Learning: with Applications in R by Gareth James - Springer Publisher.

**ELECTIVE I: INTERDISCIPLINARY ELECTIVE (IDE) -  
WILDLIFE CONSERVATION**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: V</b>	<b>CREDITS: 5</b>	<b>NO.OF HOURS PER WEEK: 5</b>

**Course Objectives:**

- To provide education and awareness and to encourage appreciation and importance of wildlife and also to provide knowledge for competitive job-oriented examinations

**UNIT – I**

**15 Hours**

Introduction to wildlife and its conservation. Economic importance and Need for conservation - Definition of wildlife – Causes of wildlife depletion – Endangered species – Threatened and Rare species - India as a mega wildlife diversity country- Gulf of Mannar – Marine ecosystem sanctuary – Mangrove ecosystem - National Biodiversity Authority

**UNIT – II**

**15 Hours**

Population Estimation : Basic concepts and application – Direct Count (Block Count, Transect Methods, Point Counts, Visual Encounter Survey, Waterhole Survey) – Indirect Count (Call Count, Track and Signs, Pellet Count, Pug Mark) – Tagging - Wildlife Photography: Types of camera, camera traps - Field equipments – Altimeter, Pedometer, Field Compass, Binoculars, Radio Collaring, GPS, GIS - Remote sensing in wildlife management

**UNIT – III**

**15 Hours**

Wildlife health care and human wildlife confliction - Infectious wildlife diseases – Viral (Rabies) – Bacterial (Anthrax) – Basic reasons for conflicts - Damage caused by wild animals and control measures

**UNIT – IV**

**15 Hours**

Wildlife Management and Legislation – Wildlife Protection Act 1972, IUCN, CITES, NBA, Project Tiger, Project Elephant – Wildlife Trade And Regulation - Biodiversity Act 2000 - Ecotourism and Eco restoration - Anti-poaching operations – Village Forest Council (VFC)

**UNIT –V**

**15 Hours**

Wildlife Protection – Definition – *in-situ* and *ex-situ* conservation – Zoos and Zoological Parks – National Parks and Sanctuaries (Aringar Anna Zoological Park, Guindy National Park, Srivilliputtur Wildlife Sanctuary, Vedanthangal Bird Sanctuary, Mudumalai and Periyar Tiger Reserves, Nilgiris Biosphere Reserve) – National Bureau of Plant Genetic Resources, Fish Genetic Resources and Animal Genetic Resources

**Exercises (Optional)**

- Visit to National Zoological Parks and Sanctuaries
- Study on wetlands or about high-altitude fauna

**Reference Books:**

1. Saharia, V.B. (1987). Wildlife in India. Nataraj Publications, Dehradun.
2. The Eye of the Elephant: An Epic Adventure in the African Wilderness by Delia Ownes
3. The Book of Indian Birds by Salim Ali.
4. Analysis and Management of Animal Population by Byron.K. Williams.
5. A Book on Wildlife Protection Act 1972, Lawmann
6. A Book on the Red Data Books by IUCN.

# Semester VI

### **CORE XIII: ENVIRONMENTAL BIOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 3</b>	<b>NO.OF HOURS PER WEEK: 4</b>

#### **Course Objectives:**

- To educate the students about the basic environmental phenomena and enable them to understand the adaptations of the animals to their environment
- To study about the conservation of resources via the recycling of waste materials
- To understand the environmental problems due to unsustainable human behavior
- To know about the changes in economics, policy and education that promote sustainability
- To understand the technologies, tools and techniques in the field of environmental biotechnology
- To study about the recoveries of more valuable products such as metals, oils, and vitamins

#### **UNIT I**

**12 Hours**

Ecology – Definition - Subdivision and scope of Ecology - Ecological factors - Temperature and light as ecological factors - Ecosystem – Definition – Types of Ecosystem - Components of ecosystem - Grazing and Detritus type of food chain - Food web and trophic levels - Ecological pyramids -Pyramids of number - Biomass and Energy

#### **UNIT II**

**12 Hours**

Energy flow - Flow of energy through a food chain in relation to laws of thermodynamics - Biogeochemical cycles – Nitrogen and Phosphorous cycle - Laws of limiting factor- Liebig's Law of Minimum, Shelford's law of tolerance and concept of limiting factors. Ecological niche – Concept of ecological niche - Ecological succession – Definition - Types of succession

#### **UNIT III**

**10 Hours**

Freshwater habitats – Lentic and Lotic; Marine habitat – Zonation - Intertidal sandy shore, Intertidal muddy shore, Rocky shore – Deep sea adaptation

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; Edges and Ecotones

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations.

National and International Environmental Organizations - Red Data Book - Wildlife management – Conservation of biodiversity.

## **UNIT IV**

**13 Hours**

Bioremediation of Environmental Pollutants in soil and water – oils, heavy metals and detergents – Microbial biodegradation of Xenobiotic compounds – Bioremediation - concepts and application – Biotreatment of dye industrial waste – source and origin of dyes. Treatment technologies of dyes – Bioplastics: Biopols (PHB), Biolac (Polylactic acid)

## **UNIT V**

**13 Hours**

Non-conventional source – Biomasses as a source of bioenergy – types of biomass – plant, animal and microbial biomass – Various industrial effluent treatment methods – sugar, distillery, dairy, tannery and pharmaceutical industries – Biogas from solid waste – composting and vermicomposting

### **Reference Books:**

1. Mayr, E., Principles of Systematic Zoology, McGraw-Hall, New York.
2. Krebs, J.C., Ecology, Harper & Row, Publ., New York.
3. Odum, E.P., Fundamentals of Ecology, Saunders College Publishers, Philadelphia.
4. George L.C., Elements of Ecology, Johnes Wiley, New York.
5. Kendeigh, S.C., Ecology with special reference to animals, Prentice-Hall of and New Delhi.
6. Smith, Ecology, Harper & Row Publishers, New York.
7. Kormondy, Concepts of Ecology, Prentice Hall of India, New Delhi.
8. Jogdand, G. N. (1995). EBT: Himalaya Publishers.
9. S. K. Agarwal. (1998). EBT, APH Publishers
10. Alan Scragg, (1999). Environmental Biotechnology, Longman “Environmental Biotechnology: Concepts and Application” by Jordening H J and Winter J n Publication.
11. Evans G M and Furlong J C. Environmental Biotechnology: Theory and Application”.
12. Bhattacharya B C and Banerjee R. Environmental Biotechnology
13. Indu Shekhar Thakur. Environmental Biotechnology: Basic Concepts and Applications”
14. Perry L McCarty and Bruce E Rittmann. Environmental Biotechnology
15. P K Mohapatra. Textbook of Environmental Biotechnology
16. S K Agarwal. Environmental Biotechnology

**CORE XIV:  
GENETIC ENGINEERING AND RECOMBINANT DNA TECHNOLOGY**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

**Course Objectives:**

- To facilitate students to understand the basic concepts involved in genetic manipulation and the application of rDNA technology.
- To understand the principles and methods in genetic engineering and the role of protein engineering
- To acquire the knowledge on the production of cloned and transgenic animals
- To explain the techniques of Hybridization, PCR and rDNA technology in medicine

**UNIT I**

**12 Hours**

**Biotechnology** – Definition and scope - Achievements of biotechnology - Biotechnology in India - Introduction to gene cloning - DNA manipulative enzymes - Nucleases, Ligases, Polymerases, Modifying enzymes, Restriction enzymes and its nomenclature, topoisomerases – plasmids - Basic features of plasmids - Plasmid classification - Blunt and Sticky ends - Linkers and Adapters

**UNIT II**

**12 Hours**

**Vectors:** Bacterial vector – pBR322 and pUC vectors - Phage vectors – Lambda, M13, cosmid and phagemid - Artificial chromosomes - YAC, BAC, PAC, HAC - Expression vectors and shuttle vectors - Plant vectors - Ti and Ri - Animal virus derived vectors - SV40, vaccinia, Retro viral vectors - Host strain for transformation.

**UNIT III**

**12 Hours**

**Genetically Modified Organisms**

Production of cloned and transgenic animals - Nuclear transplantation - Retroviral method - DNA microinjection - Applications of transgenic animals - Production of pharmaceuticals - Production of donor organs - Knock out mice - Production of transgenic plants - Agrobacterium mediated transformation - Applications of transgenic plants - Insect and herbicide resistant plants.

**UNIT IV**

**12 Hours**

Agarose and polyacrylamide gel electrophoresis - Southern, Northern and Western blotting - Colony hybridization - *In situ* hybridization - Genomic cloning - Transformation of *E. coli*, yeast and plant cells - PCR: Types, applications and limitations - Applications of rDNA technology in Medicine and Agriculture

**UNIT V**

**12 Hours**

**Animal Cell Culture and rDNA Application in Health**

Basic techniques in animal cell culture - Primary culture and cell lines - Culture media - Natural and synthetic - Cryopreservation of cultures - Recombinant vaccines - Gene therapy (*in-vivo* and *ex-vivo*), Production of recombinant proteins - Monoclonal antibodies - Insulin and growth hormones – Medicine - Hepatitis vaccine production

## Reference Books:

1. Dubey, R.C. (1995). A Text Book of Biotechnology, S. Chand & Co. Ltd., Ram Nagar, New Delhi – 110 055.
2. Kumaresan V. (2005). Biotechnology, Saras Publications. Nagercoil.
3. J. Sambrook, D.W. Russell (2001). Molecular cloning: A laboratory manual (Cold spring Harbour Laboratory Press).
4. R.M. Old, S.B. Primrose (2001). Principles of gene manipulation (Wiley- Blackwell).
5. B. D. Hames, S. J. Higgins (1995). Gene probes: A. practical approach (Oxford University Press).
6. Tuan Rocky S. (1997). Recombinant gene expression protocols (Edition Illustrated, Publisher Springer).
7. White Bruce A. (1997). PCR cloning protocols: from molecular cloning to genetic engineering (Humana Press).
8. Sandy B. Primrose, Richard Twyman (2006). Principles of gene manipulation and genomics (Wiley Blackwell).
9. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Publishing Co., USA.
10. Terence A. Brown (2006). Gene cloning and DNA analysis: An introduction (Wiley-Blackwell).
11. Bernard R. Glick, Cheryl L. Patten, (2017) Molecular Biotechnology, Principles & applications of recombinant DNA, 5th edition, ASM Press.



## **CORE XV: APPLIED MICROBIOLOGY**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

### **Course Objectives:**

- To familiarize the students with basic concepts in microbiology and to provide broad understanding of microbial classification
- To acquire skills on various microbial techniques like sterilization, microscopy, culture techniques, Media preparation and fermentation
- To appreciate the importance and value of beneficial microbes in various industries
- To create an awareness among the students on epidemiology, pathogenicity, diagnosis and treatment of various diseases caused by the microorganisms
- To demonstrate the role of microbes in controlling and monitoring of environmental pollutants
- To gain scientific skills and knowledge to pursue a career in the field of microbiology

### **UNIT I**

**8 Hours**

History - Scope of Microbiology in India – Case studies: Leishmaniosis, Leptospirosis, Salmonellosis, Typhoid, Bengal famine (Cholera), Romanian Plague, Spanish flu, Corona virus, Fungus: Cutaneous, Sub-cutaneous and Systemic; Parasites: Malaria, Elephantiasis, Giardia.

Microscopy: Principle of microscopy – Light Microscopy - Bright field, Dark field, Phase contrast, Fluorescent, Electron Microscopy – Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM) - Whittaker's classification of microbes - Morphology and fine structure of bacteria: Size, shape, cilia, pili, flagella, capsule, cell wall and its composition - Cytoplasmic membrane, protoplast, spheroplast, cytoplasm, vacuoles, genetic material (genomic DNA and plasmid), cell inclusions, bacterial spores

### **UNIT II**

**8 Hours**

Evolution of microbes - Classification and salient features of Bacteria, Actinomycetes, Virus, Fungi and Algae.

Nutritional requirements - Culture techniques: Media and its types - Microbial growth: Monod Growth curve and its significance - Generation time - Measurement of growth - Effect of environmental factors on growth.

### **UNIT III**

**10 Hours**

Bacterial inoculation methods - Spread Plate (quadrant, continuous and lawn culture) and pour plate - Anaerobic culture methods - Methods of preservation and maintenance of cultures

Staining: Principles of staining - Types: Simple staining, differential staining (gram, acid-fast), negative staining, special staining (flagellar, capsular and endospore staining, metachromatic granular staining) - Bacterial identification methods: Morphology, biochemical and molecular technique (16s r RNA)

Sterilization and disinfection – Principles – Physical and chemical methods

## UNIT IV

20 Hours

### Applied Microbiology

**Food Microbiology:** Fermented foods (pickles, bread, idly) - Food spoilage - Food poisoning - Food preservation

**Dairy Microbiology:** Milk and fermented milk products (curd and cheese) – Pasteurization – Probiotics - Milk - borne diseases (Tuberculosis, Brucellosis, Mad cow disease)

**Soil Microbiology:** Common soil microbes – Plant growth promoting microbes (bacteria and endophytic fungus) – Nitrogen fixation - Siderophores – Phosphatase, IAA, biofertilizer

**Water Microbiology:** Microbiology of drinking water - Water-borne diseases

**Medical Microbiology:** Koch's postulate - Host-microbe interaction - Diseases of Gastro-enteric system: Cholera, typhoid and viral hepatitis - Respiratory system: Influenza, Pneumonia - Nervous system: Meningitis, Tetanus and Polio - Genital system: Gonorrhea, Syphilis and Candidiasis - Zoonotic: Rabies and Plague - Nosocomial infection - Methicillin Resistance *Staphylococcus aureus* (MRSA) - *Pseudomonas aeruginosa* (blue wound) - Antibiotics: Classification and mechanism of action

## UNIT V

14 Hours

**Industrial Microbiology:** Fermentation - Basic concepts and types of fermentation (submerged and solid state) - Basic design of fermentor and types - Application of microbes in industrial products: Ethanol, wine, vinegar preparation - Microbial enzymes: Amylase, protease, cellulase and lipase - Organic acid: Lactic acid and citric acid - Nutraceuticals: Vitamins, Amino acids and Phytohormones  
Biopesticides - Biosurfactants – Biosensors - Antibiotics (Penicillin) – Brief Account

**Environmental Microbiology:** Role of Microbes in Sewage and Waste water treatment, bioremediation, biomineralization, biomining and bioleaching (Brief account)

### Reference Books:

1. Jacquelyn G. Black, Laura J. Black, (2005). Microbiology: Principles and Exploration. Wiley
2. Subhash Chandra Parija, (2009). Textbook of Microbiology and Immunology. Elsevier- Reed Elsevier India Pvt. Ltd.
3. Dubey, R. C. and Maheshwari, D.K. (2005). A Text Book of Microbiology. S. Chand & Co. Ltd., New Delhi.
4. Joanne, M. Willey, Linda M. Sherwood and Christopher, J. Woolverton, (2008). Microbiology – McGraw – Hill. International Edition
5. Tortora, Funke and Case. (2006). Microbiology- An Introduction. Pearson Education
6. Sundara Rajan, S (2002). College Microbiology – Vol. I to IV, Vardhana Publications, Bangalore – 560 095
7. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. (2001) Microbiology – McGraw Hill Inc. New York.
8. Alexander N. Glazer and Hiroshi Nikaido, (1994). Microbial Biotechnology: Fundamentals of Applied Microbiology. W.H. Freeman and Co., New York.
9. Stuart Hogg. (2005). Essential Microbiology. John Wiley & Sons Ltd.
10. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R., (1999) General Microbiology – Macmillan Education Ltd. London.
11. Rittmann, B.E. and P.L. McCarty, (2001). Environmental Biotechnology: Principles and Applications. McGraw- Hill, New York.

12. Ahmed, N., F.M. Qureshi and O.Y. Khan, (2001). Industrial Environmental Biotechnology, Horizon Press.
13. Edward Alcamo, (1995). Microbiology. Wiley Publishing Inc.
14. Thomas J Montville, Karl R. Mathews, (2005). Food Microbiology: An Introduction. ASM Press, Washington, DC

## **ELECTIVE II: CLINICAL LABORATORY TECHNIQUES**

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 5</b>	<b>NO.OF HOURS PER WEEK: 5</b>

### **Course objectives:**

- To prepare competent Medical laboratory technician with the necessary skills, attitudes, and professional integrity
- To acquire the knowledge and research practices required for clinical testing laboratories
- Students will be able to follow ethical practice associated with medical lab technology
- To acquaint the students to the specimen collection, preparation, processing and clinical interpretation of a test result.
- To understand the principle and working procedure of the laboratory instruments

### **UNIT I**

**10 Hours**

Introduction – Scope of the subject - Basic laboratory principles - Code of conduct of medical laboratory personnel - Use of the laboratory - Organization of clinical laboratory and role of medical laboratory technician - Medical laboratory professional and professionalism in laboratory workers - Clinical Laboratory records- Modern Laboratory set up - Quality control: Accuracy, Precision, and Reference values - Clinical borne infection and personnel hygiene

Common causes of accidents in lab – laboratory safety – Biomedical waste. Classification of wastes coding – Treatment of medical waste disposal- Personal safety measures – Fire safety

### **UNIT II**

**10 Hours**

Common Laboratory Equipment's: Incubator, Hot Air Oven, Water Bath - Anaerobic Jar, Centrifuge, Autoclave, Colorimeter, pH meter, Haemoglobinometer, Hemocytometer, Microtome, PCR. Glassware – Description of glassware, its use, handling and care  
Imaging Techniques: X-ray – Ultrasound – MRI - CT and PET scan

### **UNIT III**

**15 Hours**

Basic steps for drawing a blood specimen - requirement of blood collection - Blood collection - Phlebotomy - Sampling errors - Collection and preservation of biological fluids - Anticoagulants - Preservation of samples - Chemical preservatives - Process of analyzing the specimens - The laboratory report.

Total Cell Count – RBC, WBC, Platelets and Absolute eosinophil count - Estimation of hemoglobin PCV and Erythrocyte Indices - M.C.V. - M.C.H - M.C.H.C (Methods and process of estimation) - Erythrocyte Sedimentation Rate (E.S.R.) - Westergren Method - Factors influencing sedimentation - Laboratory factors which influence ESR - Importance of ESR reticulocyte count - Differential Count - Bleeding time - clotting time - prothrombin time

### **UNIT IV**

**20 Hours**

Evaluation of organ function test - Function of liver in health and disease – Jaundice – Hepatitis - Liver function test - Assessment and clinical manifestation of renal, hepatic, pancreatic, gastric & intestinal function - Enzyme of pancreatic origin and biliary tract - Test of myocardial infarction

Examination of Urine – Collection of urine - Components of routine urine analysis - Physical and Chemical Examination - Sugar in Urine - Tests for Sugar (Benedict's test) – Test for Protein - Ketone Bodies (Rothera's Test, Gerhardt's test) - Bile in Urine (Test for Bilirubin) - Test for Bile salts - Hay's Test - Blood in Urine: Test for Hematuria (Benzidine Test and Guaiacum Test)

Microscopic Examination of Urine: Kidney function test - Crystals found in urine (uric acid & urates, Calcium oxalates, Cystine, Drug crystals, Ammonium magnesium phosphates, Calcium carbonate) - Casts in urine - Cells in urine - RBC, pus cells, epithelial cells, spermatozoa, bacteria and tumour cells

Examination of stool - physical, chemical and microscopic examination

## **UNIT V**

**20 Hours**

Body Fluids: Characteristics of Cerebrospinal Fluid - Synovial fluid - Pleural fluid - Pericardial fluids - Peritoneal Fluids - Semen analysis - Physical, chemical and microscopic examination - Sperm count, motility and its interpretation

Disorders of lipid metabolism - Normal levels of cholesterol, triglycerides, phospholipids, free fatty acids and lipoprotein in blood - Abnormal levels of lipids causing diseases - Lipidosis, Atherosclerosis, Hyper and Hypo lipo-proteinemias, Sphingolipidoses, Niemann-Pick disease, Gaucher's and Tay-Sach's disease – Causes and pathology.

Thyroid Profile - Rheumatoid arthritis profile - Pregnancy test - Hormone Tests for Ovarian and Testicular Disorder

### **Reference Books:**

1. Teitz, Clinical Chemistry. W.B. Saunders Company Harcourt (India) Private Limited, New Delhi.
2. Kaplan, Clinical Chemistry, Mosby Company, St. Louis Washington, D.C. Toronto.
3. Satyanarayan, U. Biochemistry, Books and Allied (P) Ltd. Kolkata-India
4. Ramanic Sood, Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, New Delhi
5. Mukharji, Medical Laboratory Techniques, Vol - I, II & III, 5th Edn. Tata Mc Graw Hill, Delhi.
6. Satish Gupta, Short text book of Medical Laboratory for technician J.P. Bros, New Delhi
7. Fischbach, (2005). Manual of lab and diagnostic tests, Lippincott Williams Wilkins, NY
8. Gradwohls, (2000). Clinical laboratory methods and diagnosis. (ed) Ales C. Sonnen wirth and leonard jarret, M.D.B.I., New Delhi.
9. Ochei, J., and Kolhatkar, (2002). Medical laboratory science theory and practice, Tata McGraw-Hill, New Delhi.
10. Kanai L. Mukherjee, (2007). Medical laboratory technology Vol.1.Tata McGraw Hill.

### ELECTIVE III: ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT

<b>SUBJECT CODE:</b>	<b>THEORY</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 5</b>	<b>NO.OF HOURS PER WEEK: 5</b>

#### Course Objective:

- To appreciate the diversity of insects and their role in the ecosystem
- To identify and classify insects upto order
- To understand the morphology, anatomy and physiology of insects
- To understand the role of hormones in reproduction and metamorphosis of insects
- To realize the economic importance and organized social life of insects
- To create awareness among students about the adverse effects of insecticides on the environment
- To understand the need for eco-friendly approach for the management of insect pests
- To comprehend the role of integrated pest management in sustainable agriculture
- To understand the applications of various pest control techniques
- To gain working skills in collection, mounting and preservation of insects

#### UNIT I

**12 Hours**

**Entomology** – Introduction - **Salient features of Insects** - Classification of insects up to orders (Economical important groups) - Methods of collecting, mounting and preservation of insects

#### UNIT II

**15 Hours**

**Morphology of Insects** - Segmentation in insect - Structure of head, antennae, thorax, legs and wings - Various types of mouth parts

**Reproduction and development:** Embryonic and post-embryonic development - Types of metamorphosis - Role of Neuroendocrine system in development.

**Beneficial and harmful insects** - Economic importance of honeybees, silkworm and lac insect – Parasitic and predatory insects

#### UNIT III

**13 Hours**

**Pests:** Origin and history – Definition - Classification of pests - Pest status - Pest population dynamics - Types of crop losses

#### UNIT IV

**15 Hours**

**Bionomics/Ecology and Management**

**Crop pests:** Rice (*Leptocorisa acuta*) - Wheat (*Sesamia inferens*) - Pulse (*Helicoverpa armigera*) - Sugarcane (*Scirpophaga nivella*, *Pyrilla perpusilla*) - Cotton (*Earias vitella*, *Pectinophora gossypiella*) - Vegetable (*Raphidopalpa faveicollis*) - Fruit (*Papilio demoleus*)

**Stored grain pests:** *Sitophilus oryzae* - *Corcyra cephalonica* - *Trogoderma granarium* - *Callosobruchus chinensis*.

**Medically important and household pests:** Fleas, mosquitoes, housefly, sandfly, cockroach, and termites

#### UNIT V

**20 Hours**

**Integrated pest management (IPM):** – Definition – Principle - Components of IPM and advantages – Strategies for integrated pest management: Mechanical, Physical and Cultural

**Biological Control** – Principle - Bio-control agents (Parasitoids, predators and pathogens (NPV, Bacteria, Fungi and Nematodes) - Merits and demerits (Brief account)

**Chemical Control** - Classification of insecticide - Conventional insecticides - Insecticide adjuvants and formulations - Control with reference to Chlorinated hydrocarbons – Organophosphates, Carbamates, Botanical, Synthetic pyrethroids – Fumigants -Insect Growth Regulator (IGR) compounds & Pheromones (Brief account)

**Genetic Control** - Sterile insect techniques (SIT)- Sterile insect release method (SIRM)- Radio-sterilization and chemo-sterilization, Hybrid sterility and other strategies of Genetic control (Brief account)

Pesticides and environmental pollution – Precautions in handling pesticides

Role of Biotechnology in pest management (Brief account)

#### **Reference Books:**

1. David, B.V. and T. Kumarasamy, (1984). Elements of Economic Entomology, Popular Book Depot, Madras
2. Nayar, K.K., T.N. Ananthakrishnan and B.V. David. (1992). General and Applied Entomology. Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. David, B.V., (1992). Pest Management and Pesticides Indian Scenario, Namratha Publications, Madras.
4. Metcalf, C.L. and W.P. Flint, (1973). Destructive and Useful Insects. 4th Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi
5. Roy D.N. and A.W.A. Brown (Eds), (1981). Entomology Medical and Veterinary (3rd Ed.) The Bangalore Printing and Publishing Company, Bangalore
6. Ramakrishna Iyer, T.V., Economic Entomology, Government Publications. Madras.
7. Imms, A. D. A General Text Book of Entomology. Chapman & Hall, UK
8. Chapman, R. F. (1998) The Insects: Structure and Function. Cambridge University Press, UK
9. Snodgrass, R. E. Principles of Insect Morphology. Cornell Univ. Press, USA
10. Borror, D. J., Triplehorn, C. A., and Johnson, N. F. Introduction to the Study of Insects. M Saunders College Publication, USA
11. Tembhare, D.B. (2012). Modern Entomology, Himalaya Publishing House Pvt, Ltd, Mumbai
12. Atwal, A.S. (1993) Agricultural Pests of India and South East Asia. Kalyan Publishers, New Delhi.
13. Dennis, S. Hill (2005) Agricultural Insect Pests of the Tropics and their Management, Cambridge University press
14. Pedigo, L.P. (1996) Entomology and Pest Management. Prentice Hall, New Delhi.
15. S. Pradhan. Insect Pest of Crops. National Book Trust, New Delhi.

**CORE XI: PRACTICAL III**  
**ANIMAL PHYSIOLOGY, BIOCHEMISTRY,**  
**DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY**

<b>SUBJECT CODE:</b>	<b>PRACTICAL</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

*Semester: VI*

*Credit: 4*

**Animal Physiology**

1. Survey of digestive enzymes in Cockroach
2. Study of human salivary activity in relation to temperature
3. Estimation of oxygen consumption in fishes with reference to body weight
4. Study of ciliary activity in Freshwater Mussel in relation to temperature
5. Detection of nitrogenous waste products in fish tank water, bird excreta and Mammalian kidney
6. Preparation of Hemin crystals
7. Determination of bleeding time and clotting time
8. Measurement of blood pressure using sphygmomanometer
9. Measurement of oxygen consumption of cockroach using Respirometer. (Demonstration)
10. Use of Kymograph
11. Histological Slides - Mammalian Pituitary, Thyroid, Pancreas, Adrenal Gland

**Biochemistry**

12. Qualitative analysis of protein and lipids
13. Qualitative analysis of sugar (Glucose, Fructose, Lactose and Starch)
14. Estimation of total protein by Lowry's method.
15. Estimation of carbohydrates by Anthrone reagent
16. Qualitative analysis of human urine for sugar
17. Preparation of starch from potato
18. Preparation of casein from milk
19. Preparation of gluten from wheat flour
20. Chromatographic techniques – Paper and TLC
21. Determination of pH in milk

**Developmental Biology**

1. Study of the following prepared slides, museum specimens and materials.
2. Section of testis and ovary showing the maturation stages of gametes.
3. Slides of mammalian Sperm and Ovum.
4. Study of Egg types – Frog's egg, Hen's egg.
5. Slides of cleavage stages, blastula, gastrula and neurula of frog.
6. Slides of different stages of chick embryo. 18 Hours (primitive streak stage), 24 hours, 48 hours, 72 hours and 96 hours.
7. Placenta of Sheep, Pig and Man.

**Immunology**

1. Immuno-electrophoresis
2. Antigen - antibody reactions – Agglutination, Precipitation ring test. (Demonstration)
3. ABO, Rh typing
4. Hemagglutination, Yeast agglutination and Hemagglutination -inhibition assay



**CORE XII: PRACTICAL IV**  
**ENVIRONMENTAL BIOLOGY, BIOTECHNOLOGY AND**  
**MICROBIOLOGY**

<b>SUBJECT CODE:</b>	<b>PRACTICAL</b>	<b>MARKS: 100</b>
<b>SEMESTER: VI</b>	<b>CREDITS: 4</b>	<b>NO.OF HOURS PER WEEK: 4</b>

**Environmental Biology**

1. Estimation of O<sub>2</sub>, Salinity, pH, free CO<sub>2</sub>, Carbonates and bicarbonates, Calcium in water samples
2. Use of Rain gauge, Maximum & Minimum Thermometer, Hygrometer, Anemometer and Barometer
3. Analysis of phytoplankton and zooplankton in fresh water and marine water
4. Adaptations of aquatic and terrestrial animals based on a study of museum specimens - Rocky, Sandy, Muddy Shore Animals, Flying and Burrowing Animals
5. Study of natural ecosystem and field report of the visit

**Biotechnology**

1. Isolation of DNA and RNA
2. Analysis of DNA by agarose gel electrophoresis
3. Demonstration of PCR technique
4. Separation of proteins by Native and SDS-PAGE
5. Demonstration of Blotting techniques
  - a. Southern blot
  - b. Northern blot
  - c. Western blot
6. Instrumentation – Components and application of instruments – Homogenizer, Centrifuge, Electrophoresis, Colorimeter, Spectrophotometer, pH meter.
7. Project report on animal cell culture / Visit to any Biotechnology Institute

**Microbiology**

1. Staining - Simple staining, Gram staining
2. Media Preparation for microbial culture
3. Preparation of Solid media – Nutrient agar, Mac Conkey's agar
4. Preparation of Liquid media – Nutrient broth, Peptone water
5. Biochemical characterization and Identification of Microbes – *E.coli* – (Demonstration)
6. Antibiotic sensitivity test – Demonstration
7. Examination of algae in freshwater bodies
8. Milk quality test-methylene blue reductase test, Urea test
9. Screening for Lipase and amylase producing bacteria
10. Identification of fungus by using Lactophenol cotton blue staining
11. Instruments –Autoclave, Hot air oven, Laminar air flow, Incubator, Fermentor
12. Microscopy – Light Microscope, Phase Contrast Microscopy
13. Spotters – *E. coli*, *Staphylococcus aureus*, *Penicillium*, *Rhizopus*, *Aspergillus niger*, *Aspergillus flavus*, *Streptomyces*, *Lactococcus lactis*, Parasite - cyst and eggs