

GURU NANAK COLLEGE

(AUTONOMOUS)

Guru Nanak Salai, Velachery, Chennai – 600 042

Re-accredited at 'A- Grade' by NAAC

(Affiliated to the University of Madras)



MASTER OF SCIENCE

DEPARTMENT OF M.SC (ZOOLOGY)

(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
TOTAL		142			142			167			170		

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:

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

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

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

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:

Percentage of General Attendance	Marks Awarded
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"> • Interdisciplinary Elective – Digital Logic Fundamentals • Operating Systems • Data Visualization using Tableau • Pentaho/ Looker
6.	Commerce (PA)	Office Management & Methods
7.	Commerce (CA)	<ul style="list-style-type: none"> • Entrepreneurial Development • Production & Supply Chain Management • Business Information System
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.

M.Sc. DEGREE Course in ZOOLOGY 2021-2022 onwards

Sem	Part	Subjects	Cdt	Hrs.	Exam Hrs	Total
I	Core-1	Invertebrata and Chordata	4	4	3	100
	Core-2	Cell and Molecular Biology	4	4	3	100
	Core-3	Genetics and Evolution	4	4	3	100
	Elective Paper-1	Fishery Biology	4	4	3	100
	Core practical- 4	Invertebrata, Chordata, Fishery Biology and Animal Physiology	*	6	*	*
	Core practical-5	Cell and Molecular Biology, Genetics, Microbiology, Immunology and Genetic Engineering	*	6	*	*
	Soft Skill-1	Personality Enrichment	2	2	3	100
Total			18	28		500
II	Core Paper-6	Animal Physiology	4	4	3	100
	Core Paper-7	Microbiology and Immunology	4	4	3	100
	Elective Paper-2	Genetic Engineering	4	5	3	100
	ED-1	Wild Life Management	3	3	3	100
	Core practical-4	Invertebrata, Chordata, Fishery Biology and Animal Physiology	4	6	4	100
	Core practical-5	Cell and Molecular Biology, Genetics, Microbiology, Immunology and Genetic Engineering	4	6	4	100
	Soft skill-2	Workplace Communication Skills	2	2	3	100
Total			25	30		700
III	Core Paper- 8	Developmental Biology and Environmental Biology	4	4	3	100
	Core Paper-9	Economic Entomology and Pest Management	4	4	3	100
	Elective Paper-3	Biophysics and Biostatistics	4	3	3	100
	Elective Paper-4	Aquaculture	3	2	3	100
	ED-2	Public Health and Hygiene	3	3	3	100
	Core practical-10	Developmental Biology, Environmental Biology and Entomology	*	6	*	*
	Core practical-11	Biophysics, Biostatistics, Biochemistry and Bioinformatics	*	6	*	*
	Soft Skill-3	Self and Time Management Skills	2	2	3	100
		Internship	2	*	-	100
Total			22	30		700
IV	Core Paper -12	Biochemistry and Bioinformatics	4	4	3	100
	Core Paper-13	Research Methodology	4	4	3	100
	Elective Paper- 5	Applied Zoology	4	4	3	100
	Core practical-10	Developmental Biology, Environmental Biology and Entomology	4	6	4	100
	Core practical-11	Biophysics, Biostatistics, Biochemistry and Bioinformatics	4	6	4	100
	Soft Skill-4	Spoken and Presentation Skills	2	2	3	100
	Core-14	Project	6	4	-	100
Total			28	30		700
Total Credits			93	120		

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS
WITHOUT PRACTICAL**

QUESTION ALLOTMENT	MAXIMUM 100 MARKS PASSING MINIMUM 50 MARKS THREE HOURS DURATION
QUESTIONS 1-12 Answer any 10 out of 12	PART-A (10X3=30MARKS) ANSWER ANY TEN QUESTIONS EACH QUESTION CARRIES 3 MARK
QUESTIONS 13-20 Answer any 5 out of 8	PART-B (5X 6=30) ANSWER ANY FIVE QUESTIONS EACH QUESTION CARRIES 6 MARKS
QUESTIONS 21 - 26 Answer any 4 out of 6	PART-C (4X10=40 MARKS) ANSWER ANY FOUR QUESTIONS EACH QUESTION CARRIES 10 MARKS

SEMESTER - I

SEMESTER- I
INVERTEBRATA AND CHORDATA

Subject Code:	Core Paper 1: Theory	Marks: 100
Semester: I	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Course objectives:

To relate the morphological adaptations with phylogenetic study of Invertebrata and Chordata.

UNIT I

10 Hrs

Levels of organization: Development of coelom- Acoelomate- pseudocoelomate and coelomate organization - Radial and bilateral symmetry. **Protozoa** – Mode of feeding and Locomotion. **Porifera** – Canal System and Reproduction in Sponges; in sponges. **Coelenterata** – Metridium; Polymorphism; Coral and Coral Reefs and their Theories.

UNIT II

10 Hrs

Platyhelminthes: Parasitism in Platyhelminthes; Reproduction in Platyhelminthes. **Nemertoda:** Ascaris. **Annelida:** Nephridia and Coelomoducts – Adaptive Radiation in Polychaetes. **Arthropoda:** Polymorphism; Crustacean larvae and their Significance; Pheromones in insects – Endocrine organs in Crustacea.

UNIT III

10 Hrs

Mollusca: Filter Feeding in Mollusca; Advanced features of Cephalopods; Gastropoda; Adaptive Radiation in Mollusca. **Echinodermata:** Larval forms and their Evolutionary Significance. **Minor Phyla:** Rotifera, Acanthocephala, Ectoprocta, Entoprocta, Phoronida, Brachiopoda, Chaetognatha. Invertebrate fossils. Trilobites and cephalopods. Regeneration in invertebrates.

UNIT IV

15 Hrs

Origin of Chordates- Theories. Broad classification of Chordates – Phylogenetic Affinities of Cephalo chordata and Urochordata. Evolutionary and structural peculiarities of Cyclostomata and affinities – Petromyzon, Economic importance of fishes. Migration and Parental care in fishes. Respiration and Parental care in Amphibians. Fossae in Reptiles. Evolutionary significance of Archaeopteryx.

UNIT V

15 Hrs

Aves – Migration - Flight adaptation - Types of beaks in birds. Flightless birds. Origin and evolution of Mammals critical account of Prototheria, Metatheria and Eutheria. Adaptive radiation in mammals. Comparative anatomy of Vertebrates - Respiratory organs - Kidney, Urinogenital organs, Brain, Heart and Aortic arches.

TEXTBOOKS:

1. Barrington, E.J. W. 1969. Invertebrate Structure and Functions. English Language, Book Society.
2. Newman, The Phylum Chordata, Mac Millan and Co.

REFERENCE BOOKS

1. Barnes: Invertebrate Zoology – Toppan International Co.,
2. Hyman L. H. The Invertebrata, Vol. I to IV.
3. Carter, G. S. A General Zoology of Invertebrates, (Sidewick and Jackson Ltd., (London)
4. Borradile, L. A. The Invertebrata. Cambridge University Press.
5. Gardinar, M. S. 1972 Biology of the Invertebrates, Mc Graw Hill Book Co., New York.
6. R. L. Kotpal: Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
7. Moore, R. C. Lalilcker, C.G. and Fisher, A. G. Invertebrate Fossils, Mc. Graw Hill Book Co., New York.
8. Colbert, E.H. Evolution of Vertebrates. Wiley Eastern Limited.
9. Hyman, L.H – Comparative Vertebrate Zoology. University of Chicago Press.
10. Romer, A.S. Vertebrate body. Saunders Company.
11. Young, J.A- Life of Vertebrates. Oxford press.
12. Waterman, A.J – Chordate structure and Function. Mac Millan and co.

CELL AND MOLECULAR BIOLOGY

Subject Code:	Core Paper 2 / Theory	Marks: 100
Semester: I	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Course Objective: To impart knowledge of cellular organelles, cancer and signaling concepts in cell and Molecular Biology.

UNIT I

5 Hrs.

Structural organization and function of intracellular organelles: Structure of model membrane, Nucleus, Mitochondria, Ribosome, Golgi bodies, Lysosomes, Endoplasmic reticulum, structure & function of cytoskeleton and its role in motility.

UNIT II

15 Hrs.

Cancer: Cancer cell- Characteristics, Differences between normal and cancer cell, Membrane and Biochemical changes in cancer cells, Apoptosis, Nuclear and Chromosome changes, Carcinogenesis - Tumor viruses, Oncogenes, Tumor Suppressor genes, Hormones in relation to cancer, Treatment of cancer at molecular level.

UNIT III

15 Hrs.

Informational macromolecules: Chemistry of DNA, Polymorphism of DNA, A, B, C and Z forms of D.N.A. Mechanism and Enzymology of DNA Replication - Role of Helicases, Primases, Nucleases, Ligases and Telomerases. Chemistry of RNA, Different types of RNA- mRNA, tRNA, rRNA and their functions.

UNIT IV

15 Hrs.

Information transfer: Genetic code and its characteristic features. Information transfer in prokaryotes and eukaryotes. Transcription – promoters, initiators, terminators. RNA processing – trimming of introns, splicing of exons, Ribozyme. Transcription and Translation in Prokaryotes and Eukaryotes.

UNIT V

10 Hrs.

Cell Signaling: Signaling molecules and their receptors – functions of cell surface receptors – Pathways of intracellular signal transduction.

TEXT BOOK:

1. Cooper: The Cell, A Molecular approach.

REFERENCE BOOKS:

1. David Frifielder: Molecular Biology.
2. Gerald Karp: Cell Biology- Mc Graw Hill.
3. Lodish, Berk, Zipursky, Matsuda and Baltimore, Molecular cell biology IV edition.
4. W. H. Freeman and Company. George M. Malinski, 2010. Essential of molecular biology
Watson: Molecular Biology of the Gene, 4th edition, Narosa publicatio

GENETICS AND EVOLUTION

Subject Code:	Core Paper: 3 / Theory	Marks: 100
Semester: I	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Course Objective: To understand the fine structure of genetic materials and regulation of their action. To know the chromosomal basis of genetic disorders, development and differentiation. Also, to know the importance of population genetics and nuances of genetic engineering and applied genetics. To explore the process and product of evolution since nothing in biology makes sense except in the light of evolution.

UNIT I

10 Hrs

Gene Structure and Function: Molecular structure of DNA and RNA -Replication, theories, Gene concept -One gene one polypeptide concept. Identification of DNA and RNA as the genetic material. Microbial Genetics-Conjugation, transformation and transduction and Packaging DNA molecules into chromosomes. Chromosome mapping in prokaryotes (Virus, Bacteria) and eukaryotes (Neurospora, and Man)

UNIT II

10 Hrs

Enzyme regulation of gene action. Gene regulation of gene action -Operon concept-GA L and LAC Operon system. Evidence of regulation of gene action. Hormonal control of gene action. Genes and metabolism. Inborn errors of metabolism in Man. Regulation of gene expression in prokaryotes (*E. coli*) and eukaryotes (*Drosophila*). **Human Genetics:** Polygenic inheritance, Genetic counseling. Principles and methods of pedigree analysis.

UNIT III

15 Hrs

Genes in development and differentiation: Mechanism of chromosomal breakage -physical chemical and biological factors or agents. Mutagens and mutagenesis and carcinogenesis. Radiation induced mutations. Population genetics: Population and gene pool. Hardy Weinberg Law-Genetic equilibrium. Calculation of gene frequencies for Autosomal (Complete dominance, codominance and multiple alleles) and sex inked genes. Factors affecting Hardy Weinberg equilibrium.

UNIT IV

15 Hrs

Evolutionary Thought and Causal Factors: Neo- Lamarckism- Neo- Darwinism; Adaption, struggle, fitness and natural selection. **Paleontology:** Geological time scale- Fossil records (nature; conditions and dating) - Man in the fossil records- mass extinction. **Polyploidy and evolution** – genetic assimilation – genetic speciation – species concept – evolutionary trends – canalization of selection – orthoselection. Genetic Polymorphism - genetic drift- Animal coloration and mimicry- Micro and Macro evolution. Adaptation, Pre - adaptation and Post-adaptation.

UNIT V

10 Hrs

Adaptation, Speciation, Man and Natural Selection: Adaptive radiation in reptiles and mammals- Convergence- Parallelism - Co-evolution - evolutionary constancy- speciation and Isolating mechanisms - Hybridization as an evolutionary catalyst- Evolutionary genomics- Evolution of population – from races to species, adaptation pattern, behavioral adaptations and strategies, sexual competition and selection, isolating mechanisms, mode of speciation and evolutionary rate.

TEXT BOOK:

1. Peter J. Russel W.W. Genetics. Benjamin Cummings. 2002. **Website:** www.geneticsplace.com.
2. Darwin, C.R. 2000. On the Origin of species by means of natural selection (Revised edition) Collier Books, New York.

REFERENCE BOOKS:

1. Anna.C. Pai: Foundation Genetics, Mc Graw Hill Book Company.
2. Burns, G.W. - The Sciences of Genetics, Mac millan publications.
3. Gardner: Principles of Genetics. 8th Edition, John Wiley and Sons.
4. Ursula Good enough: Genetics, Saunders College Publishing.
5. Benjamin Lewin Gene VII (2000). Oxford University press.
6. Griffiths, Gelbart, Lewontin and Miller. Modern Genetic Analysis. W.H. Freeman and Company.
7. P.K.Gupta. Biotechnology and Genomics. Rastogi publications.
8. Dodson, E.O. 1990. A Text Book of Evolution, W.B. Saunders, Philadelphia.,
9. Lull.R.S.1984.Organic evolution, Seema publications.

FISHERY BIOLOGY

Subject Code:	Elective Paper – 1 / Theory	Marks: 100
Semester: I	Credits:4	No. of Hours per week: 4

Teaching Hrs: 45

Course Objective: This subject gives the in-depth knowledge about fishes and fish farming systems.

UNIT - I

5 Hrs

World and Indian Fisheries – Prospects and Problems – Plans, Policies and Current Status of Indian Fisheries. Definition – salient features of the fishes - classification- Berg's classification.

UNIT – II

7 Hrs

Marine fisheries; Bionomy, Taxonomy and Economic importance: Fish - Sardines, Mackerels, Bombay duck, Pomfrets, and Sea Bass: Prawn – *Penaeus monodon*, Crabs, Lobsters, Oysters, and Mussels.

UNIT - III

10 Hrs

Inland fisheries; Freshwater – riverine, reservoir, pond and Coldwater fisheries – Spawning and breeding habits of fishes. Estuarine and brackish water fisheries and their economics. Fish Gears and Crafts used in South Indian Fisheries. Ornamental fish culture and economics.

UNIT- IV

10 Hrs

Assessment of fish stocks: Marking and recapture method, area sampling method, biostatistical method, egg count method, hydroacoustic method, remote sensing. Age and Growth: Scale method, otolith method, other skeletal parts as age indicators, length – frequency method, length – weight relationship and condition factor. Population studies: estimation of population size, marking, tagging, population dynamics, population models.

UNIT V – Culture and Capture fisheries in India:

13 Hrs

Culture fisheries: Integrated fish farming technology – rice – cum – brackish water fisheries, rice-cum-common carp culture, fish –cum-duck culture, Sewage – fed fisheries – monosex culture – polyculture. Fish endocrinology – Induced breeding – techniques – examples. Fish Processing and Preservation – fish by – products – brief account on transport and marketing. Effect of pollution of fisheries. Fish Pathology: Parasites – Protozoan, fungal, bacterial, worms and arthropods.

REFERENCE BOOKS:

1. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
2. Hanifa, M.A, 2011. Aquatic resources and aquaculture, Dominent, NewDelhi.
3. Pandey. K and Shukla, J.P.2010. Fish and fisheries, Rastogi Publications, Meerut.
4. Parihar, R.P. 1996. A text book of fish biology and Indian fisheries, central publishing house, Allahabad, India.

5. Khanna, S.S., and Singh H.R.2012.A text book of fish biology & fisheries, Narendra publishing house.
6. Baluyut, E. A. (1989). Aquaculture systems and Practices. A selected review Publishing House, New Delhi.
7. Chondar. A (1970). Handbook of breeding of Indian major carps by pituitary hormone injection. Agra Satish Book Enterprise.
8. Day. F (1958). Fishes of India, Vol. I and Vol. II. William Sawson and Sons Ltd., London.
9. Jhingran, C. G. (1981). Fish and Fisheries of India. Hindustan Publication Co., India.

**PRACTICAL I – INVERTEBRATA, CHORDATA, FISHERY BIOLOGY
AND ANIMAL PHYSIOLOGY**

Subject Code:	Core Practical : 4	Marks: 100
Semester: I &II	Credits: 4	No. of Hours per week: 6

Teaching Hours: 60 hrs.

INVERTEBRATA

1. Identification study and medical importance of selected Protozoans and Helminthes.
2. Identification study and sections of Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of Coelom.
3. Identification study and larval forms from all Major Phyla of Invertebrates.
4. Identification study of Invertebrate Fossils.
5. Commercially important Invertebrates: Crab, Lobsters, Pearl Oyster, Edible Oyster, Mytilus, Sepia and Loligo.
6. Dissection and mounting of Digestive and Nervous in 1. Earth worm 2. Prawn 3. Pila globosa and 4. Fresh Water Mussel
7. Mounting of Body setae and Penial setae of Earth Worm.
8. Mounting of salivary gland of Cockroach.
9. Mounting of Radula of Pila globosa.
10. Mounting of appendages of Prawn.

CHORDATA

1. Identification of important Prochordates, Fishes, Amphibians, Reptiles, Birds and Mammals.
2. Digestive system of Teleost Fish.
3. Dissection and Display of Arterial and Venous System, in Teleost fish.
4. Mounting of brain of fish.
5. Mounting of different types of Scales in Fishes.

FISHERY BIOLOGY

1. Morphometric and Meristic characteristic features of Fish.
2. Identification of: a) Marine, fresh water and estuarine fishes up to species level.
b) Cultivable prawns.
3. Age determination in fishes by Scale method and Otolith method.
4. Mounting of Weberian Ostricles in fishes.
5. Observation of maturity stages of gonads and determination of Gonado somatic index and fecundity in Fishes.
6. Observation of maturity stages of gonads and determination of Gonado somatic index and fecundity in Crabs.
7. Gut content analysis of fishes in relation to feeding habits.
8. Observation of Gears and Crafts.
9. Observation of fish ectoparasites.
10. Observation of Larvivorous fishes and Aquarium fishes.
11. Observation of seaweed species and their economic importance.
12. Observation of Live feed organisms.

ANIMAL PHYSIOLOGY

1. Estimation of Respiratory Quotient in fish with reference to Temperature.
2. Oxygen consumption in a terrestrial animal (cockroach).
3. Ciliary activity of Fresh Water Mussel in relation to Temperature.
4. Salt loss and salt gain in fish.
5. Estimation of excretory products in Chordates.
6. Determination of amino acids in the tissues (Liver/muscle) of fish/egg albumin (paper chromatography).
7. Principles and applications of the following instruments:
 - a. Kymograph,
 - b. Spectrophotometer,
 - c. Sphygmomanometer,
 - d. Electrophoretic Unit.

STUDY TOUR

Report on field visit for studying the adaptation of animals.

**PRACTICAL II: CELL AND MOLECULAR BIOLOGY, GENETICS,
MICROBIOLOGY, IMMUNOLOGY AND GENETIC ENGINEERING**

Subject Code:	Core Practical : 5	Marks: 100
Semester: I & II	Credits: 4	No. of Hours per week: 6

Teaching Hours: 60 hrs

CELL AND MOLECULAR BIOLOGY

I. Cytological techniques

- a) Microscopy – Compound and Light Microscope.
- b) Study on Camera Lucida.
- c) Micrometry: Microscopic calibration and Measurements of cell size using ocular and stage micrometers.
- d) Estimation of total RBC count in human blood.
- e) Estimation of total WBC count in human blood
- f) Blood cells –Differential count in man.
- g) Sandwich Eliza Test by Pregnancy Kit method.
- h) Mounting of Human Buccal Smear for squamous epithelial tissue.
- i) Study of mitotic cell division by Squash preparation Onion root tip.
- j) Study of meiotic cell division by mounting of testis of Grasshopper.

II. Histological techniques in animal tissues

- a) Fixation,
- b) Dehydration,
- c) Embedding,
- d) Staining and
- e) Mounting.

*Each student should produce at least five histological slides.

GENETICS

1. Preparation of culture medium and culture of Drosophila-methods of maintenance.
2. Identification of Drosophila species and mutants.
3. Preparation of Human karyotypes – Analysis of Normal and abnormal karyotypes (Down's syndrome, Turner's syndrome, Klinefelter's syndrome).
4. Study of Giant Chromosome – Chironomous larva.

MICROBIOLOGY

I. Sterilization of Glass wares and media

II. Culture medium and preparation

- a) Peptone water
- b) Nutrient broth
- c) Solid media
- d) Serial Dilution

III. Staining Techniques

- a) Simple Staining
- b) Grams Staining

IV. Biochemical Tests

- a) Motility
- b) Catalase
- c) Oxidase
- d) Indole
- e) Methyl Red
- f) Voges Proskauer
- g) Triple Sugar Ion
- h) Citrate
- i) Urease

V. Enumeration of bacterial colonies

- a) Direct Plate count
- b) Observation of colony morphology (Colour, margin and diameter)
- c) Enumerate bacterial colonies and entry on record

VI. Microscopic observation for identification and characterization of following microorganisms.

- a) *Staphylococcus aureus*
- b) *Escherichia coli*
- c) *Rhizopus*
- d) *Aspergillus niger*
- e) *Aspergillus flavus*
- f) *Penicillium*
- g) *Nostoc*
- h) *Oscillatoria*
- i) *Volvox*

IMMUNOLOGY

1. Histology of Lymphoid organs (Spotter study)
2. Haemagglutination - Qualitative analysis – ABO Blood groupings.
3. Haemagglutination - Quantitative analysis – haemagglutination titration.
4. Preparation of Antiserum.
5. Antigen-Antibody reaction Immuno-Electrophoresis - Demonstration.

SEMESTER - II

SEMESTER-II
ANIMAL PHYSIOLOGY

Subject Code:	Core Paper: 6 / Theory	Marks: 100
Semester: II	Credits: 4	No. of Hours per week: 4

Teaching Hrs. 60

Course Objective: To enlighten the functional aspects of organ system in the body of animal and man.

UNIT I **15 Hrs**

Homeostatic mechanisms: ionic and osmoregulation in crustaceans and fishes – temperature and pH regulations in animals. Light – photobiological processes – pressure – acclimatization to high altitudes – Hydrostatic pressure – Buoyancy.

UNIT II **10 Hrs**

Carbohydrate metabolism – Glycogenesis, Glycogenolysis, Glycolysis, Kreb's cycle, HMP pathway, Gluconeogenesis.

Protein metabolism – Deamination, transamination and transmethylation of amino acids. **Lipid metabolism** - Oxidation and biosynthesis of fatty acids. Integrated metabolism – Mineral metabolism (with special reference to Na⁺, K⁺ and Ca²⁺).

UNIT III **10 Hrs**

Respiration: Respiratory pigments and their functions – Exchange of gases – Transport of oxygen and carbon-di-oxide – Regulatory mechanisms.

Circulation: Chemistry of blood – inorganic and organic components their regulations and functions -blood pigments and functions – Types of transport mechanisms – Cardiac cycle – Blood Pressure –ECG.

Excretion: Excretion in relation to different habitats – Detoxication pathways of ammonia – Regulation of nitrogen excretion.

UNIT IV **15 Hrs**

Muscles: Mechanism of muscle contraction- Regulation and energetics of contraction – Electric organs in Norcine. Nervous co-ordination: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Propagation and transmission of nerve impulse – Synaptic transmission. Bioluminescence – Biological clocks.

UNIT V **10 Hrs**

Endocrine glands in mammals – hypothalamus, Pineal, Thyroid, Parathyroid, Pancreas, Adrenal, Testis and Ovary-Location and structure – Hormones and functions. Physiology of reproduction: Mammalian reproductive physiology – Reproductive cycles – Hormonal control. Molecular mechanism of hormone action.

TEXT BOOK:

1. Hoar, W.S. General and Comparative Physiology.

REFERENCE BOOKS:

1. David Saunders: An Introduction to Biological Rhythms.
2. K. Nagabushanam, M.S.Kodarkar and R.Sarojini: An Introduction to Animal Physiology.
3. Prosser C.L.Comparative animal physiology.
4. Schmidt-Nielson: Animal physiology.

MICROBIOLOGY AND IMMUNOLOGY

Subject Code:	Core Paper: 7/Theory	Marks: 100
Semester: II	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Course Objective: To gain knowledge about the morphology of microbial pathogens, its role in ecology and industrial biotechnology; to know about the human immune system and Immune Deficiency Diseases.

UNIT-I

15 Hrs

History and Scope: Milestones in Microbiology- Microbial Taxonomy- Classification system- Phenetic- Numerical- phylogenetic. Morphology-Ultra structure of Bacteria, Fungi and Viruses- Enumeration of bacteria – Viable plate count-MPN procedure. **Medical Microbiology-** Pathogenic Microbes in Bacterial- Tuberculosis,. Viral- HIV. Protozoan- Amoebiasis and Malaria. Cure, Control and Prevention.

UNIT-II

10 Hrs

Microbial Ecology and Environmental Microbiology- Role of microorganisms in Carbon, Nitrogen and Sulphur cycle. Population interaction – Commensalism, Co-metabolism, Epiphyte, Synergism, Mutualism, Competition, Predation and Parasitism.

UNIT-III

15 Hrs

Food and Dairy Microbiology- Dairy and Non-dairy-Fermented food and Alcoholic beverages. Microorganisms and Food spoilage. **Industrial Microbiology-** Industrial uses of microbes- Fermentation products. Production of Penicillin, Ethanol and Vinegar. Types of Reactors: Animal and Plant Cell Bioreactors.

UNIT IV

10 Hrs

Scope of Immunology – Types of Immunity - Innate and Acquired, Passive and Active. Primary and Secondary Lymphoid Organs – Structure and Function of Bone Marrow, Thymus, Spleen, Bursa of Fabricius, GALT, BALT, MALT and Lymph Nodes. Cells of Immune System Origin and Differentiation of T & B Cells and Macrophage. Antigens- Haptens - Antigenic determinants – Adjuvants. Antibody – Immunoglobulin – Primary Structure – Classes, Functions, Synthesis. Cell mediated immunity, Humoral immunity and Autoimmune disorders.

UNIT V

10 Hrs

Humoral and cell mediated immunity – regulation of immune response – Tolerance – Antigen and antibody reaction – Physical and Biological – Vaccination – Allergy – AIDS – Congenital immunodeficiencies.

TEXT BOOK:

1. Michael. J. Pelczar Jr, Chan. E.C.S, Kriej, Noel.R. Microbiology. Tata Mac Grawhill.
2. T.A. Brown – Gene cloning an Introduction (1995), Third edition Stanley Thornes Publishers.

REFERENCE BOOKS:

1. Dubey, R.C. and Maheswari, D.K, A text book of Microbiology.
2. Lansing, M. Prescott, John P.Harley and Donald A. Klein. Microbiology Mc Graw Hill (1999):
3. Patel, A.H. - Industrial Microbiology (2001). MacMillan India Limited.
4. Powar and Daginwala: General Microbiology - Vol II Microbiology-fourth edition.
5. Ronald, M. Atlas, Principles of Microbiology (1997)
6. Sharma. P.D, Microbiology- A text book for university students.
7. Benjamin Lewin Gene VII (2000) Oxford University press.
8. Desmond S.T. Nicholl- An introduction to Genetic Engineering (1996) – Cambridge University press.
9. Purohit-Biotechnology.
10. Schlegel- Genetic Engineering.
11. R.W. Old and S.B. Primrose Principles of Gene Manipulation. (1994). V-Edition Blackwell Science.

GENETIC ENGINEERING

Subject Code:	Elective Paper: 2/Theory	Marks: 100
Semester: II	Credits: 4	No. of Hours per week: 5

Teaching Hrs: 45

Course Objective: To understand the Principles and methods in genetic engineering and the role of Protein engineering.

UNIT-I

10 Hrs

Principles and methods in genetic engineering: Host cell restriction; Restriction modification; Restriction enzymes: Types and applications; Restriction mapping; DNA finger printing; RFLP, RAPD and AFLP techniques; Nucleases, Ribonucleases, DNA ligases, Taq Polymerases, Methylases, Topoisomerases, Gyrase and Reverse Transcriptases.

UNIT- II:

10 Hrs

Vectors: plasmid vectors: pSC101, pBR322, pUC series and Ti plasmids based vectors; Bacteriophage vectors: Lambda phage based vectors, phagemids, cosmids, and M13 based vectors; Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system; Bacterial artificial chromosome and yeast artificial chromosome. Expression vectors, Insect vectors.

UNIT III:

10 Hrs

Cloning techniques: Genomic DNA and cDNA library Construction; Screening methods; Cloning in *E. coli*, *Bacillus*, *Pseudomonas*, *Streptomyces* and yeast; Expression systems; Gene fusion and Reporter genes; Gene targeting; Methods of gene transfer - Transformation, Transfection; Electroporation, microinjection and biolistic.

UNIT IV:

5 Hrs

Analysis of Recombinant DNA: Polymerase chain reaction; Principles and techniques of nucleic acid hybridization and cot curves; Southern, Northern blotting techniques; Dot and Slot blotting.

UNIT V:

10 Hrs

DNA and protein sequencing; Protein engineering; Protoplast fusion; Hybridoma Technology, cell & tissue culture in plants & animals. Transgenic animals & plants; Applications of genetic engineering in agriculture, health and industry including gene therapy.

TEXT BOOK:

1. Dubey R.C. (2008) A text Book of Biotechnology. S. Chand and Company, New Delhi
2. Satyanarayana. U. (2005) Biotechnology. Books and Allied P. Ltd. Kolkata.

REFERENCE BOOKS:

1. Brown, C.M., Campbell, I. and Priest, F.G. (1988), Introduction to Biotechnology, Blackwell Scientific Publications, UK.
2. Primrose, S.B. (2000), Modern Biotechnology, Blackwell Scientific Publications, Oxford, London.
3. Keshav Trehan (1996), Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi.
4. Watson et.al. (1999) Recombinant DNA. Freeman and Company, New York
5. Ignacimuthu, S. (1998), Basic Biotechnology, Tata McGraw Hill Publishing Co., New Delhi.
6. Kumar, H.D. (1998), Modern Concepts of Biotechnology, Vikas Publishing House Pvt. Ltd., New Delhi.

SEMESTER - III

SEMESTER-III
DEVELOPMENTAL BIOLOGY AND ENVIRONMENTAL BIOLOGY

Subject Code:	Core Paper: 8/ Theory	Marks: 100
Semester: III	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Objective: Developmental biology helps to understand the ontogeny of animals. To study the interaction between living organism and the environment.

UNIT-I

15 Hrs

Basic concepts of development: Potency, commitment, specification, competence, determination; cell fate and cell lineages;

Gametogenesis – Spermatogenesis – Biochemistry of semen, Sperm physiology – Oogenesis – Superovulation, ICSI, GIFT – Embryo cloning. Fertilization – *In Vitro* fertilization – vitellogenesis. Morphogenetic gradients in egg-double gradient theory. Embryonic fields and their properties.

Differentiation: Concept and nature of differentiation-selective action of genes in differentiation in *Drosophila* development, recognition of gene to signal molecules – time factor in progressive differentiation.

UNIT-II

15 Hrs

Embryonic induction-concepts-organizers-classical experiments on organizers-analysis of the nature of primary organizer-chemical nature of inducing substances – mechanism of induction competence of organizer. Influence of hormones on growth and metamorphosis of insects and amphibians. Regenerative ability in *Planaria* and Salamander-blastema formation – Factors affecting regeneration. Aging and alterations in development – Gene regulation of aging.

UNIT-III

10 Hrs

Fertilization and early development: Cell surface molecules in sperm-egg recognition in animals; embryo sac development and zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals. embryonic adaptation and the development of mammals. Gene activity during Gastrulation- Involvement of paternal the core genes in the development.

UNIT-IV

10 Hrs

General components of Environment:

Stability and complexity - Primary Production and secondary production - Biogeochemical cycles-nitrogen and carbon. Population dynamics- growth curve. Trends in human population – urbanization. Natural resources – Renewable (food, water and forest) and non-renewable (land, energy and mineral) resources. Conservation of natural resources and biota-soil conservation.

UNIT-V

10 Hrs

Biodiversity –basic concepts, types, values, threats, methods of conservation- sustainable development and biodiversity indices. Wildlife conservation-Wildlife sanctuaries and National Parks-Biosphere Reserves - Habitat Ecology- lake, marine, rocky, muddy and sandy shore, estuary, terrestrial grassland, forest, desert.

Pollution – sources, effects, and control of air, water, organic pollutants, BOD, COD, pesticides, heavy metals, thermal, radiation, oil, land and noise pollution – indicator organisms -bioaccumulation – biomagnification and biomonitoring of pollutants. Environmental impact assessment (EIA) – definition, steps in EIA, method of EIA, problems involved in EIA, reporting (EIS).

TEXT BOOK:

1. Balinsky B.I., An introduction to Embryology. (1981) Saunders, Philadelphia.
2. Anantha krishnan, T.N., Bioresources Ecology. (1982) Oxford- IBH Publishing Co, New Delhi.

REFERENCE BOOKS:

1. M.J. Berrill–Developmental Biology. (1986) Tata Mc Graw Hill, publications Ltd.
2. Raven: An outline of developmental physiology. Porgaman press.
3. Robert S.Rugh: The frog Reproduction. (1951) Tata Mc Graw Hill publications Ltd.
4. P.K. Gupa, Biotechnology and genomics.
5. Began M. J. L. Harper and C. R. Town Send (1990), Ecology, individuals, populations and communities. Blackwell Scientific Publication, London.
6. Clarke, G. L., Elements of Ecology (1954), John Wiley, New York.
7. Odum. E.P. Fundamentals of Ecology (1971) 3rd Edition, W.B. Saunder Co, Philadelphia.
8. Elton,C. Animal Ecology, (1971), Metheun company.
9. Rastogi, V.B. and Jayaraj, M. S., Animal ecology and distribution of animals,

ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT

Subject Code:	Core Paper: 9/Theory	Marks: 100
Semester: III	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Course Objective:

To study about the insects, their habitats and physiology; to acquire the knowledge on the economic importance of insects.

UNIT I

10 Hrs

Brief account of morphology, classification (Major orders) and development (Metamorphosis) of insects. Biology of an insect with special reference to the following: Nutrition, Development, Reproduction and Endocrinology. Insects and their interrelationships with environments (Interspecific and Intraspecific).

UNIT II

10 Hrs

Beneficial and harmful insects. Economic importance of honeybees, silkworm and lac insect – parasitic and predatory insects. Damages to plants, animals and man by insects. Brief account of any three pests of 1. Rice, Cholan and Pulses 2. Sugarcane 3. Cotton 4. Groundnut, Gingely and Coconut 5. Brinjal, Tomato and Lady's finger 6. Cardamom, Chilies, tea and Coffee 7. Mango and Citrus.

UNIT III

15 Hrs

Insects as crop pests: Types of injuries and loss caused to plants in general factors governing the outbreak of pests – Insect vectors of plants, animals and man – Other insects affecting the health of man domestic animals.

UNIT IV

10 Hrs

Insect pest control methods (Physical, mechanical, biological and chemical) – Classification of pesticides and their modes of action. Traditional methods – Poison bait, Stomach Poison, Light Trap, Attractants, Repellents, and Antifeedants.

UNIT V

15 Hrs

Pesticide – basic principles of insecticide formulations and their application in pest control. Classification of Insecticides- Inorganic, organic and synthetic organic compounds. Plant protection appliances- Dusters and Sprayers, Aircraft and Other equipments. Pesticides and environmental pollution – precautions in handling pesticides.

TEXT BOOK:

1. David, B.V. and T. Kumarasamy, 1984. Elements of Economic Entomology, Popular Book Depot, Madras, 536 pp.

REFERENCES:

1. The Science of Entomology. William S. Romoser and John G. Stoffolano. Wm. C. Brown Publishers, England.1994.
2. The Silkworm. An important laboratory tool. By Yataro Tazima, Kodarsha, Scientific Book Ltd., Japan.1978.

3. Sericulture Manual: FAD, Agril, Service Bulletin, Rome.
4. Applied Entomology: P. G. Fenemore, Allaprkash, Wiley Eastern Ltd., Delhi.1992.
5. Park, J. E and K. Park. Textbook of social and preventive medicine. Publ. Mis. Banarasides Bharol. Jabalpur.
6. Nayar, K. K, Ananthakrishnan, T. Nand B. V. David. General and Applied Entomology. Tata McGraw Hill Publ., New Delhi.1989.
7. Entomology and Pest Management. Larry, P. Pedigo Prentice Hall, New Jersey.1989.

BIOPHYSICS AND BIOSTATISTICS

Subject Code:	Elective Paper – 3/ Theory & Problems	Marks: 100
Semester: III	Credits: 4	No. of Hours per week: 3

Teaching Hrs: 45

Course Objective: To highlight the statistical applications in biological sciences and to enhance the principles of physics in biology.

UNIT-I

5 Hrs

Principles of Light Microscopy, Electron Microscopy and their applications; Principles and methods of Histology and Histochemistry, Freeze-drying, Freezing Microtome and Cryostat.

UNIT-II

10 Hrs

Electronic configuration of an atom: Vander Waal's forces – Hydrophobic and hydrophilic interactions; Principles and different types of Chromatography and Electrophoresis; Principles and applications of Colorimetry, Spectroscopy, Ultra violet and Infrared Spectroscopy in Biological investigations.

UNIT-III

10 Hrs

Phenomenon of Radioactivity: Isotopes and their use in biological investigations. Biological effects of radiation- Determination and measurement of radio activity-Geiger Muller and scintillation counter- Biological applications of radio isotopes and autoradiography.

UNIT-IV

5 Hrs

Collection of data-primary and secondary, Methods of Classification and tabulation of data. Variables -Qualitative and Quantitative, Discrete and Continuous. Types of classification- Qualitative and Quantitative. Qualitative - chronological, geographical etc., Quantitative – Frequency distribution, Discrete and Continuous frequency distribution.

UNIT- V

15 Hrs

Measures of central tendency: Arithmetic Mean, Median and Mode. Definition and computation for different types of data (ungrouped, discrete and continuous frequency distribution). Measures of Dispersion: Mean deviation-coefficient of variation- variance- Standard deviation and standard error. Regression analysis. Correlation- Definition and Types, Scatter diagram, Computations of Karl Pearson's coefficient of correlation, Regression analysis. Students "t" test and Chi square analysis.

TEXT BOOKS:

1. Dr. S. P. Gupta, Statistical Methods. (1984) Sultan Chand and Sons, New Delhi.
2. M.A Subramanian, Biophysics Principles and Techniques (2005), MJP Publishers.

REFERENCE BOOKS:

1. Pillai, R.S.N.and Bagawathi.V Statistical Theory and practice (1989).
2. Sokal, R.R and Roulf, F.J - Biometry. The Principles and Practice of Statistics in Biological Research. (1969).

AQUACULTURE

Subject Code:	Elective Paper: 4 / Theory	Marks: 100
Semester: III	Credits: 3	No. of Hours per week: 2

Teaching Hrs: 45

Course Objective: This paper is focused mainly on the site selection for Aquafarm designing, construction and different types of farming practices.

UNIT I: Ocean – General:

5 Hours

Classification of coastal environment – marine, brackish, estuarine, mangroves, lagoons and coral reefs – their physicochemical features. East and West coast fisheries in India. Activities of CMFRI, CIFE, CIBA, MPEDA, INCOIS and FIRMA. Aquaculture Authority Act-Coastal Regulation and EEZ.

UNIT II: Live feed & Plankton

10 Hours

Methods of collection of live food organisms, identification, isolation and maintenance of phytoplankton, mass culture of phytoplankton and zooplankton (Brachionus, Copepods and Moina), culture of Artemia, production of cyst and their utilization. Classification of plankton, methods of collection, preservation, analysis and biomass of phytoplankton and zooplankton.

UNIT III: Fish Farming Management

10 Hours

Water supply to fish farm – controlling devices of flow, pump types – aerating equipments and filtration systems. Open sea – farming – site selection, Constraints and prospects of open sea farming – Culture in Cages, Pens, rafts rack and raceways: design, construction, repairing and maintenance.

UNIT IV: Diseases – Finfishes & Shell fishes

10 Hours

Disease development factors involved, abiotic and biotic. Detailed study on diseases of finfish (food fishes) – viral, bacterial, fungal, parasitic (protozoan & metazoan), environmental and nutritional diseases. Environmental and nutritional diseases. Larval health monitoring with special reference to shrimps and fishes. Modern techniques employed in diagnosis of diseases in cultivable organisms with special reference to shrimps, WSSV sample collection and preparation for different techniques (microbiology, immune studies).

UNIT V: Aquarium Fishes

10 Hours

Freshwater and marine aquaria – global status of aquarium fish keeping – advantages and benefits of fish keeping – criteria of choosing aquarium fishes – common aquarium fishes – collection techniques. Air pumps – air operated filters – biofilters – Heating devices – aquarium thermostats – water quality maintenance – lighting methods. Tropical marine set up – aquascaping – base covering – adding decorative materials – plants. Role of women in ornamental fish culture.

TEXT BOOKS:

1. Iversen, E.S., 1996. Living Marine Resources. Chapman and Hall, New York, 403 pp.
2. Castro, P. and M.E. Huber, 1997. Marine Biology, Second Edition. Mc-Graw Hill Company, New York, 450 pp.

REFERENCE BOOKS:

1. Kenneth Sherman, 1998. Large marine ecosystems of the Indian Ocean, Blackwell science-USA, 394pp.
2. Satyanarayana, U., 1999. Biochemistry, Books and Allied (p) Ltd, New Delhi, 695 pp.
3. Joachim W. Bertram and Felicitas Piedad – Pascal, 2000. Hand Book on Ingredients for Aquaculture Feeds. Kluwer Academic Publishers, London.
4. Robert R. Stickney, 2000. Encyclopedia of Aquaculture. John Wiley & Sons, Inc., New York, 1063 pp.
5. Holmer, M., 2008. Aquaculture in the ecosystem, Springer, New York, 326 pp.

**PRACTICAL-III : DEVELOPMENTAL BIOLOGY, ENVIRONMENTAL BIOLOGY
AND ENTOMOLOGY**

Subject Code:	Core–Practical - II	Marks: 100
Semester: III & IV	Credits: 4	No. of Hours per week: 6

Teaching Hours: 60

DEVELOPMENTAL BIOLOGY

1. Oogenesis and Spermatogenesis– Histological studies in mammals.
2. Study of life cycle of *Drosophila melanogaster* and record its developmental stages (Egg, larvae, pupal and adult stages).
3. Different stage in Development of Prawn (Egg, Nauplius, Metanuplius, Zoea, Mysis)
4. Different stage in Development of frog (Egg, Tadpole, Young adult with tail and adult stages)
5. Mounting of Chick embryo (24 Hrs, 48 Hrs, 72 Hrs, and 96 Hrs)
6. Slide showing C.S of Heart, Kidney, Eye lens and Limb of Frog.
7. Development of Invertebrates. Eggs, Cleavage, Gastrula, study of larval forms.
8. Development stages of Fish.

ENVIRONMENTAL BIOLOGY

1. Identification of freshwater and marine planktons.
2. Study of rocky, sandy and muddy shore fauna and their adaptations.
3. Determination of the following water quality parameters:
 - a) pH
 - b) Salinity
 - c) Free-Carbon dioxide
 - d) Dissolved Oxygen
 - e) Chemical Oxygen Demand
 - f) Calcium
 - g) Carbonate
 - h) Bi-carbonate
 - i) Ammonia
 - j) Nitrate
4. Analysis of macro and microorganisms in soil and soil litter.
5. Animal associations- parasitism, mutualism and commensalism
6. Earthworm population estimation.
7. Analysis of industrial effluent for TDS, TSS and BOD (Demonstration).
8. Study of fauna in their natural habitats by visiting places of Zoological Parks and Biosphere Reserves.

ENTOMOLOGY

1. Taxonomy: Identification and Displaying of Insects.
2. Identification of different types of Mouth parts in insects.
3. Distinguishing characters of mosquitoes by using key characters.

4. Life cycle of Mosquitoes.
5. Life cycle of Silk moth.
6. Study of Termitarium
7. Medical Entomology: Medical importance of Rat Flea and House fly.
8. Control: Insecticide formulations and mixtures, common natural enemies of crop pests; Light Trap, Poison Bait.
9. Storage Entomology: Collection, identification and familiarization with the stored grains/seed insect pests and nature of damage caused by them.
10. Plant protection appliances: Dusters and sprayers.

PRACTICAL – IV
BIOPHYSICS, BIOSTATISTICS, BIOCHEMISTRY AND BIOINFORMATICS

Subject Code:	Core Practical –12	Marks: 100
Semester: III & IV	Credits: 4	No. of Hours per week: 6

Teaching Hours: 60

BIOPHYSICS

Demonstration:

1. Spectrophotometry: Principle and application
2. Electrophoresis: Description and applications.

BIOSTATISTICS

1. Problems relating to mean, mode and median.
2. Problems relating to standard deviation.
3. Problems relating to standard error.
4. Problems relating to Chi- square method for testing genetic ratios.

BIOCHEMISTRY

1. Estimation of protein by Lowry's method from fish tissues.
2. Estimation of carbohydrates by Anthrone method from fish tissues.
3. Estimation of lipids by Zak's method from fish tissues.
4. Amino acid detection by TLC method.
5. Blood: Clotting time and bleeding time.
6. Estimation of hemoglobin.
7. Erythrocyte Sedimentation Rate (ESR) – Chick.

BIOINFORMATICS

- a. Human Genome Project,
- b. Anatomy of the Eukaryotic and Prokaryotic Genome,
- c. Repetitive DNA Content of Genomes.
- d. Gene-protein relations, Mutational sites Complementation.
- e. Genome Mapping – Mapping Genomes, Genetic and Physical Maps, Sequencing Genomes.
- f. Methodology for DNA Sequencing
- g. Assembly of a Contiguous DNA Sequence, understanding a Genome Sequence, Locating the Genes in a Genome Sequence, Determining the Functions of Individual Genes

STUDY TOUR

Report on the physiological and ecological adaptations of animals through field visit.

SEMESTER - IV

SEMESTER-IV
BIOCHEMISTRY AND BIOINFORMATICS

Subject Code:	Core Paper: 12/ Theory	Marks: 100
Semester: IV	Credits: 4	No. of Hours per week: 4

Teaching Hours: 60

Course Objective: To train the students to apply the principles for a better understanding of biological phenomena and to impart knowledge. To understand the genome architecture with gene function and regulation. To provide students with the skills of genomic data analysis.

UNIT I **10 Hrs** Nature of living matter- Biomolecules, pH, Buffers. Enzymes –Mechanism of enzyme action, coenzymes, classification and functions of Isoenzymes, Apoenzymes, Holoenzymes – Enzyme kinetics.

UNIT II **10 Hrs** Biochemical pathways of energy use – Photosynthetic fixation of CO₂ – Biosynthesis of peptidoglycan – Biosynthesis of lipids – Biosynthesis of amino acids -proline, arginine, aspartic acid, histidine- Interconversions-threonine, isoleucine and methionine; isoleucine, valine and leucine; serine and lysine; Aspartate and pyruvate. Bio synthesis of purines and pyrimidines.

UNIT III **20 Hrs** Carbohydrate catabolism – Pentose phosphate pathway – ED pathway –Energy yield in Glycolysis and aerobic respiration – Anaerobic respiration – Lactic acid fermentation – Alcohol fermentation. Protein metabolism- Amino acid metabolism- Oxidative Deamination, Transamination, Decarboxylation, Demethylation Reaction. Lipids- Lipid metabolism-Metabolism of fatty acids and glycerol.

UNIT IV **10 Hrs** Overview of bioinformatics- database types. Genomics and human genome project. Computer tools for sequence analysis; finding and retrieving tools similarity searching. Transcriptomics: Introduction and Importance, Data collection and processing. Applications and Candidate genes. Significance of Transcriptomics. Different types of RNA transcripts and, Single-cell transcriptomics.

UNIT V **10 Hrs** Pair wise and multiple sequence alignment. Structure function relationships. DNA micro array. Next Generation Sequencing - traditional sequencing/Microarrays. Various NGS technologies/platforms. Experiment types and applications. Workflows for various NGS experiments (variant discovery and expression profiling). Algorithms and tools for NGS read alignment, SNP calling. Various file formats - SAM, VCF, BED, WIG, and PILEUP. DNA

sequence genetic variations. Whole genome sequencing. Target sequencing. Sequencing Map ability. Refined alignment. Base quality Recalibration. Variants identification. Four different workflows for mutation discovery (Cross Bow, Bowtie, BWA, MAQ).

TEXT BOOK:

- a. Ambika Shanmugam: Fundamentals of Biochemistry for Medical Students.
- b. Brown, T.A. 2002 Genome. John Wiley Press, US.
- c. Campbell, A.M. & Heyer, L.J. 2002 Discovering Genomics, Proteomics and Bioinformatics. Benjamin/Cummings.

REFERENCE BOOKS:

1. J.L. Jain: Fundamentals of biochemistry (1983).
2. Lehninger, A. L. (1970): Biochemistry, worth publishing co., N.Y.
3. Lubert stryer: Biochemistry- (1975) Freeman and co.
4. D.W. Martin, P.A.Mayer and V.W.Redwell:Harper''s Review of biochemistry 19th edition (1983). Maruyen Asian Edition.
5. Primrose and Twyman 2003 Principles of Genome Analysis & Genomics. Blackwell.
6. Pasternak 2000 An Introduction to Molecular Human Genetics. Fitzgerald.

RESEARCH METHODOLOGY

Subject Code:	Core Paper: 13/Theory	Marks: 100
Semester: IV	Credits: 4	No. of Hours per week: 4

Teaching Hrs: 45

Course Objective: To acquire the knowledge on research and use of various tools and techniques in research.

UNIT-I

5 Hrs

Research Methodology - An Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Importance of knowing how research is done, Research Process, Criteria of good research. Defining the Research Problem; Research Design; Sampling Design; Methods of Data Collection; Processing and Analysis of Data; Sampling Fundamentals; Testing of Hypothesis.

UNIT-II

10 Hrs

Molecular biology methods: *In vitro* mutagenesis and deletion techniques, Gene knock out in bacterial and eukaryotic organisms; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques; isolation separation and analysis of carbohydrate and lipid molecules.

Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

UNIT-III

10 Hrs

Histochemical and immunotechniques: Flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

UNIT-IV

10 Hrs

Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Summary, Acknowledgements and Bibliography, Impact factor of Journals, When and where to publish and Research ethics: Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook. UGC care listed journals, Scopus index, Web of science and H – index.

UNIT-V**10 Hrs**

Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism Biopiracy.

TEXT BOOK:

1. Gurumani: A text Book of Research Methodology.

REFERENCE BOOKS:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R. Kothari
4. Select references from the Internet

APPLIED ZOOLOGY

Subject Code:	Elective Paper: 5 / Theory	Marks: 100
Semester: IV	Credits: 4	No. of Hours per week: 4

Teaching Hours: 45

Course Objectives:

To encourage young learners to take up the small scale industries; generate motivation for Self-Employment; disseminate information on economic aspects of Zoology; inculcate knowledge on useful animals to Mankind; satisfy the learners with modern techniques of Animal culture.

UNIT – I

5 Hrs

Sericulture:

Life cycle of Bombyx mori, Structure of silk gland and secretion of silk Silkworm rearing technology. Spinning, harvesting and storage of cocoons. Silk worm Pests and Diseases: Uzi fly; Protozoan, Viral, Fungal and Bacterial; Control and prevention. Prospects of Sericulture in India.

UNIT – II

10 Hrs

Apiculture:

Selection of Bee Species for Apiculture. Bee Keeping Equipment. Methods of Extraction of Honey (Indigenous and Modern). Bee Diseases and Enemies. Products of Apiculture Industry and its Uses (Honey, Bees Wax).

UNIT – III

10 Hrs

Vermiculture:

Introduction of Vermiculture and Vermicomposting. Vermiculture techniques. Bedding, Essential parameters for Vermiculture and Management Methods of Harvesting (Manual & Mechanical). Economic Importance of Vermiculture.

UNIT – IV

10 Hrs

Poultry Farming:

Classification of Fowls based on their use – Broilers and Commercial layers. Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs. Poultry diseases - Viral, Bacterial, Fungal, Protozoan Management of a modern Poultry Farm, progressive plans to promote Poultry as a Self- Employment venture.

UNIT – V

10 Hrs

Dairy farm and its management:

Animal Husbandry – Genetic Improvement for best breeds - Preservation of semen, artificial insemination of cattle, Induction of early puberty and synchronization of estrus in cattle. Economic importance of Dairy, Leather, Wool, Fur and Pharmaceutical Industries in India - Transgenic Animal Technology.

TEXT BOOKS:

1. Jawaid Ahsan and Subhas Prasad Sinha, 2000 A Handbook on Economic Zoology-ISBN-81-219-0876-O. S. Chand & Co., Ltd., New Delhi.
2. Ashok Kumar and Prem mohan Nigam, 1991, Economic and Applied Entomology Emkay Publications, New Delhi.

3. Banerjee, G.C. 1992, Poultry – III- Edition – ISBN-81-204-008-4. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Kaushish, S.K., 2001, Trends in Livestock Research – ISBN-81-7754-112-9. Agrobios (India), Jodhpur – India.

REFERENCE BOOKS:

1. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore
3. Ranganathan L.S, Vermicomposting technology- soil health to human health
4. Keith Wilson, N.D.P., 2005. A Handbook of Poultry Practice – ISBN-81-7754-O-69-6 Agrobios (India), Jodhpur – India.
5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.

WILD LIFE MANAGEMENT

Subject Code:	Extra Disciplinary: 1	Marks: 100
Semester: II	Credits: 3	No. of Hours per week: 3

Teaching Hrs: 45

Course Objectives: To acquire the knowledge conservation of biosphere reserve and its fauna and flora.

UNIT-I

10 Hrs

Wildlife habitat ecology: Biomes of the world – an overview; biome types of India: alpine tundra, grassland, forest, desert, aquatic and wetlands (unique features, distribution, vegetation, faunal make up and adaptations). Forest types of India.

Protected area concept: Protected area network in India; Design and management of nature reserve; concept of corridor; joint forest management.

UNIT-II

10 Hrs

Conservation biology of important wild animals: Conservation status, habit & habitat, behavioral biology, threats and conservation management of the following animals. Himalayan salamander / Olive ridley turtles / Great Indian bustard / Himalayan musk deer/ Greater one-horned rhinoceros / Fishing cat / Ganges river dolphin.

UNIT-III

10 Hrs

Basic Concept of Wildlife Biology: Definition and importance of wildlife; Wildlife wealth of India; Threatened wildlife and IUCN status - Concept of Extinct, Critically Endangered, Endangered, Vulnerable and rare species; Red data book.

Wildlife conservation Indian perspective: Aims & Objectives of wildlife conservation. A brief idea about Indian wildlife, causes for depletion of Indian wildlife; wildlife conservation in India-through age, post-independence initiatives. Different approaches for conservation – *in situ* and *ex situ*, Conservation breeding; Threats to wildlife conservation in India.

UNIT-IV

10 Hrs

Protected Area Concept: In situ conservation- problems and prospects; Sanctuaries, National parks, Community Reserves and Conservation Reserves; Biosphere Reserve, Case studies - Sundarbans Biosphere Reserve.

Wildlife Habitat Ecology: Concept of Biome, Biome types of India –a general account. Case studies: Tropical rain forest – characteristics, faunal make up and animal adaptations.

UNIT-V

5 Hrs

Wildlife sampling: random sampling, systematic sampling, stratified sampling, cluster sampling. Population estimation using Mark-recapture method, Transects; GPS use. Introduction to radio

telemetry, Larger mammal population estimation techniques. Remote sensing – aerial photography – satellite images – thermal, infra – red, radar images, ecological applications.

Peoples' participation in wildlife activities: Community participation in conservation; JFM.

TEXT BOOKS:

1. Simmons, I.G. (1981). The Ecology of Natural Resources (II Edn), Edward Arnold Publishers. Ltd., Bedford Square, London.
2. Kapoor, V.C. (1995). Theory and Practice of Animal Taxonomy (III Edn) Oxford and IBH Publishing Co., New Delhi

REFERENCE BOOKS:

1. Global Biodiversity strategy (1992). Report by World Resources Institute (WRI). The World Conservation Union, and United Nations Environment Programme (UNEP).
2. Sinha, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.
3. Solbrig, O.T., Van Emden, H.M., and Van Oort, P.G.W.J. (1995). Biodiversity and Global change. CAB International, Wallingford, U.K.

PUBLIC HEALTH AND HYGIENE

Subject Code:	Extra Disciplinary: 2 / Theory	Marks: 100
Semester: III	Credits: 3	No. of Hours per week: 3

Teaching Hrs: 45

Course Objectives:

To enlighten the students about the general knowledge on their health and hygiene. To create general health awareness the hazardous impacts and remedy.

UNIT I

5 Hrs

Scope of Public health and Hygiene – nutrition and health – classification of foods – Nutritional deficiency diseases- Vitamin deficiency diseases.

UNIT II

10 Hrs

Environment and Health hazards: Environmental degradation – Pollution – Air, Water, Land and Noise-associated health hazards.

UNIT III

10 Hrs

Communicable diseases and their preventive and control measures. Measles, Malaria, Hepatitis, Cholera, Filariasis, HIV /AIDS.

UNIT IV

10 Hrs

Non-Communicable diseases and their preventive measures. Genetic diseases, Cancer, Cardio vascular diseases, Chronic respiratory disease, Diabetes, Epilepsy.

UNIT V

10 Hrs

Health Education in India – WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on epidemic, endemic, Pandemic and sporadic diseases.

TEXT BOOKS:

1. Park and Park, 1995: Text Book of Preventive and Social Medicine – Banarsidas Bhanot Publ. Jodhpur – India.

REFERENCE BOOKS:

1. Verma, S. 1998: Medical Zoology, Rastogi publ. – Meerut – India
2. Singh, H.S. and Rastogi, P. 2009: Parasitology, Rastogi Publ. India.
3. Dubey, R.C and Maheswari, D.K. 2007: Text Book of Microbiology- S. Chand & Co. Publ. New Delhi – India.