Maharaja's College Ernakulam

A GOVERNMENT AUTONOMOUS COLLEGE

Re-Accredited by NAAC with 'A Grade'
Affiliated to Mahatma Gandhi University
Centre of Excellence under Govt. of Kerala
Identified by UGC as College with Potential for Excellence

POST GRADUATE AND RESEARCH

DEPARTMENT OF ZOOLOGY

Estd. 1875

Post Graduate Curriculum and Syllabus

(Credit Semester System)

M.Sc. ZOOLOGY

For 2022 Admission Onwards

Maharaja's College, Ernakulam

A Government Autonomous College

Affiliated to Mahatma Gandhi University, Kottayam

Post Graduate Programme in Zoology with Entomology

w.e.f. 2022 Admission Onwards

Board of Studies

Sl. No.	Name of Member	Designation
1	**Dr. Rema.L.P**	Chairperson, BOS
2	**Dr.Abraham Samuel**	External Member
3	**Prof. P. Radhakrishnan**	External Member
4	**Dr.M.H.Shyla**	Internal Member
5	**Dr. Sunish.K.S**	Internal Member
6	**Smt. Anitha Abraham**	Internal Member
7	**Dr. Prakasan.K**	Internal Member
8	**Smt.Dhanya Balakrishnan**	Internal Member
9	**Smt. Sandhya Krishnan.K.R**	Internal Member
10	**Smt. Sharmila.P.S**	Internal Member

REGULATIONS OF THE

MAHARAJA'S COLLEGE

(Government Autonomous)

POST GRADUATE PROGRAMMES

UNDER CREDIT SEMESTER SYSTEM, 2022

(MC-PGP-CSS2022)

REGULATIONS OF THE POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER

SYSTEM, 2022

(MCPGPCSS 2022

SHORT TITLE

1.1. These Regulations shall be called Maharaja's College (Government Autonomous) Regulations(2022) governing Post Graduate Programmes under Credit Semester System (MC-PGP-CSS2022)

1.2. These Regulations shall come into force from the Academic Year 2022- 2023.

2. SCOPE

2.1. The regulation provided herein shall apply to all Post- graduate programmes from the academic year 2022-2023 admission.

2.2. The provisions herein supersede all the existing regulations for the regular post-graduate programmes conducted in Maharaja's College unless otherwise specified.

3. DEFINITIONS

3.1. **Academic Committee'** means the Committee constituted by the Principal under this regulation to monitor the running of the Post-Graduate programmes under the Credit Semester System (MC-PGP-CSS2022).

3.2 **Academic Week'** is a unit of five working days in which distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day. A sequence of minimum of 18 such academic weeks constitute asemester.

3.2. **Audit Course'** is a course for which no credits are awarded.

3.3. **CE' means Continuous Evaluation (Internal Evaluation)**

3.4. **College Co-ordinator'** means a teacher from the college nominated by the College Council to look into the matters relating to MC-PGP-CSS 2022 for programmes conducted in the College.

3.5. **Comprehensive viva-voce'** means the oral examinations conducted by the appointed examiners and shall cover all courses of study undergone by a student for the programme.

3.6. **Common Course'** is a core course which is included in more than one programme with the same course code.

3.7. **Core course'** means a course which cannot be substituted by any other course.

3.8. **'Course'** means a segment of subject matter to be covered in a semester. Each Course is to be designed variously under lectures / tutorials / laboratory or fieldwork /seminar / project / practical training / assignments / viva-voce etc., to meet effective teaching and learning needs.

3.9. **'Course Code'** means a unique alpha numeric code assigned to each course of a programme.

3.10. **Course Credit'** One credit of the course is defined as a minimum of one hour lecture /minimum of 2 hours lab/field work per week for 18 weeks in a Semester. The course will be considered as completed only by conducting the final examination.'

3.11. **Course Teacher'** means the teacher of the institution in charge of the course offered in the programme.

3.12. **Credit (Cr)'** of a course is a numerical value which depicts the measure of the weekly unit of work assigned for that course in a semester.

3.13. **Credit point (CP)'** of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course CP = GP x Cr.

3.14. **Cumulative Grade point average' (CGPA)** is the value obtained by dividing the sum of credit points of all the courses taken by the student

for the entire programme by the total number of credits and shall be rounded off to two decimal places. CGPA determines the overall performance ofa student at the end ofa programme.

(CGPA = Total CP obtained / Total credits of the programme)

3.15. **'Department'** means any teaching Department in the college.

3.16. **'Department Council'** means the body of all teachers of a Department in aCollege.

3.17. **'Dissertation'** means a long document on a particular subject in connection with the project /research/ field work etc.

3.18. **'Duration of Programme'** means the period of time required for the conduct of the programme. The duration of post-graduate programme shall be 4 semesters spread over two academic years.

3.19. **'Elective course'** means a course, which can be substituted, by an equivalent course from the same subject.

3.20. **'Elective Group'** means a group consisting of elective courses for the programme.

3.21. '**ESE**' means End Semester Evaluation (External Evaluation).

3.22. **'Evaluation'** is the process by which the knowledge acquired by the student is quantified as per the criteria detailed in these regulations.

3.23. **'External Examiner** ' is the teacher appointed from other colleges for the valuation of courses of study undergone by the students in a College. The external examiner shall be appointed bythe University.

3.24. **'Faculty Advisor'** is a teacher nominated by the Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department of the College.

3.25. **'Grace Grade Points'** means grade points awarded to course(s), in recognition of the students' meritorious achievements in NSS/ Sports/ Arts and cultural activities etc.

3.26. **'Grade point'** (GP)-Each letter grade is assigned a 'Grade point' (GP) which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

3.27. **'Grade Point Average (GPA)'** is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points obtained in the course by the sum of the weights of the Course **(GPA =ΣWGP / ΣMW).**

3.28. **'Improvement course'** is a course registered by a student for improving his performance in that particular course.

3.29. **'Internal Examiner'** is a teacher nominated by the department concerned to conduct Internal evaluation.

3.30. **'Letter Grade' or 'Grade'** for a course is a letter symbol (A+,A,B+,B,C+,C,D) which indicates the broad level of performance of a student for a course.

3.31. **MC-PGP-CSS2022 means Maharaja's College (Government Autonomous) Regulations Governing Post Graduate programmes under Credit Semester System, 2022.**

3.32. **'Parent Department'** means the Department which offers a particular postgraduate programme.

3.33. **'Plagiarism'** is the unreferenced use of other authors' material in dissertations and assignments and is a serious academic offence.

3.34. **'Programme'** means the entire course of study and examinations.

3.35. **'Project'** is a core course in a proramme. It means a regular project work with stated credits on which the student undergo a project under the supervision of a teacher in the parent department / any appropriate research center in order to submit a dissertation on the project work as specified. It allows students to work more autonomously to construct their own learning and culminates in realistic, student-generated products or findings.

3.36. **'Repeat course'** is a course that is repeated by a student for having failed in that course in an earlier registration.

3.37. **'Semester'** means a term consisting of a minimum of 90 working days, inclusive of examinations, distributed over a minimum of 18 weeks of 5 working days each.

3.38. **'Seminar'** means a lecture given by the student on a selected topic and is expected to train the student in self-study, collection of relevant matter from various resources, editing, document writing and presentation.

3.39. **'Semester Grade Point Average' (SGPA)** is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits for the course in that semester. The SGPA shall be rounded off to two decimal places. SGPA determines the overall performance ofa student at the end of a semester **(SGPA = Total CP obtained in the semester / Total Credits for the semester).**

3.40. **'Tutorial'** Tutorial means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

3.41. **'University'** means Mahatma Gandhi University, Kottayam, Kerala.

3.42. **'Weight'** is a numeric measure assigned to the assessment units of various components of a course of study.

3.43. **'Weighted Grade Point' (WGP)** is the grade point multiplied by weight.

(WGP = GP xW).

3.44. **'Weighted Grade Point Average (WGPA)' is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points by the sum of the weights. WGPA shall be obtained for CE(Continuous Evaluation) and ESE(End Semester Evaluation) separately and then the combined WGPA shall be obtained for each course.**

3.45. **'Internship'** means gain a professional work experience

4. ACADEMIC COMMITTEE

4.1. There shall be an Academic Committee constituted by the Principal to manage and monitor the working of MC-PGP-CSS2022.

4.2. The Committee consists of

(a) Principal

(b) Vice-Principal

(c) Secretary, Academic Council

(d) The Controller of Examinations

(e) Two Teachers nominated from among the College Council

4.3. There shall be a subcommittee nominated by the Principal to look after the day-to-day affairs of the Regulations for Post Graduate Programmes under MC-PGP-CSS2022.

5. PROGRAMME STRUCTURE

5.1. Students shall be admitted to post graduate programme under the various faculties. The programme shall include three types of courses, Core Courses, Elective Courses and Common core courses. There shall be a project with dissertation and comprehensive viva-voce as core courses for all programmes. The programme shall also include assignments / seminars / practicals etc.

5.2. No regular student shall register for more than 25 credits and less than 16 credits per semester unless otherwise specified. The total minimum credits, required for completing a PG programme is 80.

5.3. Elective courses and Groups

5.3.1. There shall be at least two and not more than four elective groups(Group A, Group B, Group C, etc.) comprising of three courses each for a programme and these elective courses shall be included either in fourth semester or be distributed among third and fourth semesters. This clause is not applicable for programmes defined by the Expert Committees of Music and Performing Arts.

5.3.2. The number of elective courses assigned for study in a particular semester shall be the same across all elective groups for the programme concerned.

5.3.3. The colleges shall select any one of the elective groups for each programme as per the interest of the students, availability of faculty and academic infrastructure in the institution.

5.3.4. The selection of courses from different elective groups is not permitted.

5.3.5. The elective groups selected by the College shall be intimated to the Controller of Examinations within two weeks of commencement of the semester in which the elective courses are offered. The elective group

selected by the college for the students who are admitted in a particular academic year shall not be changed.

5.4. Project work

5.4.1. Project work shall be completed in accordance with the guidelines given in the curriculum.

5.4.2. Project work shall be carried out under the supervision of a teacher of the department concerned.

5.4.3. A candidate may, however, in certain cases be permitted to work on the project in an Industrial/Research Organization on the recommendation of the supervising teacher.

5.4.4. There shall be an internal assessment and external assessment for the project work.

5.4.5. The Project work shall be evaluated based on the presentation of the project work done by the student, the dissertation submitted and the viva-voce on the project.

5.4.6. The external evaluation of project work shall be conducted by two external examiners from different colleges and an internal examiner from the college concerned.

5.4.7. The final Grade of the project (External) shall be calculated by taking the average of the Weighted Grade Points given by the two external examiners and the internal examiner.

5.5. **Assignments:** Every college going student shall submit atleast one assignment as an internal component for each course.

5.6. **Seminar Lecture:** Every regular student shall deliver one seminar lecture as an internal component for every course with a weightage of two. The seminar lecture is expected to train the student in self-study, collection of relevant matter from the various resources, editing, document writing, and presentation.

5.7. **Test Papers(Internal):** Every regular student shall undergo at least two class tests as an internal component for each course with a weightage of one each. The best two shall be taken for awarding the grade for class tests.

5.8. No courses shall have more than 5 credits unless otherwise specified.

5.9. **Comprehensive Viva-Voce** -Comprehensive Viva-Voce shall be conducted at the end of fourth semester of the programme and its evaluation shall be conducted by the examiners of the project evaluation.

5.9.1. **Comprehensive Viva-Voce** shall cover questions from all courses in the programme.

5.9.2. There shall be an internal assessment and an external assessment for the comprehensive Viva-Voce.

6. ATTENDANCE

6.1. The minimum requirement of aggregate attendance during a semester for appearing at the end-semester examination shall be 75%. Condonation of shortage of attendance to a maximum of 15 days in a semester subject to a maximum of two times during the whole period of the programme may be granted by the Principal.

6.2. If a student represents his/her institution, University, State or Nation in Sports, NCC, or Cultural or any other officially sponsored activities such as college union / university union etc., he/she shall be eligible to claim the attendance for the actual number of days participated subject to a maximum 15 days in a Semester based on the specific recommendations of the Head of the Department or teacher concerned.

6.3. Those who could not register for the examination of a particular semester due to shortage of attendance may repeat the semester along with junior batches, without considering sanctioned strength, subject to the existing University Rules and Clause 7.2.

6.4. A Regular student who has undergone a programme of study under earlier regulation / Scheme and could not complete the Programme due to shortage of attendance may repeat the semester along with the regular batch subject to the condition that he has to undergo all the examinations of the previous semesters as per the MC-PGP-CSS2022 regulations and conditions specified in 6.3.

6.5. A student who had sufficient attendance and could not register for fourth semester examination can appear for the end semester examination in the subsequent years with the attendance and progress report from the Principal.

7. REGISTRATION / DURATION

7.1. A student shall be permitted to register for the programme at the time of admission.

7.2. A student who has registered for the programme shall complete the programme within a period of four years from the date of commencement of the programme.

8. ADMISSION

8.1. The admission to all regular PG programmes shall be through PG-CAP (Centralized Allotment Process) of the Maharaja's College unless otherwise specified.

8.2. The eligibility criteria for admission to PG Programmes shall be published by the Maharaja's College along with the notification for admission.

9. ADMISSION REQUIREMENTS

9.1 Candidates for admission to the first semester of the PG programme through CSS shall be required to have passed an appropriate Degree Examination recognized by Mahatma Gandhi University as specified or any other examination of any recognized University or authority accepted by the Academic council of Mahatma Gandhi University as eligible thereto.

9.2 Students admitted under this programme are governed by the Regulations in force.

10. PROMOTION:

10.1. A student who registers for a particular semester examination shall be promoted to the next semester.

10.2. A student having 75% attendance and who fails to register for examination of a particular semester will be allowed to register notionally and is promoted to the next semester, provided application for notional registration shall be submitted within 15 days from the commencement of the next semester.

10.3. The medium of Instruction shall be English except programmes under faculty of Language and Literature.

11. EXAMINATIONS

11.1. There shall be End Semester Examinations at the end of each semester.

11.2. Practical examinations shall be conducted by the College at the end of each semester or at the end of even semesters as prescribed in the syllabus of the particular programme. The number of examiners for the practical examinations shall be prescribed by the Board of Studies of the programmes subjected to the approval of the Academic Council of the College.

11.3. End-Semester Examinations: The examinations shall normally be conducted at the end of each semester for regular students.

11.4. There shall be one end-semester examination of 3 hours duration for each lecture based and practical courses.

11.5. A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Different types of questions shall have different weightage.

12. EVALUATION AND GRADING

12.1. **Evaluation**: The evaluation scheme for each course shall contain two parts; (a) End Semester Evaluation(ESE) (External Evaluation) and (b) Continuous Evaluation(CE)(Internal Evaluation). 25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is 1:3. Both End Semester Evaluation(ESE) and Continuous Evaluation(CE) shall be carried out using direct grading system.

12.2. **Direct Grading:** The direct grading for CE (Internal) and ESE (External Evaluation) shall be based on 6 letter grades (A+, A, B, C, D and E) with numerical values of 5, 4,3,2, 1 and 0 respectively**.**

12.3. **Grade Point Average (GPA):** Internal and External components are separately graded and the combined grade point with weightage 1 for internal and 3 for external shall be applied to calculate the Grade Point Average (GPA) of each course. Letter grade shall be assigned to each course based on the categorization provided in12.15.

12.4. **Internal evaluation for Regular programme: The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars, lab skills, records, viva-voce etc.**

12.5. **Components of Internal** (CE) **and External Evaluation(ESE):** Grades shall be given to the evaluation of theory / practical / project / comprehensive viva-voce and all internal evaluations are based on the Direct Grading System.

Proper guidelines shall be prepared by the BoS for evaluating the assignment, seminar, practical, project and comprehensive viva- voce within the framework of the regulation.

12.6. There shall be no separate **minimum grade point for** internal evaluation.

12.7. The model of the components and its weightages for Continuous Evaluation(CE) and End Semester Evaluation(ESE) are shown in below:

a) For Theory (CE) (Internal)

	Components	**Weightage**
i.	Assignment	1
ii.	Seminar	2
iii.	Best Two Test papers	2(1 each)
Total		**5**

(Grades of best two test papers shall be considered. For test papers all questions shall be set in such a way that the answers can be awarded A+, A, B, C, D and E grade)

b) For theory (ESE) External Evaluation is based on the pattern of questions specified in 12.15.5

c) For Practical (CE) Internal

Components	**Weightage**
Written/Lab test	2
Lab involvement and Record	1
Viva	2
Total	**5**

(The components and the weightage of the components of the practical (Internal) can be modified by the concerned BOS without changing the total weightage 5**)**

d) For Practical (ESE) External

Components	Weightage
Written / Lab test	7
Lab involvement and Record	3
Viva	5
Total	**15**

(The components and the weightage of the components of the practical (Internal) can be modified by the concerned BOS without changing the total weightage 15**)**

e. For Project (CE) Internal

(The components and the weightage of the components of the practical (Internal) can be modified by the concerned BOS without changing the total weightage 5**)**

A two stage Internal evaluation to be followed for the fruitful completion of the project.

f) For Project (ECE) External

Components	Weightage
Relevance of the topic andanalysis	3
Project content and presentation	7
Project viva	5
Total	**15**

(The components and the weightage of the components of the Project (External) can be modified by the concerned BoS without changing the total weightage 15**)**

g) Comprehensive viva-voce

Components	Internal (CE) Weight	External (ESE) Weight
Basic knowledge and Presentation skills	1	3
Topic of interest	1	3
Knowledge of core courses	3	9
Total	**5**	**15**

These basic components can be subdivided if necessary. Total as well as component weightage shall not be changed.

12.8. All grade point averages shall be rounded to two digits.

12.9. To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination.

12.10. There shall not be any chance for improvement for internal grade.

12.11. The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the University through the Principal and a copy should be kept in the college for verification for at least two years after the student completes the programme.

12.12. External Evaluation. The external examination in theory courses is to be conducted by the University at the end of the semester. The answers may be written in English or Malayalam except those for the Faculty of Languages. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination preferably through Centralized Valuation.

12.13. Photocopies of the answer scripts of the external examination shall

be made available to the students on request as per the rules prevailing in the College/University.

12.14. The question paper should be strictly on the basis of model question paper set and directions prescribed by the BoS.

12.15. Pattern of Questions

12.15.1. Questions shall be set to assess knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. Due weightage shall be given to each module based on content/teaching hours allotted to each module.

12.15.2. The question setter shall ensure that questions covering all skills are set.

12.15.3. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

12.15.4. The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E grades.

12.15.5. Weight: Different types of questions shall be given different weights to quantify their range as follows:

Sl. No.	Type of Questions	Weight	Number of questions to beanswered
1.	Short Answer type questions	1	8 out of 10
2	Short essay/ problem solving type questions	2	6 out of 8
3.	Long Essay type questions	5	2 out of 4

12.16. Pattern of question for practical. The pattern of questions for external evaluation of practical shall be prescribed by the Board of Studies.

12.17. Direct Grading System. Direct Grading System based on a 6— point scale is used to evaluate the Internal and External examinations taken by the students for various courses of study.

Grade	Grade Points	Range
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

12.18. Performance Grading. Students are graded based on their performance (GPA/SGPA/CGPA) at the examination on a 7-point scale as detailed below.

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good(Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal(pass)
up to 1.99	D	Deficient(Fail)

12.19. No separate minimum is required for internal evaluation for a pass, but a minimum C grade is required for a pass in an external evaluation. However, a minimum C grade is required for pass in a course.

12.20. A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.

12.21. Improvement of Course- The candidates who wish to improve the grade / grade point of the external examination of a course / courses he/ she has passed can do the same by appearing in the external examination of the semester concerned along with the immediate junior batch. **This facility is restricted to first and second semesters of the programme.**

12.22. One Time Betterment Programme - A candidate will be permitted to improve the CGPA of the programme within a continuous period of four semesters immediately following the completion of the programme allowing only once for a particular semester. The CGPA for the betterment appearance will be computed based on the SGPA secured in the original or betterment appearance of each semester whichever is higher. If a candidate opts for the betterment of CGPA of a programme, he/she has to appear for the external examination of the entire semester(s) excluding practicals / project/ comprehensive viva-voce. One time betterment programme is restricted to students who have passed in all courses of the programme at the regular (First appearance).

12.23. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) Calculations. The SGPA is the ratio of sum of the credit points of all courses taken by a student in the semester to the total credit for that semester. After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below.

Semester Grade Point Average -SGPA (S_j) = $\Sigma(C_i \times G_i) / \Sigma(C_i$

(SGPA= Total credit Points awarded in a semester / Total credits of the semester)

Where 'Sj' is the j semester, 'Gi ' is the grade point scored by the Student in the 'i' course 'q' is the credit of the i^{th} course.

12.24 Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula:-

Cumulative Grade Point Average (CGPA) = $\Sigma((C_i \times S_i) / \Sigma(C_i$

(CGPA= Total credit points awarded in all semesters / Total credits

Where 'CI' is the credits for the 'i' semester 'Si' is the SGPA for the i^{th} semester. The SGPA and CGPA shall be rounded off to 2 decimal points. For the successful completion of semester, a student shall pass all courses and score a minimum SGPA of 2.0.However, a student is permitted to move to the next semester irrespective of her/his SGPA.

13. GRADE CARD

13.1 The University under its seal shall issue to the students, a consolidated grade

card on completion of the programme, which shall contain the following information.

- Name of College
- Title of the PG Programme.
- Name of the Semesters
- Name and Register Number of the student
- Code, Title, Credits and Max GPA (Internal, External & Total) of each course (theory& Practical), project, viva etc. in each semester.
- Internal, external and total grade, Grade Point (G), Letter Grade and Credit Point (P) in each course opted in the semester.
- The total credits and total credit points in each semester.
- Semester Grade Point Average (SGPA) and corresponding Grade in each semester
- Cumulative Grade Point Average (CGPA), Grade for the entire programme.
- Separate Grade card will be issued at the request of candidates and based on University Guidelines issued from time to time.
- Details of description ofevaluation process- Grade and Grade Point as well as indicators, calculation methodology ofSGPA and CGPA as well as conversion scale shall be shown on the reverse side of the grade card.

14. AWARD OF DEGREE

The successful completion of all the courses with 'C' grade within the stipulated period shall be the minimum requirement for the award of the degree.

15. MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Vice- chancellor to monitor the internal evaluations conducted by institutions.

16. RANK CERTIFICATE

The College shall publish the list of top 10 candidates for each programme after the publication of the programme results. Rank certificate shall be issued to candidates who secure positions from 1st to 3rd in the list. Position certificate shall be issued to candidates on theirrequest.

Candidates shall be ranked in the order of merit based on the CGPA secured by them. Grace grade points awarded to the students shall not be counted for fixing the rank/position. Rank certificate and position certificate shall be signed by the Controller of Examinations.

17. GRIEVANCE REDRESSAL COMMITTEE

17.1 **Department level:** The College shall form a Grievance Redressal Committee in each Department comprising of the course teacher and one senior teacher as members and the Head of the Department as Chairperson. The Committee shall address all grievances relating to theinternal assessment grades of the students.

17.2. **College level:** There shall be a college level Grievance Redressal Committee comprising of faculty advisor, college co-ordinator, one senior teacher and one staff council member and the Principal as Chairperson.

18. REPEAL

The Regulations now in force in so far as they are applicable to programmes offered by the College and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the existing regulations and these regulations relating to the Credit Semester System in their application to any course offered in a College, the latter shall prevail.

19. Credits allotted for Programmes and Courses

19.1 Total credit for each programme shall be 80.

19.2 Semester-wise total credit can vary from 16 to 25

19.3 The minimum credit of a course is 2 and maximum credit is 5.

20. Common Course: If a course is included as a common course in more than one programme, its credit shall be same for all programmes.

21. Course codes: The course codes assigned for all courses (core courses, elective courses, common courses etc.) shall be unique.

22. Models of distribution of courses, course codes, type of the course, credits, teaching hours for a programme are given in the following tables.

Programmes with practical -Total Credits 80- Scheme of the Syllabus

Semester	Course-code	Course name	Type ofthe course	TeachingHours Per Week	Credit	Total Credits
I	Course.code1	Name1	core	4	4	19
	Course.code2	Name2	core	4	4	
	Course.code3	Name3	core	4	4	
	Course.code4	Name4	core	3	3	
	Practical Course.code5	Name5	core	10	4	
II	Course.code6	Name6	core	4	4	20
	Course.code7	Name7	core	4	4	
	Course.code8	Name8	core	4	4	
	Course.code9	Name9	core	3	4	
	Practical-Course.code10	Name10	core	10	4	
III	Course.code11	Name11	core	4	4	20
	Course.code12	Name12	core	4	4	
	Course.code13	Name13	core	4	4	
	Course.code14	Name14	core	3	4	

	Practical Course.code15	Name15	core	10	4	
IV	Course.code16	Name16	Elective	5	3	21
	Course.code17	Name17	Elective	5	3	
	Course.code18	Name18	Elective	5	3	
	Practical- Course.code19	Name19	core	10	5	
	Project- Course.code20	Name20	core		5	
	Comprehensive viva- voce - Course.code 21	Name 21	core		2	
	Total					**80**

Programmes without practical -Total Credits 80- Scheme of the Syllabus

Semester	Course. code	Course. name	Type of the course	Teaching Hours per week	Credit	Total Credits
I	Course.code1	Name 1	core	5	4	20
	Course.code2	Name 2	core	5	4	
	Course.code3	Name 3	core	5	4	
	Course.code4	Name 4	core	5	4	
	Course.code5	Name 5	core	5	4	
II	Course.code6	Name 6	core	5	4	20
	Course.code7	Name 7	core	5	4	
	Course.code8	Name 8	core	5	4	
	Course.code9	Name 9	core	5	4	
	Course.code10	Name 10	core	5	4	
III	Course.code11	Name 11	core	5	4	20
	Course.code12	Name 12	core	5	4	
	Course.code13	Name 13	core	5	4	
	Course.code1	Name	core	5	4	

	4	14				
	Course.code15	Name 15	core	5	4	
IV	Course.code16	Name 16	Elective	5	3	20
	Course.code17	Name 17	Elective	5	3	
	Course.code18	Name 18	Elective	5	3	
	Course.code19	Name 19	core	5	4	
	Project-Course.code 20	Name 20	core	5	5	
	Comprehensive viva-voce-Course.code21	Name 21	core		2	
	Total					**80**

Appendix

1. Evaluation first stage – Both internal and external (to be done by the teacher)

Grade	Grade Points	Range
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

The final Grade range for courses, SGPA and CGPA

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal
Upto 1.99	D	Deficient(Fail)

Theory External (ESE)

Maximum weight for external evaluation is 30. Therefore maximum Weighted Grade Point (WGP) is 150.

Type of Question	Qn. No's	Grade Awarded	Grade point	Weights	Weighted Grade Point
Short Answer	1	A+	5	1	5
	2	-	-	-	-
	3	A	4	1	4
	4	C	2	1	2
	5	A	4	1	4
	6	A	4	1	4
	7	B	3	1	3
	8	A	4	1	4
	9	B	3	1	3
	10	-	-	-	
Short Essay	11	B	3	2	6
	12	A+	5	2	10
	13	A	4	2	8
	14	A+	5	2	10
	15	-	-	-	-
	16	-	-	-	-
	17	A	4	2	8
	18	B	3	2	6
Long Essay	20	A+	5	5	25
	21	-	-	-	-
	22	-	-	-	-
	23	B	3	5	15
			TOTAL	**30**	**117**
Calculation : **Overall Grade of the theory paper = Sum of Weighted Grade Points /Total weight 117/30 = 3.90 = Grade B**					

Theory – Internal (CE)

Maximum Weight for internal evaluation is 5. *ie*., maximum WGP is 25

Components	Weight (W)	Grade Awarded	Grade Point (GP)	WGP=W*GP	Overall Grade of the course
Assignment	1	A	4	4	**WGP/Total weight = 24/5 =4.8**
Seminar	2	A+	5	10	
Test paper 1	1	A+	5	5	
Test paper 2	1	A+	5	5	
Total	**5**			**24**	**A +**

Practical-External-ESE

Maximum weight for external evaluation is 15.

Therefore Maximum Weighted Grade Point (WGP) is 75.

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Written/Lab test	7	A	4	28	**WGP/Total weight = 58 / 15 = 3.86**
Lab involvement & record	3	A+	5	15	
viva	5	B	3	15	
Total	**15**			**58**	**B**

Practical-Internal-CE

Maximum weight for internal evaluation is 5.

Therefore Maximum Weighted Grade point (WGP) is 25.

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Written/ Labtest	2	A	4	8	**WGP/Total weight =17/5=3.40**
Lab involvement & record	1	A+	5	5	
viva	2	C	2	4	
Total	**5**			**17**	**B**

Project-External-ESE

Maximum weight for external evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) is 75.

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Relevance of the topic & Analysis	2	C	2	4	**WGP/Total weight = 59/15=3.93**
Project content & presentation	8	A+	5	40	
Project viva-voce	5	B	3	15	
Total	**15**			**59**	**B**

Project-Internal-CE

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the course
Relevance of the topic & Analysis	2	B	3	6	**WGP/Total weight = 21/5 = 4.2**
Project content & presentation	2	A+	5	10	
Project viva-voce	1	A+	5	5	
Total	**5**			**21**	**A**

Comprehensive viva-voce-External-ESE.

Maximum weight for external evaluation is 1.5. Therefore Maximum Weighted Grade Point (WGP) is 75.

Comprehensive viva voce-Internal-CE

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	Internal (CE) Weight	External (ESE) Weight
Basic knowledge and Presentation skills	1	3
Topic of interest	1	3
Knowledge of core courses	3	9
Total	**5**	**15**

These basic components can be subdivided if necessary

2. Evaluation - second stage -

Consolidation of the Grade(GPA) of a Course PC-I.

The End Semester Evaluation(ESE) (External evaluation) grade awarded for the course PC-I is A and its Continuous Evaluation(CE)(Internal Evaluation)grade is A. The consolidated grade for the course PC-I is as follows:

Evaluation	Weight	Grade awarded	Grade Points awarded	Weighted Grade Point
External	3	A	4.20	12.6
Internal	1	A	4.40	4.40
Total	**4**			**17**
Grade of a course.	GPA of the course =Total weighted Grade Points/Total weight **17/4 =4.25 = Grade A**			

3. Evaluation -Third Stage

Semester Grade Point Average (SGPA).

Course code	Title of the course	Credits (C)	Grade Awarded	Grade Points(G)	Credit Points (CP=C X G)
01	**PC-1**	**5**	**A**	**4.25**	**21.25**
02	**-----**	**5**	**A**	**4.00**	**20.00**
03	**-----**	**5**	**B+**	**3.80**	**19.00**
04	**-----**	**2**	**A**	**4.40**	**8.80**
05	**-----**	**3**	**A**	**4.00**	**12.00**
TOTAL		**20**			**81.05**
SGPA	**Total credit points / Total credits = 81.05/20 = 4.05= Grade- A**				

4. Evaluation - fourth Stage -

Cumulative Grade Point Average (CGPA)

If a candidate is awarded three A+ grades in semester 1 (SGPA of semester 1), semester 2 (SGPA of semester 2) and semester 4 (SGPA of semester 4) and a B grade in semester 3 (SGPA of semester 3). Then the CGPA is calculated as follows:

Semester	Credit of the Semesters	Grade Awarded	Grade point (SGPA)	Credit points
I	20	A+	4.50	90
II	20	A+	4.60	92
III	20	B	3.00	60
IV	20	A+	4.50	90
TOTAL	**80**			**332**
CGPA= Total credit points awarded / Total credit of all semesters = 332 / 80 = 4.15 (Which is in between 4.00 and 4.49 in 7-point scale)Therefore the overall Grade awarded in the programme is A				

PROGRAMME STRUCTURE MSc ZOOLOGY 2022

PROGRAMME CODE: MRZOOPG

Semester	Course-code	Coursename	Type of the course	Teaching Hours Per Week	Credit	Total Credits
I	PG1ZOOC01	Animal Diversity-Taxonomic & Phylogenetic Approaches.	Core	4	4	19
	PG1ZOOC02	Evolutionary biology & Ethology	Core	3	4	
	PG1ZOOC03	Biochemistry	Core	4	4	
	PG1ZOOC04	Biostatistics,Computer Application & Research Methodology	Core	4	4	
	PG1ZOOP01	Biosystematics,Animal diversity,Evolutionary Biology & Ethology, Biochemistry, Biostatistics,Computer Application & Research Methodology	Core	10	3	
II	PG1ZOOC05	Ecology, Principles & Practices	Core	3	4	19
	PG1ZOOC06	Genetics & Bioinformatics	Core	4	4	
	PG1ZOOC07	Developmental Biology	Core	4	4	
	PG1ZOOC08	Biophysics, Instrumentation & Biological techniques	Core	4	4	
	PG1ZOOP02	Ecology- Principles & Practices, Genetics & Bioinformatics, Developmental Biology, Biophysics Instrumentation &Biological Techniques	Core	10	3	
III	PG1ZOOC09	Animal Physiology	Core	4	4	19
	PG1ZOOC10	Cell & Molecular Biology	Core	4	4	
	PG1ZOOC11	Microbiology & Biotechnology	Core	4	4	
	PG1ZOOC12	Immunology	Core	3	4	

	PG1ZOOP03	Cell & Molecular Biology, Microbiology & Biotechnology	Core	10	3	
	PG1ZOOP04	Animal Physiology &Immunology	Core	10	3	
IV	PG1ZOOC13	Entomology-1- Morphology & Taxonomy	Elective	5	4	23
	PG1ZOOC14	Entomology II- Anatomy & Physiology	Elective	5	4	
	PG1ZOOC15	Entomology III- AppliedEntomology	Elective	5	4	
	PG1ZOOP05	Morphology, Anatomy & Taxonomy	Elective	10	2	
	PG1ZOOP06	Insect Physiology & Applied Entomology	Elective	10	2	
	PG4ZOOD01	Project			4	
	PG4ZOOD02	Comprehensive Viva			3	
	Total					**80**

POST GRADUATE PROGRAMME OUTCOME

1.Critical and creative thinking:

- Enables to evaluate information and its sources critically. .
- Engage the imagination to explore new possibilities.
- Formulate and articulate ideas.
- Identify, evaluate and synthesize information (obtained through library, world-wide web, and other sources as appropriate) in a collaborative environment.

2.Synergetic work culture and effective communication:

- Enables to develop a synergistic working relationship, which is essential for achieving a higher quantity and quality output.
- Help to increase team productivity, enhanced individual performance and better customer engagement.

3. Social Consciousness:

- Enables to understand one's role , status, rights and responsibilities as a social being which is essential for the society
- Helps to employ the knowledge and methodologies acquired to better understand economic, legal, and social issues and act effectively.

4. Subject knowledge:

- Possess breadth and depth of knowledge within their discipline and more particularly within their chosen specialization.
- They can articulate their interpretations with an awareness and curiosity for other people's perspectives.

5.Lifelong learning:

- Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
- Understands his or her learning preferences and knows how to adapt them to maximize learning under different circumstances.

6. Multidisciplinary approach:

- Brings pragmatism and flexibility, allowing students to carve their path.
- Develop knowledge in a specific topic to instill in students the ability to assess information and apply it to real-life situations.

PROGRAMME SPECIFIC OUTCOMES OF MSc ZOOLOGY- 2022

PROGRAMME CODE : MRZOOPG

PSO NO.	PROGRAMME SPECIFIC OUTCOMES	**PSO mapped to PO**
1	Understand themolecular or biochemical basis of life, biological diversity and grades of complexity of various animal forms through their systematic classification and comparative structural studies.	1,4,5.
2	Learn how earth was formed and how life started and evolved on the planet through process of organic evolution	4,6.
3	Understand the roles of plants, animals and microbes in the sustainability of the environment and their interaction among themselves and deterioration of the environment due to anthropogenic activities.	1.3,5.
4	Understand the concepts and principles of Biochemistry, Immunology, Physiology, Ethology, Endocrinology, Developmental biology, Cell biology, Genetics, Molecular biology, Microbiology with special emphesis on the health and well being of man, Biostatstics, Computer Applications, Research methodology, Biophysics, instrumentatiuon and Biological Techniques.	4,6.
5	Develop technical skills in Biotechnology, Bioinformatics, Biostatistics and Computer applications.	2,5.
6	Delve into the wonderful world of insects, their success on the planet and their diversity .	3,4.
7	Aquire knowledge on harmful and beneficial insects, their adaptations for life and control measures.	1,4,5.
8	Perform laboratory procedures as per standard protocols in the areas of animal diversity, Systematics, Cell biology, Genetics, Biochemistry, molecular biology, Microbiology, Physiology, Immunology, Developmental Biology,Environmental Biology, Ethology, Evolution, Biostatistics, Computer applications, biophysics, Instrumentation & biological Techniques and Entomology.	2,5,6.
9	Equip the learners to critically evaluate the debates and take a stand based on science and reason.	1,5.

SEMESTER-1

M.Sc ZOOLOGY

PG1ZOOCO1 : ANIMAL DIVERSITY: PHYLOGENETIC

AND TAXONOMIC APPROACHES

72 Hours

(4hrs/week) **Credit-4**

Course Outcome

CO No.	Course outcome	Cognitive level	PSO No.
1	Apply the International rules of Nomenclature to give a scientific name to animals which are found during research	R, U, Ap, An, E	8
2	Understand the gradual development and evolutionary history of different kinds of living organisms from earlier forms over several generations	R, U, An, E, C	1,2,3,6,8
3	Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.	R, U, An, E, C	1,2,3,6,8
4	Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.	R, U, An, E, C	1,2,3,8
5	Understand how morphological change due to change in environment helps drive evolution over a long period of time.	R, U, An, E	1,2,3,6,8

PSO – Programme Specific Outcome, CO-Course Outcome.

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG1ZOOCO1

ANIMAL DIVERSITY: PHYLOGENETIC AND TAXONOMIC APPROACHES

72 Hours **Credit-4**

Unit/Module	Contents	Content Mapped to CO No	Hours
Unit-1 Taxonomic Approaches Module -1	**Concept and Scope of Biosystematics** **1.1**.Scope and significance of biosystematics, **1.2**.Relationship between experimental, phylogenetical and classical taxonomy taxonomic terms; **1.3**.Taxonomy; classification and nomenclature; phenon, taxon and category; α, β and γ taxonomy, **1.4.**Experimental category- Turreson categories, **1.5**.Importance of application of	**1,2**	**6 Hours**

	Systematics in biology		
2	**Biological Classification** **2.1**.Hierarchy of categories and higher taxa. **2.2.**Taxonomic Procedures-collection, preservation, curetting and process of identification (Brief and general account only). **2.3**.Taxonomic characters of different kinds. **2.4**.International code of Zoological Nomenclature – features, principles and rules. Phylocode. Zoobank	**1,2**	**4 Hours**
3	**Taxonomic Keys and Publications** **3.1.**.Different types of keys – single access keys, diagnostic and synoptic keys, dichotomous and polytomous keys. Taxonomic keys presentation. Computer aided keys. Merits and demerits of keys. **3.2**.Types of taxonomic publications – atlas, catalogue, checklist, filed guide, field book, hand book, manual, monographs. Zoological records. **3.3**. Ethics in taxonomy	**1,2,5**	**5 Hours**
4	**New trends in Taxonomy** **4.1**.Modern methods – Morphological, embryological, ecological, behavioural, cytological, biochemical, numerical, molecular.Cytotaxonomy, Chemotaxonomy. **4.2**.Bar coding of life – basics of barcoding, application of barcode. **4.3**.Molecular operational taxonomic units (MOTU), Integrated operational taxonomic unit (IOTU),Global taxonomic initiative (GTI) Constraints of DNA taxonomy. Integrative taxonomy. **4.4.**Microtaxonomy: species concepts; typological species concept, nominalistic species concept, biological species	**1,2,3,4,5**	**7 Hours**

	concept and evolutionary species concept. **4.5.**Macrotaxonomy: Phenetics, cladistics and phylogenetics and their comparison, e- taxonomy, Cyber taxonomy.		
5	**Molecular Phylogeny and Systematics** **5.1**.Use of protein and nucleotide sequence in molecular phylogeny. Protein sequence – haemoglobin and cytochrome. Nucleic acid phylogeny. Importance of molecular phylogeny. **5.2**.Cladistic analysis – Apomorphy, Plesiomorphy, Symplesiomorphy and Synapomorphy. Characteristic features of cladistics. Methodology of cladistics analysis – construction of cladogram. Significance ofphylogenetic systematics. **5.3**.Phylogenetic trees. Different kinds – cladogram, phenogram, phylogram, dendrogram, curvogram, eurogram, swoopogram, chronogram.	**1,2,3,4,5**	**5 Hours**
UNIT II Phylogenetic Approaches 6	**6.1. Origin of Animals** • Origin of Protists • Ediacaran and Burgess Shale fauna. • Cambrian explosion- causes and consequences. Cropping and Red Queen Principle • Different hypothesis of metazoan origin Gastraea hypothesis, Planula hypothesis. • Symmetry, Coelom and Metamerism- evolutionary advantages. **6.2.Invertebrate Phylogeny** • Phylogenetic relationships among Porifera, Placozoa, Mesozoan; Cnidaria and Ctenophora; • Platyhelminthes and other acoelomates. • Phylogenetic relationships among the protostome lineage – Mollusca, Annelida and Arthropoda. • Reasons for the success of Arthropod.	**2,3,4,5**	**20 Hours**

	• Adaptive radiation in Mollusca, Annelida, Arthropod and Echinoderms. • Position and phylogeny of Hemichordates.		
7	**Vertebrate Phylogeny** **7.1.**Ancestry of Chordates- Cephalochordates and Urochordates. **7.2.**Paedomorphosis in vertebrate phylogeny. **7.3**. Jawless vertebrates – Ostracoderms and Cyclostomes. **7.4**. Properties and advantages of bone in vertebrate evolution. **7.5**.Evolution of jawed vertebrates – Acanthodian,Placoderm, Chondrichthyes, Osteichthyes. Actinopterygians and Sarcopterygians.	**2,3,4,5**	**10 Hours**
8	**8.1.Phylogeny of Amphibians and Reptiles** • Amphibian phylogeny, stem tetrapoda and early amphibians. • Lissamphibia – distribution, diversity, status and threats. • Reptilian phylogeny – origin, phylogeny and adaptive radiation. • Importance of skull in reptilian classification. • Endothermy in Dinosaurs. Causes of extinction. **8.2. Phylogeny of Birds and Mammals** • Origin, phylogeny and adaptive radiation of birds . • Mammalian phylogeny and therapsids – significance of teeth, jaws and hearing. • Adaptive radiation in mammals. • Class Mammalia: Prototheria and Theria, Phylogeny of Mammalian orders. • Rare, endangered and endemic birds and mammals of Indian subcontinent.	**2,3,4,5**	**15 Hours**

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SEMESTER-1

BLUE PRINT

PG1ZOOCO1 ANIMAL DIVERSITY: PHYLOGENETIC AND TAXONOMIC APPROACHES

Unit/Module	**Hrs Allotted**	**Part A Weight 1 8/10**	**Part B Weight 2 6/8**	**Part C Weight 5 2/4**	**Total questions**
1	6	1			**1**
2	4			1	**1**
3	5		2		**2**
4	7	3	1		**4**
5	5	2	2		**4**
6	20	2	1	1	**4**
7	10	1	1	1	**3**
8	15	1	1	1	**3**
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER-1

PG1ZOOCO1 ANIMAL DIVERSITY: PHYLOGENETIC AND TAXONOMIC APPROACHES

Time: 3 hrs **Max.Weight -30**

Part-A Short Answer Questions

I. Answer any 8 questions. Each question carries 1weight each

1. Numerical Taxonomy
2. Red Queen Hypothesis
3. Explain Alpha, beta and gamma diversity
4. Mention the evolutionary advantage of Symmetry in animals.
5. Properties and advantages of bone in vertebrate evolution.
6. Comment the phylogeny of Ostracoderms.
7. Turreson categories,
8. Explain the role of protein in Taxonomic study with an example
9. Barcoding of Life
10. Briefly explain the origin of Birds. **(8x1=8 weight)**

Part-B Short Essay Questions

II. Answer any 6 questions. Each question carries 2 weight each

11. Explain Taxonomic publication
12. Describe species concept
13. Give an account on Cladistics
14. Explain Cambrian Explosion
15. Describe different types of keys. Mention its merits and demerits.
16. Explain the diversity of Reptilian skulls
17. Explain the status, phylogeny and evolutionary significance of hemichordates
18. Describe Paedomorphosis in vertebrate phylogeny. **(6x2=12 weight)**

Part-C Long Essay Questions

III. Answer any two questions. Each question carries 5 weight

19.Explain International Code of Zoological Nomenclature

20.Briefly explain Tetrapod phylogeny. Comment on the diversity of modern amphibian and mention the major threats faced by this group

21. Discuss the major classes under phylum Arthropoda and mention its adaptive radiation.

22.Give an account of the structural and functional modifications in birds for aerial life.

(2x5=10 weight)

Semester I

M.Sc. ZOOLOGY

PG1ZOOC02 - EVOLUTIONARY BIOLOGY AND ETHOLOGY

54 Hours

(3hrs. /week) **Credit- 4**

Course Outcomes

CO No.	Course Outcome (Expected)	Cognitive Level	PSO No.
1	Understand the process and theories in evolutionary biology.	U	2
2	Develop an interest in the debates and discussions taking place in the field of evolutionary biology	C	2
3	Equip the learners to critically evaluate the debates and take a stand based on science and reason.	E	9
4	Get exposed to the basics and advances in ethology.	U	8
5	Generate an interest in the subject in order to understand the complexities of both animal and human behavior.	U	8

PSO – Programme Specific Outcome, CO-Course Outcome.

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG1ZOOC02 - EVOLUTIONARY BIOLOGY AND ETHOLOGY

54 Hours **Credit- 4**

Module	Course Description	Hours	Content mapped to CO No.
1	**UNIT 1 EVOLUTIONARY BIOLOGY** **1.1** Concepts in Evolution • Post Darwinian - Mutation and the evolutionary synthesis. • Neutral Evolution, Molecular Evolution, Molecular evolution in Darwinian finches, • Punctuated equilibrium. **1.2.** Origin and Evolution of Life • Evolution of Prokaryotes, RNA world, Idea of Panspermia • Origin of eukaryotic cells- evolution of unicellular eukaryotes, Endosymbiotic theory, Invagination theory, Genome evolution. • Evolution of Anaerobic metabolism, Origin of photosynthesis and Aerobic metabolism. **1.3** Geological Time scale • Geological time scale – Eons, Eras, Periods and Epochs, Major events in evolutionary timescale. Anthropocene. • Tools and techniques in estimating evolutionary time scale. Mass extinction and its consequences.	**14hrs**	**1,2,3**
2	**2.1**. Population Genetics	**10hrs**	**1,2,3**

	• Gene pool, gene frequency, Hardy-Weinberg Law. Rate of change in gene frequency through natural selection, migration and random genetic drift. • Founder effect, Bottleneck effect. • Isolating mechanisms - geographic and reproductive- Prezygotic and Postzygotic. • Speciation- allopatric, peripartric, parapatric and sympatric speciation **2.2**. Developmental and Evolutionary Genetics • The idea of Evo-Devo, Heterochrony, Heterotopy, Heterometry and Heterotypy. • Developmental genes and gene co-option. • Evolution of plasticity and complexity.		
3	**3.1**. Primate Evolution and Human Origins • Stages in Primate evolution- Prosimians, Anthropoideans and Hominids. • Factors in human origin, hominid fossils. • Cytogenetic and molecular basis of origin of man-African origin of modern man. • Mitochondrial Eve, Y chromosomal Adam.	**6hrs**	**1,2,3**
4	**UNIT 2 ETHOLOGY** **4.1**. Introduction • Approaches and method of study in behavior. • Ethological concepts-Sign Stimulus, Super normal stimuli, Stimulus Filtering, Fixed Action Patterns. **4.2.** Neurophysiological Aspects of Behaviour • Reflex action, Sherrington's neuro-physiological concepts in behaviour– Latency, summation, fatigue. **4.3** .Motivation • Goal oriented drive, Hormones and behavior. • Psycho-hydrologic model of motivation. • Motivation studies in Guppies. **4.4.** Learning • Habituation, Classical conditioning (Pavlov's experiments), Operant conditioning, Instrumental conditioning, Latent learning, Trial and error learning, Instinct, Imprinting. **4.5.** Communication • Sensory mechanisms: Electrical, Chemical, Olfactory, Auditory and Visual. Dance language of honey bees, Mechanical and Pheromonal mechanism of communication (Insects and mammals).	**13hrs**	**4,5.**
5	**5.1**. Reproduction and Behaviour • Reproductive strategies. • Mating systems, Courtship. • Sexual selection- Intrasexual selection (Male rivalry), Intersexual selection (Female choice), infanticide, sperm competition, mate guardians. • Parental care and investment. **5.2**. Complex Behaviour	**11hrs**	**4,5**

	• Orientation- Taxes and kinesis • Navigation • Migration (Fishes and birds), Navigation cues. • Biological rhythms – Circadian, Circannual, Lunar periodicity, Tidal rhythms. **5.3**. Social Behaviour • Sociobiology (Brief account only) Aggregations – schooling in fishes, herding in mammals, Group selection, Kin selection, altruism, reciprocal altruism, inclusive fitness, co-operation, territoriality, alarm call. • Social organization in insects and primates.		

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Web Resources: www.animalbehavioronline.com/modestable.html

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PG1ZOOC02 - EVOLUTIONARY BIOLOGY AND ETHOLOGY

Module	**Hrs Alloted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	14	2	1	1	**4**
2	10	2	2		**4**
3	6	2	1	1	**4**
4	13	2	2	1	**5**
5	11	2	2	1	**5**
Total	**54**	**10**	**8**	**4**	**22**

Semester I

PG1ZOOC02 - EVOLUTIONARY BIOLOGY AND ETHOLOGY

Time: 3 Hrs **Max. Weight: 30**

Part A - Very Short Answer Questions.
Answer any 8 questions. Each question carries Weight 1

1. Instinct
2. State Endosymbiotic theory
3. What is punctuated equilibrium?
4. Comment on RNA world
5. Founder effect
6. Define heterochrony
7. Y Chromosomal Adam
8. What is Prosimii?
9. Behavioural Bouts
10. Explain Fixed Action Pattern **(8 x 1 = 8 wt)**

Part B -Short Essay type questions.
Answer any 6 questions. Each question carries Weight 2

11 Give a short account on evolution of anaerobic metabolism
12. Citing Pavlov's experiment, explain classical conditioning
13. Discuss major events in the evolutionary time scale
14. Define fossil. Add a note on fossilization
15. Explain the different types of Plasticity
16. Explain how co-option is exhibited at the molecular level.
17. Give an account on various stages in primate evolution.
18. Differentiate between orientation and navigation **(6 x2 = 12 wt)**

Part C - Long Essay Questions.
Answer any 2 questions. Each question carries weight 5

19. Critically evaluate post-Darwinian theories of evolution.
20. Write an essay on hominid fossils.
21. Elaborate the neurophysiological aspects of behaviour
22. Define communication. Explain different methods of animal communication. **(2x5=10 wt**)

Semester I

PG1ZOOC03- BIOCHEMISTRY

72Hrs
(4hrs/week) **Credit-4**

Course outcomes

CO No.	Course outcome	Cognitive level	PSO No.
1	To understand the chemical nature of life and life process	R,U,A	1,4,5,8
2	To provide an idea on structure and functioning of biologically important molecules.	R,U,A,A,E	1,4,5,8
3	demonstrate knowledge and understanding of the molecular machinery of living cells, the principles that govern the structures of macromolecules and their participation in molecular recognition	R,U,A,A,E	1,4,5,8
4	To impart knowledge on various biochemical molecules and path ways in life processes	R,U,A,A,E,C	1,4,5,8
5	To generate an interest in the subject and help students explore the newdevelopments in Biochemistry	R,U,A,A,E,C	4,5,8
6	To understand the importance of metabolism of bio macromolecules in normal physiology of a man, understanding of the principles and basic mechanisms of metabolic control.	R,U,A,A,E,C	4,5,8
7	To understand the abnormal metabolism of biomolecules and the resultant diseases.	R,U,A,A,E,C	4,8

PSO – Programme Specific Outcome, CO-Course Outcome.

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG1ZOOC03- BIOCHEMISTRY

72 hrs **Credit-4**

Module	**Content**	Content mapped to CO	Hrs
1	**1.1.**Atoms, molecules and chemical bonds, Importance of Carbon- Physico-chemical and biological peculiarities of 'Carbon', Water: Biological importance, pH and acid - base balance. Buffers - biologicalimportance.	**1,2,3,4,5,6, 7.**	**2 hrs**
2	**2.1** Carbohydrates: Classification, Structure, nomenclature and Biological functions of carbohydrates. Glycoproteins and Mucoproteins. Isomerism – structural isomerism and stereoisomerism, optical isomerism, epimerism and anomerism. Mutarotation and inversion of sugars. Glycosidic bond.	**1,2,3,4 5,6,7.**	**18 hrs**
	2.2 . Carbohydrate Metabolism: Major metabolic pathways- Glycolysis – Fate of pyruvate. Citric acid cycle and its significance; Central role of citricacid cycle. Oxidative and substrate level phosphorylation. Gluconeogenesis,		

	Cori cycle, Glycogen metabolism- Glycogenesis, Glycogenolysis, Adenylate cascade system, Ca^{+2} Calmodulin-sensitive phosphorylase kinase. Regulation of glycogen synthesis. Minor metabolic pathways of carbohydrates: Pentose Phosphate pathway, Glucuronic acid metabolism, Galactose metabolism.		
	2.3 Disorders of Carbohydrate Metabolism: (brief account only) Inborn errors associated with carbohydrate metabolism. Glycogen storage diseases, Lactose intolerance, Galactosuria,.		
3	**3.1** Proteins: Structure, classification and amino acids. Amphoteric properties of amino acids, pK value and iso-electric point of amino acids. Classification and biological functions of proteins. Primary structure of protein (e.g. insulin). Conformation of proteins-chemical bonds that stabilize higher order structures. Secondary structure- Alpha helix, Collagen helix, Beta pleated sheet, Ramachandran angles and Ramachandran map. Fibrous proteins- examples (brief account on any two: Keratin, Collagen, Elastin, Resilin, Fibrous muscle proteins). Chaperons. Tertiary structure- e.g. Myoglobin. Quaternary structure – e.g. Haemoglobin.	**1,2,3,4 5,6,7.**	**16 hrs**
	3.2. Protein Metabolism: Amino acid metabolism-Deamination, Transamination and Trans-deamination. Formation and disposal of ammonia. Urea cycle. Fate of carbon skeletons of amino acids: glucogenic, ketogenic, partly glucogenic and ketogenic with examples.		
	3.3. Inborn Errors of Metabolism: (very brief account only) Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia.		
4	**4.1**. Lipids: Classification of lipids: simple, compound and derived lipids. Biological importance of lipids. Fatty acids: classification, Genevan system of nomenclature. Simple fats: Triacylglycerol (Triglycerides) :-fats, oils and waxes. Acid number, Saponification number, Iodine number, Polenske number and Reichert Meissl number of lipids. Compound lipids: Phospholipids- Lecithin, Phosphatidyl inositol, Cephalins, Plasmologens. Glycolipids, Sphingolipids. Derived Lipids, Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Ergosterol, Terpenes, Lipoproteins.	**1,2,3,4, 5,6,7.**	19 hrs

	Prostaglandins- structure, types and functions.		
	4.2. Lipid metabolism: Beta oxidation, alpha oxidation and omega oxidation of fatty acids. *De novo* synthesis of fatty acids, Metabolism of cholesterol, synthesis and its regulation, Metabolism of ketone bodies - Ketogenesis, Ketolysis, Ketosis.		
	4.3. Disorders of lipid metabolism: (very brief account only) Plasma lipoproteins, cholesterol and its clinical significance,, triglycerides & phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia		
5	**5.1.** Nucleic acids: Structure of nucleic acids and nucleotides: Structural organization of DNA (Watson – Crick model), Characteristic features of A, B, C and Z DNA., Protein-nucleic acid interaction, Stability of proteins and nucleic acids., DNA regulatory proteins, folding motifs, conformation flexibilities, denaturation, renaturation, Biological roles of nucleotides and nucleic acids.	**1,2,3,4 5,6,7.**	**7 hrs**
	5.2 Nucleic acid metabolism; Catabolism of purines and pyrimidines.		
6	**6.1.** Enzymes: Classification- (I.U.B.system), co-enzymes, iso-enzymes, ribozyme., , Mode of action of enzymes. Formation of enzyme-substrate complex. Lowering of activation energy, Lock and key theory, induced fit theory, transition state and strain theory, Concept of Active site, Enzyme kinetics: Michaelis-Menten equation. Km value and its significance. Enzyme velocity and factors influencing enzyme velocity, Inhibitors of enzyme action, Kinetics of enzyme inhibition, suicide inhibition and feedback inhibition- sequential, concerted and cumulative feedback control. Enzyme regulation: Allosteric regulations. Monod-Wyman-Changuex model, Koshland-Nemethy-Filmer model Key enzymes, Covalent modification. Enzyme engineering.	**1,2,3,4,5,6, 7.**	**10 hrs**

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SEMESTER-1

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PG1ZOOC03- BIOCHEMISTRY

Module	**Hrs Alloted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	2	2	1		3
2	18	2	2	1	5
3	16	2	1	1	4
4	19	1	2	1	4
5	7	1	1	-	2
6	10	2	1	1	4
Total	**72**	**10**	**8**	**4**	**22**

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FIRST SEMESTER ZOOLOGY

PG1ZOOC03- BIOCHEMISTRY

Time: 3 hours **Maximum wt: 30**

Part A Short answer type questions

Answer any 8 questions. (Each question carries Weight 1)

1. Glycogen storage disease
2. Pentose phosphate pathway
3. Conformational variants of DNA
4. Most fatty acids have an even number of carbons. Why?
5. Ornithine cycle.
6. Ramachandran map
7. Biological peculiarities of Carbon
8. Buffers and its biological significance
9. Ribozymes
10. Enzyme engineering

(8 x 1= 8 wt)

Part B - Short essay type questions

Answer any six questions. (Each question carries Weight 2)

11. Effect of substrate concentration on the rate of enzyme catalysed reaction. Derive Michaelis-Menten equation
12. Write on any two disorders of lipid metabolism
13. Catabolism of purines and pyrimidines
14. Comment on importance f water.
15. Chaperones.
16. Prostaglandins
17. Glycogenesis and glycogenolysis
18. Classify polysaccharides with examples for each.

(6 x 2= 12 wt)

Part C- Long essay type questions.

Answer any two questions. Each question carries Weight 5)

19. Classify lipids with examples. Comment on the biological importance of various classes

20. Write an essay on enzyme inhibitors. Add a note on kinetics of enzyme inhibition.

21. Describe the complete oxidation of a molecule of glucose. Comment on the yield of ATP.

22. Comment on structural organizations of protein. **(2x5= 10 wt)**

Semester I

PG1ZOOC04: BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

72 hrs **Credit 4**

(4hrs/week)

Course outcomes.

CO No.	Course outcome	Cognitive level	PSO No.
1	Impart concepts, generate enthusiasm and make awareness about the tools/gadgets and accessories of biological research	R, U, Ap, An, E	1,4,5,8
2	Equip the learner to carry out original research in biology	R, U, Ap, An, E, C	4,5,8
3	Inculcate analytical and critical thinking skills through problem solving	R, U, Ap, An, E	4,5,8
4	Acquire hands on training in the use of various tools and techniques suggested in the course.	R, U, Ap, An, E, C	1,4,5,8
5	Develop skills including computing skills to solve scientific and research problems with statistical formulas, research methodology and information technology concepts	R, U, Ap, An, E	1,4,5,8

PSO – Programme Specific Outcome, CO-Course Outcome.

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG1ZOOC04: BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

72 hrs **Credit 4**

Unit/Module	Contents	Content Mapped to CO No	Hours
Unit1 Biostatistics Module 1	**Basics of Biostatistics** **1.1.** Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources). **1.2.**Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias. **1.3.** Organization of Data - Classification, Tabulation (forming a frequency distribution from raw data and types and characteristics of	**1,2,3,5**	**5**

	a Frequency table). **1.4.** Presentation of Data - Types and Characteristics of Tables and Visual aids – Graphs, Charts, Diagrams, Flow charts, Cartographs. **1.5.**Statistical Analysis Tools - Parametric and Non-Parametric; Bivariate and Multivariate Analysis. Interpretation and Forecasting.		
2	**Measures of Central Tendency and Measures of Dispersion** **2.1.** Merits and Demerits of Mean, Median and Mode. Calculations/Problems for different data (raw, frequency table). Harmonic and Geometric Mean (Brief account only). **2.2.** Merits and Demerits of Range, Quartile Deviation, Mean Deviation and Standard Deviation. Calculations/Problems for frequency table. Standard Error and Relative Measures of Dispersion, Skewness and Kurtosis (Brief account only).	**1, 2, 3, 5**	**7**
3	**Correlation Analysis and Regression Analysis** **3.1.** Correlation - types and methods of correlation analysis, Problems for Karl Pearson's correlation coefficient and Spearman's rank correlation. **3.2.** Regression and Line of Best Fit , Types and methods of regression analysis. Graphic Methods (Scatter method, Curve fitting). Algebraic method (Fitting of strait line through regression equation). Probit Analysis (Brief account only), Mathematical Models in Biology (Brief account only). Length – Weight Relationship, Von- Bertalanffy's Growth (VBG) Model.	**1, 2, 3, 4, 5**	**8**
4	**Theory of Probability** **4.1.** Measures of Probability and Theorems in Probability. Probability distributions – Binomial, Poisson and Normal (Brief Account only).	**1, 2, 3, 5**	**3**
5	**Testing of Hypothesis and Vital Statistics** **5.1.** Hypothesis and types, Confidence Interval, Sampling, Methods and Errors.		

	5.2. Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small samples), Chi- Square Test (Problem for 2×2 table only). Student's 't' test (Problem for small samples comparing mean of two variable). F-test and Analysis of Variance (ANOVA - One way) (Brief account only). **5.2.** Non-parametric tests: Mc Nemar and Mann Whitney U test (Brief account only). **5.3.**Introduction, uses, records and system of classification of vital statistics. Sample registration system, Sample design, Survey of causes of death and Age classification. Measures of Vital Statistics and Measures of Population (Mortality rates, Fertility rates). Life tables (Brief account only).	**1, 2, 3, 5**	**8**
UNIT II Computer Applications 6	**Basics of Computers** **6.1.** Types of Computers. Binary Number System, Digital and Analog systems. Hardware/Software/Firmware. **6.2.** Basics of Computer Functioning- Booting; Formatting; **6.3.** File, File Extensions; Temporary Files; Folder; GUI, Icon; **6.4.** Installation of Programs, Commands, Bios setup, Date and Time, Memory Partitions, Registry, Default Operations; Defragmentation (Brief account only).	**1, 2, 4, 5**	**5**
7	**Hardware and Software Basics** **7.1.**Memory -Classification and Types of memory; memory devices; Units. **7.2.** Input Devices -Types, working and functions. Output Devices–Types, working and functions. **7.3.**CPU components - Processors, Mother boards, SMPS, Accessory Cards – Graphic /Sound/ Networking/Bluetooth/Wifi (Brief account only). **7.4.** New Generation Computers - Servers, Laptop; Palmtop; Cyborgs; Robotics, Zoobotics (Brief account only). **7.5.** System Software/Operating System -System Files; Working of OS; DOS, Widows, Linux and UNIX (Brief account only).	**1, 2, 5**	**12**

	7.6. Application Software -Programs and Packages- Publisher, Acrobat Reader, E Book Reader, Explorer, Photoshop. **7.7.** Virus and Antivirus (Brief account only). **7.8.** Statistical Software (MS Excel, PH Stat, SPSS), Databases -MS Access (Brief account only).		
8	**Computer Language and Programming** **8.1.** Computer language -Classification and types, HTML, C and Java Programming concepts – Algorithm, Codes (Brief account only).	**1, 2, 5**	**4**
9	**Networking, Internet and Information Technology** **9.1.**Computer Communication -Network Topology, Media of networking, **9.2.** Networking Protocols, PAN, LAN, WAN, MAN, INFLIBNET, Modem and Gateway. **9.3.** Internet and Internet Services -World Wide Web, Uploading, Downloading, Hosting, Portal, Open access initiatives and open access publishing, Firewall. Global Information System -BIOSIS, Medline and Medlars, AGRIS; E Journals and E Books Publishing. **9.4.** Cyber Crime and Cyber Laws, **9.5.**Futuristic IT- Robotics and Artificial Intelligence, virtual reality, biocomputing (Brief account only).	**1, 2, 4, 5**	**5**
UNIT III Research Methodology 10	**Science and Life Sciences** **10.1.** Basic concepts of Science, Scientific temper, Empiricism, Rationalism	**1, 2, 3**	**1**
11	**Concepts of Research** **11.1.** Basic concepts of research, Types of Research (Descriptive/Analytical, Applied/ Fundamental, Quantitative/Qualitative, Conceptual/ Empirical Research methods versus Methodology, Research and scientific method. Research Process.	**1, 2, 3, 5**	**3**
12	**Research Formulation and Research Designs** **12.1.** Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction. Defining and formulating the research problem, Selecting the problem and	**1, 2, 3, 5**	**6**

	necessity of defining the problem. **12.2.** Literature review -Importance of literature reviewing in defining a problem, Critical literature review. **12.3.** Research Design -Basic principles. Types of research designs. Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs. Data collection techniques.		
13	**Scientific Documentation and Communication** **13.1.** Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).	**1, 2**	**2**
14	**Information Science, Extension and Ethics** **14.1.**Sources of Information - Primary and secondary sources. Library - books, journals, periodicals, reference sources, abstracting and indexing sources, Reviews, Treatise, Monographs, Patents. **14.2.** Internet -Search engines and software, Online libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites. Intellectual Property Rights - Copy right, Designs, Patents, Trademarks, Geographical indications. **14.3.** Safety and precaution - ISO standards for safety, Lab protocols, Lab animal use, care and welfare, animal houses, radiation hazards. **14.4.**Extension: Lab to Field, Extension communication, Extension tools. Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution.	**1, 2**	**3**

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SEMESTER-1

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PG1ZOOC04: BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

Unit/Module	**Hrs Allotted**	**Part A Weight 1 8/10**	**Part B Weight 2 6/8**	**Part C Weight 5 2/4**	**Total questions**
Unit 1 Module 1	5	2			**2**
2	7	1	1		**2**
3	8		2		**2**
4	3			1	**1**
5	8	1	1	1	**3**
6	5	1			**1**
7	12	1	1	1	**3**
8	4	1			**1**
9	5		1		**1**
10	1	1			**1**
11	3	1			**1**
12	6		1	1	**2**
13	2		1		**1**
14	3	1			**1**
Total	72	**10**	**8**	**4**	**22**

FIRST SEMESTER M.Sc. ZOOLOGY

PG1ZOOC04: BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

Time: 3 hours **Maximum wt: 30**

Part A- Short answer type questions

Answer any 8 questions (Each question carries Weight 1)

19. Distinguish between parametric and non-parametric tests.
20. Write short notes on different probability sampling methods.
21. Distinguish between skewness and kurtosis.
22. Comment on ANOVA.
23. Differentiate between digital and analog system.
24. Write short notes on SPSS.
25. What are algorithms?
26. Distinguish between empiricism and rationalism.
27. Write short notes on research process
10. Write short notes on Intellectual Property Rights **(8 x 1= 8 wt)**

Part B - Short essay type questions

Answer any six questions. Each question carries Weight 2.

11. Calculate the standard deviation of intelligence quotient (IQ) of 68 students from the given data.

IQ	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No: of students	5	12	15	20	10	4	2

12. Explain VBG model
13. Explain types of correlation
14. Distinguish between t test and z test.
15. Discuss briefly about new generation computers.
16. Write notes on cybercrimes and cyber laws.
17. Comment on the importance of literature reviewing in research.
18. Mention the steps involved in project proposal writing **(6 x 2= 12 wt)**

Part C- Long essay type questions.

Answer any two questions . Each question carries Weight 5.

19. Write an essay on probability distributions.
20. Write an essay on testing of hypotheses.
21. Explain input and output devices.
22. Give an account on research design. **(2x5=10wt)**

SEMESTER I

M.Sc. ZOOLOGY PRACTICAL I
PG1ZOOP01: BIOSYSTEMATICS AND ANIMAL DIVERSITY, EVOLUTIONARY BIOLOGY AND ETHOLOGY, BIOCHEMISTRY, BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

180 Hours (10hrs./week) **Credit-3**

Biosystematics and Animal Diversity, Evolutionary Biology and Ethology

- Study of museum specimens - 50 invertebrates and 20 vertebrates (List the studied items with brief descriptions. Diagrams not necessary).
- Larval forms – any 10 larvae from different taxa
- Study of the skull of vertebrates – Shark, Frog, Varanus, Crocodile, Bird, Dog, Rabbit/ Rat
- Preparation of dichotomous key of 4 specimens up to family (insects/ fishes/ snakes of any three taxa).
- Preparation of Cladogram based on the specimens provided (at least five museum specimen).
- Calculating gene frequencies and genotype frequencies in the light of Hardy-Weinberg Law in human/ other populations.
- Study of fish in response to three temperatures (Normal ,+ 5^0 and -5^0C) of water in a microenvironment and preparation of an ethogram
- Study of the grooming behaviour in insects/bird

Biochemistry

- Quantitative estimation of blood glucose by Folin-Wu/Anthrone /DNS/ O-Toluidine/Enzymatic method .
- Estimation of proteins by Biuret/ Lowry *et al.* method
- Quantitative estimation of blood urea/ creatine/ uric acid
- Quantitative estimation of cholesterol in the blood
- Estimation of alkaline and acid phosphatases

Biostatistics

(Problems can be solved using scientific calculator).

These exercises can be done as assignments of the theory sessions

- Calculation of mean, median and mode from grouped data

- Calculation of mean deviation and standard deviation from grouped data Calculation of Pearson correlation coefficient.

- Calculation of regression coefficient and regression equation ('x' on y' only) Calculation of length-weight relationship

- Calculation of 'Z' value (small sample only) Calculation of Chi square value (2×2 table only)
- Calculation of 't' value (for small sample comparing two variable)

- Draw line graph, vertical bar diagram, horizontal bar diagram, histogram, frequency polygon, frequency curve, pie diagram and ogives on graph paper for simple grouped data.

Computer Applications

- MS Excel: Formula writing (Addition, Subtraction, Multiplication, Division, Power and Root) MS Excel: Correlation Analysis
- MS Power Point: Preparation of a presentation with minimum 5 slides based on First Semester theory topics

M.Sc. ZOOLOGY (CSS) FIRST SEMESTER PRACTICAL EXAMINATION

Model Question paper.

PRACTICAL-1: PG1ZOOP01-BIOSYSTEMATICS AND ANIMAL DIVERSITY, EVOLUTIONARY BIOLOGY AND ETHOLOGY, BIOCHEMISTRY, BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

Time: 4 hrs **Total Weight: 15**

Part A (1 weight each)

1. Identity and comment on the given larvae (2 numbers).
2. Give the scientific names of two specimens provided and comment on the evolutionary relationship/ significance/adaptations.
3. Write down the dental formula of the given Mammalian skull and comment on its feeding habit.
4. Conduct an experiment to record the grooming pattern in an insect. (Experiment & Interpretation)
5. Prepare a cladogram based on the specimens provided. (4 specimens from different classes)

Part B

6. Estimate the quantity of glucose in the sample provided. (Principle wt-1, Expt. and calculation wt-2. Result wt-1)

Part C

7. Calculate the standard deviation for the following data.

Class	Frequency
10-20	150
20-30	200
30-40	50
40-50	250
50-60	400
60-70	100
70-80	50

Equation wt 1, Calculation and Result W

Part D

8. Following data represent the education and crime rate ratings for selected US cities. Calculate correlation using MS Excel/PH STAT

City	Education (X)	Crime (Y)
NewYork	30	25
Detroit	31	16
Los Angeles	32	20
Boston	35	12
Chicago	35	10
Washington DC	36	13

(Weight-2)

Certified record Weight 1

Semester II

PG2ZOOC05- ECOLOGY: PRINCIPLES AND PRACTICES

54 Hours
(3hrs/week) **Credits-4**

CO No.	**Course Outcome (Expected)**	**Cognitive level**	**PSO No.**
1	Develop a thorough understanding of ecological components and concepts as well as ecosystem functions.	R, U	1,4
2	Understand community composition and population dynamics.	R, U, An, E	3,4
3	Recognize different environmental concerns and their anthropological impact.	R, U, An, E	3,4
4	Appreciate environmental resources, their management and restoration.	R, U, Ap, An, E	2,3,4
5	Analyze ecological tools and techniques to construct and assess conservation initiatives.	R, U, Ap, An, E, C	2,4,5
6	Become familiar with the structural and functional properties of ecological regulations.	R, U, An	4

PSO – Programme Specific Outcome, CO-Course Outcome.

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG2ZOOC05- ECOLOGY: PRINCIPLES AND PRACTICES

54 Hours **Credits-4**

Module	**Course description**	**Content mapped to CO**	Hours
1	**Ecology and Environment** **1.1**. Physical Environment- biotic and abiotic factors, effect of light and temperature on animals. **1.2** .Gaia hypothesis. **1.3** .Concept of habitat and niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement. **1.4**. Concept of homeostasis. **1.5**. Concept of limiting factors- Liebig's law, Shelford's law.	**1,4,6.**	**8hrs**

	1.6 .Ecological footprints		
2	**Ecosystem** **2.1.** Structure and Function of ecosystem **2.2** .Laws of thermodynamics, energy flow in the ecosystem. **2.3**. Primary productivity, Biomass and productivity measurement, Secondary production **2.4.** Biogeochemical cycles- patterns and types (CNP).	**1,6.**	**10hrs**
3	**Population and Community ecology** **3.1**. Population group properties- density, natality, mortality, population age structure, growth forms and concept of carrying capacity, population fluctuations, density dependent and density independent factors. Population age structure, aggregation, Allee's principle. **3.2** . Life history strategies, r & k selection. **3.3**. Concept of metapopulation. Characteristics of metapopulation. Levin's model of metapopulation. **3.4**. Concept of community - community structure and attributes, ecotone and edge effect. **3.5**. Ecological succession, concept of climax. **3.6**. Species diversity in community and its measurement-Alpha diversity, Simpson's diversity index, Shannon index, Fisher's alpha, rarefaction. Beta diversity-Sorensen's similarity index, Whittaker's index, Evenness, Gamma diversity, Guild and its functioning in the community. **3.7**. Drivers of species diversity loss and conservation	**1,2,5,6.**	**14hrs**

4	**Resource ecology** **4.1**. Natural Resources: Soil-soil formation, physical and chemical properties of soil. Significance of soil fertility. Mineral resources with reference to India. Impact of mining on environment. Sand mining and its impacts; Forest resources-deforestation, Aquatic resources - Freshwater and water scarcity, water conservation measures - case studies from India; Wetland reclamation-causes and consequences. **4.2**. Recent issues in energy production and utilization; Energy audit, Green technology and sustainable development. **4.3**. Ecosystem monitoring-GIS, Physics of remote sensing, role of remote sensing in ecology, GPS and its application; EIA- tools and techniques, Ecosystem Modelling (Brief account only).	**4,5,6.**	**10hrs**
5	**Applied ecology** **5.1**. Environmental Pollution-types, causes and consequences – Air, Water and soil. **5.2**. Environmental biotechnology and solid waste management- aerobic and anaerobic systems. Concept of bioreactors in waste management. **5.3**. Bioremediation- need and scope of bioremediation in cleaning up of environment. Phytoremediation, bio-augmentation, biofilms, bio filters, bio scrubbers and trickling filters. **5.4**. Radiation Biology - natural and man-made sources of radioactive pollution; effects and management of radioactive pollution.	**3,5.**	**7hrs**
6	**Biogeography and Conservation** **6.1**. Biogeographical zones of India. Western Ghats and its significance. **6.2**. Theory of island biogeography	**5,6 .**	**5hrs**

	6.3. Restoration Ecology- need and policies, case studies and success stories – global and national. **6.4.** Sacred groves, Bio villages. **6.5.** Role of Intergovernmental and Non-governmental organizations in conservation-WRI, WWF, CI and Green Peace. National and Local NGOs.		

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PG2ZOOC05- ECOLOGY: PRINCIPLES AND PRACTICES

Module	**Hrs Allotted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	8	2	1	-	3
2	10	1	2	1	4
3	14	3	3	1	7
4	10	2	2	1	5
5	7	1	-	1	2
6	5	1	-	-	1
Total	**54**	**10**	**8**	**4**	**22**

PG2ZOOC05- ECOLOGY: PRINCIPLES AND PRACTICES

Time:3 Hours **Maximum Weight: 30**

Part A - Short Answer Questions

(Answer any 8 questions. Each question carries weight 1)

1. Gaia hypothesis.
2. Ecotone and edge effect.
3. Bioremediation.
4. Differentiate between alpha diversity and beta diversity.
5. Briefly explain concept of homeostasis
6. Allee's principle
7. GPS and its application.
8. Green Peace.
9. Functions of ecosystem
10. Energy audit.

(8 X 1= 8 Wt)

Part B Short Essay Questions

(Answer any six questions. Each question carries weight 2)

11. Differentiate between r and k selection.
12. Describe the concept of meta-population.
13. Comment on diversity indices.
14. Describe biomass and productivity in ecosystem.
15. Assess the causes and consequences of wetland reclamation.
16. Describe ecological footprints.
17. Describe energy flow in an ecosystem.
18. Explain sand mining and its impact on environment.

(6 X 2 = 12 Wt)

Part C- Long Essay Questions

(Answer any two questions. Each question carries weight 5)

19. Describe the biological effect and control of radioactive pollution.
20. Explain species diversity in community and its measurement.
21. Give an account of ecosystem monitoring.
22. Describe biogeochemical cycles with diagrams. **(2 X 5= 10 Wt)**

Semester II

PG1ZOOC06 : GENETICS & BIOINFORMATICS

72 Hours

(4hrs/week) **Credits-4**

Course Outcomes

CO No.	Course Outcomes	Cognitive Level	PSO No.
1	Give an in-depth understanding on the principles and mechanism of inheritance.	**U**	**4,5,8**
2.	Analyze the fine structure and molecular aspects of genetic material	**An**	**4,5,8**
3	Learn the importance of inheritance in man, Linkage & Recombination, Mutation, Extra Chromosomal Inheritance, Epigenetics and Population Genetics.	**U**	**4,5,8**
4	Identify the mechanism involved in DNA replication and Gene mutation	**Ap**	**4,5,8**
5	Expose the learners to the emerging field of Bioinformatics and equip them take up bioinformatics studies.	**C**	**4,5,8**

PSO-Program Specific outcome; CO-Course Outcome. Cognitive Level: R-Remember

U- Understanding; Ap-Apply; An-Analyze, E -Evaluate; C-

PG1ZOOC06 : GENETICS & BIOINFORMATICS

72 Hours **Credits-4**

Module	Course Description	Hrs	CO. No.
1	**Transmission genetics** **1.1.**Gene interaction-epistasis, pleiotropy, genomic imprinting, phenocopy. **1.2** . Gene action-from genotype to phenotype-penetrance and expressivity. **1.3**. The standard genetic code, redundancy and Wobble. **1.4**. Genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits. **1.5**. Karyotype, pedigree analysis. **1.6** .Inheritance of mitochondrial and chloroplast genes,	**10 hrs**	**1,2,3**

	maternal inheritance.		
2	**Molecular Organization of Chromosomes** **2.1**. Structure of eukaryotic chromosome, nucleosome model. **2.2**. Chromosome condensation - euchromatin and heterochromatin. Genome size and C-value Paradox **2.3**. Kinetics of renaturation: Cot and Cot curve. **2.4.** Unique and repetitive sequences.-Mini and micro satellites. **2. 5**. Molecular structure of centromere and telomere. **2.6**. Polytene chromosomes and Lampbrush chromosomes. Chromosome banding techniques.	**7hrs**	**1,2**
3	**Gene Fine Structure.** **3.1** Modern findings on the nature of gene: Interrupted genes in eukaryotes, exons and introns. **3.2**. R loops significance of introns. Genes-within-genes (overlapping genes). **3.3.** Transposable elements in Bacteria –IS elements, composite transposons, Tn3 elements.	**6 hrs**	**1,2**

	3.4 Transposable elements in Eukaryotes-P elements, Retrotransposons, significance of transposons.		
4	**Genetic Linkage, Recombination and Chromosome Mapping.** **4.1**. Linkage and recombination of genes in a chromosome, crossing over as the physical basis of recombination. **4.2**. Stern's Experiment; molecular mechanisms of recombination (Holliday model), Gene conversion, **4.3**. Recombination mapping with two-point and three – point test cross in *Drosophila*, Coincidence and Interference. **4.4**. Genetic mapping by tetrad analysis in *Neurospora*.. **4.5**. Mapping with molecular markers and mapping using somatic cell. Lod score for linkage testing.	**11hrs**	**1,3**
5	**Gene mutation , DNA Replication,** **5.1**. Molecular basis of gene mutation; mutant types- lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants. **5.2.** The Meselson-Stahl experiment, semi conservative replication of DNA in chromosomes **5.3**. Theta replication, rolling-circle replication. **5.4**. Molecular mechanisms of eukaryotic replication. **5.5**. Enzymes involved in DNA replication. **5.6.** DNA damage and repair mechanisms.	**11 hrs**	1,4

6	**Epigenetics, Quantitative and population genetics** **6.1**. Epigenetics - from phenomenon to field, a brief history of epigenetics - overview and concepts; **6.2**. Chromatin modifications and their mechanism of action, concept of 'histone-code' hypothesis. **6.3**. Epigenetics in *Saccharomyces cervisiae*, position effect variegation, heterochromatin formation **6.4.** Estimation of heritability, QTL mapping, genotype-environment interactions, **6.5** Molecular analysis of quantitative traits, phenotypic plasticity	**9hrs**	**1,3**
7	**BIOINFORMATICS** **Introduction , Biological Databases** **7.1**. Definitions of bioinformatics, applications of bioinformatics and scope of bioinformatics. **7.2.** Primary databases - Nucleotide sequence databases: GenBank, EMBL, DDBJ. **7.3**. Protein sequence databases: SWISSPROT, PIR; Structure databases: PDB, NDB. **7.4.** Secondary databases: PROSITE, Pfam, CATH. C omposite databases: OWL. **7.5**. Literature database: PubMed. **7.6**. Database searching – Entrez; Database sequence submission – BankIt.	**7 hrs**	**5**
8	**Sequence Analysis** 8.1. Types of sequence alignment, 8.2. Methods of sequence alignment. 8.3. Scoring schemes, gaps and gap penalties. 8.4. Construction of phylogenetic trees.	**5 hrs**	**5**

9	**Genomics , Proteomics and Systems Biology** 9.1. Structural genomics, 9.2. Significance of proteomics and drug design. 9.3. Functional genomics. 9.4. Comparative genomics. 9.5. Data mining in proteomics – Microarrays 9.6. System Biology-Introduction, metabolomics, gene network.	**6 hrs**	**5**

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SEMESTER II

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PG1ZOOC06 GENETICS AND BIOINFORMATICS

Module	Hrs Allotted	Part A Weight 1 8/10	Part B Weight 2 6/8	Part C Weight 5 2/4	Total Questions
1	10	2	2		4
2	7	1		1	2
3	6	1		1	2
4	11	1	3		4
5	11			1	1
6	9	1	2		3
7	7	1		1	2
8	5	2			2
9	6	1	1		2
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER-II

M.Sc. ZOOLOGY

PG1ZOOC06 : GENETICS AND BIOINFORMATICS

Time: 3 Hours. **Max. Weight: 30**

Part A- Short Answer Questions

Answer any 8 questions. Each question carries 1 Weight.

1 Pleiotropy
2 Wobble hypothesis
3 C-value paradox
4 Split genes.
5 Linkage
6 Phenotypic plasticity
7 Applications of bioinformatics
8 Pair wise and multiple sequence alignments
9 Phylogenetic trees.
10 Applications of metabolomics **(8 x 1 = 8 Wt)**

Part B- Short Essay Questions

Answer any 6 questions. Each question carries 2 Weight.

11 Discuss the inheritance of mitochondrial genes.
12 What is genetic code? Explain the features of genetic code?
13 Explain steps involved in recombination mapping with three-point test cross.
14 What is recombination? How it helps chromosome mapping?
15 Explain Holliday model of recombination.
16 Write in detail the 'Histone code hypothesis.
17 Write a note on QTL mapping.
18 Write an account on genomics. **(6x 2 = 12 Wt)**

Part C- Long Essay Questions

Answer any 2 questions. Each question carries 5 Weight.

19 Write an essay on molecular organization of Chromosomes.
20 Give an account of different transposable elements found in prokaryotes and eukaryotes.
21 Write an essay on DNA damage and repair mechanisms.
22 Write an essay on Biological databases. **(2 x 5 = 10 Wt)**

SEMESTER II

PG2ZOOC07- DEVELOPMENTAL BIOLOGY

72 Hours

(4hrs/week) **Credit – 4**

Course outcomes

CO No.	Course Outcome (Expected)	Cognitive Level	PSO No.
1	Learn the concepts and process in developmental biology	U	4
2	Understand and appreciate the genetic mechanisms and the unfolding of the same during development	U	4
3	Create awareness on new developments in embryology and its relevance to Man	E	4
4	Acquire knowledge on teratogenesis and generate awareness in society.	U	9
5	Discuss the process of post embryonic development and regeneration	U	9
6	Learn the potential of stem cells	U	9

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level:R-Remember; U- Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG2ZOOC07- DEVELOPMENTAL BIOLOGY

72 Hours **Credit – 4**

Module	Course Description	Hours	CO No.
1	**Introduction: Basic Concepts of Development** **1.1**. Potency of embryonic cells **1.2**. Commitment **1.3.** Specification (Autonomous and Conditional)	**12hrs**	**1,2,3**

	1.4. Induction and Competence **1.5.** Determination and Differentiation **1.6**. Cell fate and Cell lineages **1.7**. Genomic equivalence **1.8**. Cytoplasmic determinants **1.9** . Morphogenetic gradients **1.10**. DNA methylation **1.11**. Genomic imprinting		
2	**Gametogenesis, Fertilization and Early development** **2.1.** Spermatogenesis and Oogenesis **2.2**. Fertilization-(biochemical and molecular aspects), Polyspermy **2.3**. Mechanisms and significance of cleavage, Blastulation **2.4**. Embryonic fields and Gastrulation.	**12 hrs.**	**1,2,3**
3	**Embryogenesis of Model organisms** (cleavage,midblastula- transition,gastrulation) **3.1**. Axis formation in Amphibia –primary embryonic induction, Anterior-posterior patterning in Amphibia- Hox code hypothesis **3.2.** Axis formation in *Drosophila* Anterior-posterior patterning in *Drosophila* (Maternal effect genes, zygotic genes, gap genes, pair rule genes, segment polarity genes; homeotic selector genes, realisator genes), Dorsal-ventral patterning and left right patterning, Dorsal protein gradient.	**8hrs**	**1,2,3.**
4	**Organogenesis of Model organisms** **4.1**. Limb development in chick **4.2**. Insect wings and legs **4.3**. Vulva formation in *Caenorhabditis elegans*	**12hrs**	**1,2,3.**
5	**Cellular Interactions in Development**	**14hrs**	**1,2,3.**

	5.1. Cellular interaction during blastulation and gastrulation Nieuwkoop centre and mesodermal polarity Molecular basis of mesoderm induction. Transcription factors induced in the Organizer and Neural induction **5.2**. Cellular interaction during organogenesis Epithelial- mesenchyme interaction Regional specificity of induction, Genetic specificity of induction **5.3**. Paracrine factors - Hedgehog family, Wnt family, TGF- β family and BMP family **5.4**. Surface receptors and signal transduction pathway RTK pathway, Smad pathway, Wnt pathway, Hedgehog pathway and cell death pathway		
6	**Metamorphosis and Regeneration** 6.1.Metamorphosis of Amphibians and Insects Hormonal control of metamorphosis. Heterochrony- neoteny, progenesis (Brief accounts) **6.2**. Regeneration Different types of regeneration Histological processes during regeneration Polarity and Metaplasia in regeneration **6.3**. Lens regeneration in amphibia; Bone and neural regeneration (Medical -Advances in regeneration).	**8 hrs.**	**5.**
7	**Teratogenesis** **7.1**. Malformations and disruptions, Gene–phene relationship, Autophene, Allophene and Pleiotrophy	**4 hrs.**	**4.**

	Teratogenic agents (*Retinoic acid, pathogens, alcohol, drugs and chemicals, heavy metals*) **7.2** .Environmental oestrogens.		
8	**Human welfare and developmental biology** **8.1**. Stem cells and their applications, ethical issues.	**2hrs**	**6.**

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SEMESTER II

BLUE PRINT

PG2ZOOC07- DEVELOPMENTAL BIOLOGY

Module	**Hrs Alloted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	12	2	1	-	3
2	12	1	1	1	3
3	8	1	1	1	3
4	12	2	1	-	3
5	14	2	2		4
6	8	2	1	1	4
7	4	-	-	1	1
8	2	-	1	-	1
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER II

PG2ZOOC07- DEVELOPMENTAL BIOLOGY

Time: 3 Hrs **Max. Weight: 30**

Part A- Very Short Answer Questions
Answer any 8 questions. Each question carries Weight 1

1. Specification.
2. Embryonic fields.
3. Pleiotrophy
4. DNA methylation
5. Realisator gene
6. Transcription factors
7. Nieukoop center.
8. Embryonic induction.
9. Fast block to polyspermy.
10. Mid- blastula transition **(8 x 1 = 8wt)**

Part-B - Short Essay questions
Answer any 6 questions. Each question carries Weight 2

11. Describe the molecular mechanism of mesoderm induction
12. Write an account on epithelial-mesenchymal interaction.
13. Discuss the roles of RTK pathway and cell death pathway in development.
14. Explain the different types of regeneration
15. What are paracrine factors? Comment on Hedgehog family and Wnt family
16. Discuss on stem cells, their significance and application.
17. Explain vulva formation in *Caenorhabditis elegans*
18. Explain the biochemical and molecular aspects of fertilization. **(6 x2 = 12wt)**

Part C- Long Essay Questions
Answer any 2 questions. Each question carries weight 5

19. Write an essay on type and mechanism of cleavage.
20. Describe the axis and pattern formation in Drosophila
21. Assess the hormonal control of metamorphosis in Amphibia
22. Justify teratogenesis with suitable examples. **(2 x5 = 10wt)**

SEMESTER II

M.Sc. ZOOLOGY

PG2ZOOC08- BIOPHYSICS, INSTRUMENTATION

AND BIOLOGICAL TECHNIQUES

72 Hours
(4hrs/week) **Credit 4**

Course outcomes

CO No.	Course outcome	Cognitive level	PSO No.
1	Learn the biophysical properties and functioning of life processes	R, U, Ap, An, E	1,4,5,8
2	Acquire skills in tools and techniques available for studying biochemical and biophysical nature of life	R, U, Ap, An, E, C	1,4,5,8
3	Equip the learner to use the tools and techniques for project work/ research in biology.	R, U, Ap, An, E, C	4,5,8
4	Get skills in histological & biochemical techniques.	R, U, Ap, An, E, C	1,4,5,8
5	Learn the application of radiations in medical treatments.	R, U, Ap, An, E	1,4,5,8

PSO-Program Specific outcome; CO-Course Outcome

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

SEMESTER II

PG2ZOOC08- BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

72 Hours **Credit 4**

Unit/Module	Contents	Content Mapped to CO No	Hours
Unit 1 Biophysics Module 1	**Diffusion and Osmosis** 1.1.Diffusion -Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient, Biological significance in animals and plants, Electrochemical gradient, Stokes-Einstein equation and Graham's law, Facilitated diffusion, Gibbs-Donnan equilibrium. **1.2.**Osmosis- osmotic concentration and Osmotic pressure, Van't Hoff's laws. Biological significance of osmosis in animals and plants.	**1,3**	**6hrs**
2	**Biophysics of Cell Membrane** **2.1.**Physico-chemical properties of cell membrane, conformational properties of cell membranes, Membrane Transport – endocytosis, exocytosis, Nutrient transport across membranes, porins facilitated diffusion, porter molecules; Facilitated transport: symport, antiport, uniport, anion porter, glucose porter; Active transport:	**1,3.**	**10 hrs**

	proton pumps, Na+ K+ pumps and Ca++ pumps, ionic channels. Functions of cell membrane. Artificial membranes.		
3	**Bioenergetics** **3.1**.Thermodynamics- Laws of thermodynamics, Entropy, Enthalpy, Free energy. **3.2**.Reversible thermodynamics and irreversible thermodynamics; Systems – open, closed and isolated. Photo bioenergetics. Photosynthesis– light and dark reactions, Redox couple and redox potential. Chemo-bioenergetics: Electron transport and oxidative phosphorylation, Chemiosmotic theory and binding change mechanism of ATP synthesis.	**1,3**	**10hrs**
4	**Radiation Biophysics**. **4.1**.Ionizing radiation, units of radioactivity, exposure and dose. **4.2.** Interaction of radiation with matter – Photoelectric effect, ion pair production, absorption and scattering of electrons. **4.3**. Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates. Cellular effects of	**1,3,4,5**	**9hrs**

	radiation: somatic and genetic. Safety guidelines **4.4**.Nuclear medicine: Internally administered radioisotopes. Radioiodine in thyroid, renal, liver and lung function analysis (brief). **4.5.** Application of radioactive tracers, Radiation protection and therapy.		
Unit 2 Instrumentation & Biological Techniques 5	**Microscopy** **5.1**.Light microscope and dark field microscope, Phase contrast microscope, Polarizing microscope, Birefringence fluorescence microscope and camera lucida **5.2**.Differential Interference contrast (Nomarsky)microscopy, Confocal microscope, Electron microscope – TEM, SEM, Scanning Tunnelling and Atomic Force Microscopes, Near field Object Microscopy and Foldscope.	**1,2,3,4.**	**5hrs**
6	**Chromatography and Electrophoresis** **6.1**.Paper chromatography, Thin layer chromatography, Ion exchange chromatography. Gel permeation chromatography, Affinity chromatography, Gas chromatography. High pressure liquid chromatography	**1,2,3,4.**	**10hrs**

	(HPLC). 6.2. Paper electrophoresis, Gel electrophoresis, Polyacrylamidegel electrophoresis (PAGE) – SDS and non SDS, Agarose gel electrophoresis, Disc electrophoresis, High voltage electrophoresis, Immuno-electrophoresis, Isoelectric focusing.		
7	**Colorimetry, Spectrophotometry and Spectroscopy** 7.1.Principle and applications of colorimetry and spectrophotometry. Spectroscopy: Flame emission spectroscopy, Atomic absorption spectroscopy, Nuclear Magnetic-resonance spectroscopy (NMR), Circular dichroism spectroscopy, ESR spectroscopy, Mass spectroscopy. Surface Plasma Resonance methods	**1,2,3,4.**	**5hrs**
8	**Centrifugation** **8.1**. Basic principles of sedimentation, Types of centrifuges, Analytical and Preparative centrifugation, Differential and density gradient centrifugation.	**1,2,3,4.**	**3hrs**
9	**Radioisotope Detection and**	**1,2,3,4,5.**	**2hrs**

	Measurement **9.1**.Dosimetry: Ionization chamber, GM counter, Solid and liquid scintillation counters, Autoradiography.		
10	**Nanotechnology, Assays and pH meter** **10.1**.Introduction to Nanobiology. Nanosensors and Nanomedicines. **10.2**.Radio ImmunoAssay Enzyme Linked Immuno Sorbant Assay (ELISA). **10.3**. Principle and working. Types of pH meters.	**1,2,3,4.**	**5hrs**
11	**Biological and Histological Techniques** **11.1**. Fixation, preparation of temporary and permanent slides, Whole mounts, Smears, Squashes and Sections. Specimen preparation for TEM, SEM, PET, CTE shadow casting, Freeze fracturing, freeze etching, Negative staining. Microphotography. **11.2**.Cytochemical and histological methods- Microtome techniques, fixation, staining. Cytochemistry of nucleic acids, detection of carbohydrates, proteins and lipids.	**1,2,3,4.**	**7hrs**

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SEMESTER II

BLUE PRINT

PG2ZOOC08- BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

Unit/Module	**Hrs Allotted**	**Part A Weight 1 8/10**	**Part B Weight 2 6/8**	**Part C Weight 5 2/4**	**Total questions**
Unit 1 Module 1	6	2			**2**
2	10	1		1	**2**
3	10	1		1	**2**
4	9	1	1		**2**
Unit 2 5	5	1	1	1	**3**
6	10	1	1	1	**3**
7	5	1	1		**2**
8	3		1		**1**
9	2		1		**1**
10	5	1	1		**2**
11	7	1	1		**2**
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER II

PG2ZOOC08- BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

Time: 3 hours **Maximum wt: 30**

Part A- Very Short Answer Questions

Answer any 8 questions. Each question carries Weight 1

1. State Vant Hoff's law.
2. Write notes on Fick's law of diffusion.
3. Comment on artificial membranes.
4. Distinguish between redox potential and redox couple.
5. Comment on photoelectric effect.
6. Write notes on phase contrast microscope.
7. Comment on disc electrophoresis.
8. Write notes on the principle of calorimetry
9. Write notes on autoradiography.
10. Distinguish between freeze fracturing and freeze etching. **(8 x 1= 8 wt)**

Part B - Short essay questions

Answer any 6 questions Each question carries Weight 2

11. Explain the biological effects of radiation.
12. Write notes on the principle and application of atomic force microscope.
13. Write down the principle and application of PAGE.
14. Describe NMR spectroscopy.
15. Describe the principle and types of centrifugation.
16. Explain the principle and applications of scintillation counters.
17. Elaborate the principle and applications of ELISA
18. Explain the specimen preparation techniques for TEM and SEM. **(6 x 2= 12 wt)**

Section III (Long essay questions)

Answer any two questions. Each question carries Weight 5 .

19. Explain the physicochemical properties of cell membrane.
20. Describe the light and dark reactions of photosynthesis.
21. Elaborate the principle and applications of different types of electron microscopes.
22. Write an essay on the principle and types of chromatography. **(2x5= 10 wt)**

SEMESTER II

M.Sc. ZOOLOGY PRACTICAL II

PG2ZOOPO2: ECOLOGY, GENETICS AND BIO-INFORMATICS, DEVELOPMENTAL BIOLOGY, BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES.

180 Hours (10 hrs./week) **Credit-3**

Ecology

- Study of Pond/ wetland/ River ecosystem- Food web and food chain (no museum specimen). Record the date, time, methodology, and observations in the record book.
- Determination of soil organic carbon and chlorides.
- Separation and identification of soil arthropods using Berlese funnel.
- Qualitative and Quantitative study of marine/freshwater planktons. Estimation of primary productivity.
- Quantitative estimation of salinity, phosphates and nitrates in water samples.
- Study of pH and conductivity using pH and conductivity meter (2different samples).
- Principles and application of the following instruments: Rain Guage, Plankton Net, Secchi Disc, GPS.
- **Field Study Report:** Three days field study covering River/ Wetland/ Marine and forests/ grassland.
- Record ecosystem components (Soil, water, flora, fauna) and interactions. Viva based on Field study.

Developmental Biology

- Identification of different developmental stages of frog (egg, blastula, gastrula, neurula, tadpole, with external gill and internal gill).
- Vital staining of early gastrula of chick – window method.
- Blastoderm mounting of chick embryo using vital stains.
- Morphological and histological studies of different types of placenta in mammals.
- Study of serial sections of embryo - chick).
- Regeneration studies in animals. (Zebra Fish/ Earth worm).

Genetics and Bioinformatics

- Culture, sexing and etherization of *Drosophila.* Study of Mutants in *Drosophila.*
- Genetics problems (Di hybrid cross, test cross and sex linked inheritance). Abnormal human karyotypes (any five).
- Data base search and data retrieval-using NCBI, SWISS-PROT, PDB, Expasy. Methods of sequence alignment-BLAST and ClustalW.
- Phylogenetic tree using PHYLIP.
- Gene Prediction using GENSCAN/GRAI. Protein structure visualization using RASMOL.

Biophysics/Instrumentation/Biological Techniques

- Micrometry- principle and measurement of microscopic objects: Low power and high power.
- Camera Lucida drawing with magnification and scale.
- Principle and working of phase contrast microscope, micro-photographic equipment and pH meter.
- TLC using amino acids from purified samples and biological materials.
- Study of Enzyme kinetics - Salivary amylase on maltose standards- influence of temperature and Substrate concentration on enzyme activity (Lineweaver Burk Plot) on enzymeactivity.

SEMESTER II

Model Question Paper

II SEMESTER M.SC DEGREE PRACTICAL EXAMINATION (CSS) - ZOOLOGY - PRACTICAL 2- PG2ZOOPO2: ECOLOGY, GENETICS AND BIOINFORMATICS, DEVELOPMENTAL BIOLOGY, BIOPHYSICS AND INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

Time: 4 Hours **Total Weightage: 15**

Part A (Wt. 1 X4 =4 wt)

I.a. Identfy the instrument andcomment on its principle and applications.

b. Identify and comment on morphological and histological details of the mammalian placenta provided

c. Identify the given specimen and comment on its trophic level in the food chain

d. Viva based on field study

Part B (Wt. 2 X 3 =6)

II..**a**.Download the structure of a macromolecule from PDB and use RASMOL to display it in the Specific format (Download-1, Display-13

b. Prepare a temporary whole mount of live chick embryo (33-48 hrs) and stain it using a suitable vital dye. Determine the approximate age giving reasons. (Expt-1wt, Determination of age-1 wt)

c. Genetic problem

A sex-linked recessive gene(c) produces red green colour-blindness in humans. A normal woman whose father was colour blind marries a colour-blind man,

a)What genotypes are possible for the mother of the colour-blind man ?

b) What are the chances that the first child from this marriage will be a colour blind boy ?

c) Of all the girls produced by these parents, what % is expected to be colour blind?

d) Of all the children (sex unspecified) from these parents, what proportion is expected to be normal?

(working 1, Answer 1)

Part C (Wt. 4 X1=4)

Estimate the phosphate content of the water sample provided Give the principl

(Principle-1, Estimation 2, Calculation and result-1)

IV. Certified Record (Weightage 1)

SEMESTER III

M.Sc. ZOOLOGY

PG3ZOOC09- ANIMAL PHYSIOLOGY

72 Hours.
(4 hrs/week) **Credit-4**
Course Outcome

CO No.	Course outcome	Cognitive level	PSO No.
1	Develop critical thinking skills and apply physiological concepts and principles at the basic and applied levels.	R, U, Ap, An, E	1,2,4,8
2	Develop a working knowledge of major physiological systems and be able to associate anatomical areas with their specific function.	R, U, Ap, An, E, C	1,2,4,8
3	Understand important physiological challenges animals face and the processes by which animals deal with them.	R, U, Ap, An	1,2,4,8
4	Identify and describe structural differences of major physiological systems that characterize different taxonomic groups of animals.	R, U, Ap, An	1,2,4,8
5	Relate physiological processes—from the biochemical to the system level—to the function of the entire organism in its environment	R, U, Ap, An, E	1,2,4,8

PSO-Program Specific outcome; CO-Course Outcome

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate;

C-Create.

SEMESTER III

PG3ZOOC09- ANIMAL PHYSIOLOGY

72 Hours.

Credit-4

Unit/Module	Contents	Content Mapped to CO No	Hours
1	**Nutrition, Digestion and Absorption** **1.1.**Physiology of digestion and absorption.\ **1.2.**Symbiotic digestion. **1.3.**Neuronal and hormonal regulation of nutritional intake, hunger drive, thirst. **1.4.**Obesity- causes and consequences, outline of hormonal involvement, Leptin: synthesis, secretion and its role in adipogenesis	**2,4,5**	**6 hrs**
2	**Circulation** **2.1.**Circulatory mechanisms in different animal groups **2.2.**Comparative anatomy of heart structure in different animals **2.3.**Pace makers and specialized conducting fibers. **2.4.**Cardiac cycle, cardiac output, Blood buffers **2.5.**ECG - its principle and significance.	**2,4,5.**	**8hrs**
3	**Respiration** **3.1.**Respiration in invertebrates and vertebrates. **3.2.**Pulmonary ventilation,Neural and hormonal regulation of respiration. **3.3.**Respiration in unusual environment – foetal and neonatal respiration, high altitude, diving..	**1,2,3,4,5**	**8hrs**

4	**Osmoregulation and Excretion** **4.1.**Osmoregulation in fresh water, marine and terrestrial animals. **4.2.**Excretion in vertebrates. **4.3.**Physiology and regulation of urine formation . **4.4.**Regulation of water balance, electrolyte balance and acid-base balance. **4.5.**Dialysis, artificial kidney, kidney transplantation.	**2,4,5.**	**8 hrs**
5	**Nerve Physiology** **5.1.**Neuroanatomy of the central and peripheral nervous system. **5.2.**Synaptic transmission- Electrical and chemical transmission Modifications of synaptic transmission **5.3.**Mechanism of excitatory and inhibitory pathway. **5.4.**Neuromuscular Junction: organization and properties of neuromuscular junction. **5.5.**Neurotransmitters, Neuromodulators.	**2,4,5.**	**6 hrs**
6	**Sensory and Effector Physiology** **6.1**.Classification of somatic senses and somatic receptors, exteroceptors, interoceptors **6.2**. Modality of sensation **6.3**. Chemical senses: taste, smell, mechanism of reception. **6.4.**Mechanoreceptors: Mechanism of hearing and equillibrium. **6.5.**Photoreceptors: Structure of vertebrate eye. Physiology of vision. **6.6.**Pain: pain receptors, headache and pain suppression (analgesia). **6.7.**Tactile sensation: touch receptors, transmission of signals,	**2,4,5.**	**9 hrs**
7	**Muscle Physiology**	**2,4,5.**	**6 hrs**

	7.1. Skeletal muscle- ultra structure and molecular organization. **7.2.**Red and white muscles, muscle proteins. **7.3.**Mechanism of muscle contraction and relaxation. Energetics of muscle contraction. **7.4.**Catch muscle and fibrillar muscle.		
8	**Thermoregulation** **8.1**. Comfort zone, body temperature-oral,skin and core. physical, chemical, neural regulation **8.2.** Temperature compensation and temperature regulation in poikilotherms and homiotherms **8.3.** Adaptations for extreme environments, aestivation and hibernation.	**3,4,5.**	**4 hrs**
9	**Endocrinology** **9.1**. Invertebrate and vertebrate endocrine glands. **9.2.** Synthesis(Insulin,steroid hormones,Thyroxine) physiological role and mechanism of hor action **9.3**. Bioamines, Ecosanoids, Chalones, Lumones, Synthetic hormones.	**2,4,5.**	**10 hrs**
10	**Reproductive physiology** **10.1.**Anatomy and histology of adult testis and ovary. **10.2.**Human reproductive cycle and its hormonal regulation. **10.3.**Physiology of implantation, pregnancy, parturition, and lactation	**2,4,5.**	**7 hrs**

8 **hr**

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SEMESTER III

BLUE PRINT

PG3ZOOC10- ANIMAL PHYSIOLOGY

Unit/Module	**Hrs Allotted**	**Part A Weight 1 8/10**	**Part B Weight 2 6/8**	**Part C Weight 5 2/4**	**Total questions**
1	6	1			**1**
2	8	1	1	1	**3**
3	8	1	1		**2**
4	8	1	1	1	**3**
5	6	1	1		**2**
6	9	1	1	1	**3**
7	6	1	1		**2**
8	4	1			**1**
9	10	1	1	1	**3**
10	7	1	1		**2**
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER- III

PG3ZOOC10- ANIMAL PHYSIOLOGY

Time: 3 Hrs **Max. wt 30**

Part A- Very Short Answer Questions.

Answer any 8 questions. Each question carries wt 1.

1. Differentiate between neurogenic and myogenic heart.
2. What is symbiotic digestion?
3. Which hormones regulate urine formation in humans?
4. Comment on synthetic hormones.
5. What are Sertoli cells?
6. Mention the role of Organ of Corti?
7. Comment on its medical significance of ECG.
8. What are chemical messengers? Give four examples.
9. Write a brief note on estrous cycle..
10. Mention the role of leptin in adipogenesis. **(8x 1 = 8 wt)**

Part B- Short essay questions.

Answer any 6 questions. Each question carries wt 2.

11. Give a brief account on the hormonal control of carbohydrate metabolism.
12. What is BMR? Explain its measurement.
13. What is implantation? Elaborate.
14. Describe the structure of a neuron.
15. Explain the ultra structure of skeletal muscles.
16. What are the mechanisms of temperature regulation in Poikilotherms and
17. homiotherms?
18. Give an account on thyroid hormone disorders in Man. **(6 x2 = 12 wt)**

Part C - Long Essay Questions.

Answer any 2 questions. Each question carries wt 5 .

19. Describe the different types of hearts in animals. Comment on cardiac cycle and cardiac output.
20. Give a detailed account of the structural organization and properties of neuromuscular junctions.
21. Describe the Structure of vertebrate eye. Explain physiology of vision.
22. Describe the process of urine formation

(2x5=10 wt)

SEMESTER III

M.Sc. ZOOLOGY

PG3ZOOC10 - CELL AND MOLECULAR BIOLOGY

72 Hours **Credit-4**

(4hrs/week)

CO No.	Course outcome	PSO No.
1	Understand the structural and functional details of the basic unit of life at the molecular level.	1,4, 8.
2	Analyse the basics of cell biology.	3,6,8.
3	Evaluate the new developments in Cell & Molecular biology and its implications in human welfare	4,5, 7.
4	Create a thorough knowledge on types and properties of Cells and genetic basis of cell reproduction.	1,2,4.
5	Apply the new strategies in cell functioning and treatments of cellular abnormalities.	6,7,8.

PSO-Program Specific outcome; CO-Course Outcome

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

PG3ZOOC10 - CELL AND MOLECULAR BIOLOGY

72 Hours **Credit-4**

Module	Content	Content mapped to CO	Hrs
1	**Cellular Membranes, Cell junctions, Cell adhesion and Extracellular matrix.** **1.1**. Membrane structure, Chemical and dynamic nature of the plasma membrane, liposomes and its application. **1.2.** Extracellular matrix: Basal membrane and laminin, Collagen, Proteoglycan,Fibronectin. **1.3** .Interaction of cells with extracellular matrix: Integrins.	**1,2, 3,4.**	**13 hrs**

	1.4 . Focal adhesion and hemidesmosomes. **1.5** Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins. **1.6** . Adherens Junctions and desmosomes. **1.7** .Tight junctions,Gap junctions and Plasmodesmata.		
2	**Cell Organelles** **2.1.** Endoplasmic reticulum, Golgi complex, Ribosome, Mitochondria. **2.2** .Lysosome, Chloroplasts, Peroxisomes and Glyoxysome **2.3** .Cytoskeleton and Cell Motility Microtubules, Microfilaments, Intermediate filaments, Molecular motors, Non muscle motility and contractility.	**1,2,3.**	**13hrs**
3	**Cell Signaling** **3.1** .Basic principles of cell communication **3.2** .Extracellular messengers (signaling molecules), role of Calcium and Nitric oxide (NO) as intracellular and intercellular messengers. **3.3** .Receptors: G- Protein coupled receptors, Receptor tyrosine kinases (R TK), Ion channel receptors, Cytokine receptors (Tyrosine kinase linked receptors). **3.4** .Second messengers: Cyclic-AMP, Cyclic-GMP, Inositol 1,4,5-trisphosphate (IP3), Di-acyl glycerol (DAG). **3.5** .Signaling pathways: G-protein coupled receptor (GPCR) and cyclic AMP pathway – role of protein kinase A (PKA), GPCR pathway in rod cells, Receptor protein tyrosine kinase and Ras-MAP kinase pathway, JAK-STAT pathway, Calcium phosphatidyl- inositol pathway, PhosphoInositide 3-kinase (PI-3 kinase),Transforming growth factor (TGF) signaling pathway. **3.6** .Regulation of signaling pathways.Convergence, divergence and crosstalk among different pathways.Bacterial chemotaxis and quorum sensing	**1,2,3,4,5**	**14 hrs**

4	**Cellular Reproduction** **4.1** . Cell cycle: Steps in cell cycle, Control of cell cycle, Checkpoints in cell cycle. Control of cell division and cell growth. **4.2.** Apoptosis- extrinsic and intrinsic pathways, significance	**1,2,4,5.**	**5 hrs**
5	**Cancer** **5.1** . Basic properties of a cancer cell, Types of cancer, Causes of cancer, Genetics of cancer, Tumour suppressor gene, Oncogene. Cancer and cell cycle. **5.2** .New strategies for combating cancer: Immunotherapy, Gene therapy, Inhibiting cancer promoting proteins, Inhibiting formation of new blood vessels.	**2,3,5.**	**5 hrs**
6	**Gene Expression** & **Regulation** **6.1**. .Relationship between genes and proteins.Transcription in prokaryotes and eukaryotes- Hn RNA and mRNA. rRNA, tRNA **6.2** RNA processing in prokaryotes and eukaryotes. **6.3** Translation in prokaryotes and eukaryotes, initiation, elongation and termination. **6.4** .Post translational modifications, protein sorting, signal sequences and signal hypothesis. **6.5**.Regulation of gene expression in *E. coli* : Catabolite repression, *Trp* operon in *E.coli*-repression and attenuation, *Ara* operon in *E.coli*-positive and negative controls. **6.6**. Riboswitches. **6.7**. General introduction to gene regulation in eukaryotes at transcriptional, post transcriptional and translational levels, transcription factors, enhancers and silencers, **6.8** .Chromatin-remodelling complexes, RNA interference (RNAi).	**1,2,3,5.**	**22 hrs**

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PG2ZOOC10- CELL BIOLOGY & MOLECULAR BIOLOGY

Module	**Hrs Alloted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	13	2	1	1	4
2	13	2	2	1	5
3	14	2	2	1	5
4	5	1	-	-	1
5	5	1	1	-	2
6	22	2	2	1	5
Total	**72**	**10**	**8**	**4**	**22**

PG4ZOOC10 – CELL BIOLOGY & MOLECULAR BIOLOGY

Time: 3 Hrs **Max. Weight: 30**

Part A- Very Short Answer Questions.

Answer any 8 questions. Each question carries Weight 1.

1.Liposomes and its applications.

2. Types of Lysosomes.

3. Post transctmription modifications in Eukaryotes .

4. What are Cadherins.

5. Comment on microtubules.

6. What are signaling molecules.

7. Intercellular messengers.

8. Oncogenes.

9. Apoptosis.

10.Riboswitches . **(8 x 1 = 8 Wt)**

Part B- Short Essay questions.

Answer any 6 questions. Each question carries Weight 2

11. Post transcription modifications in Eukaryotes .

12. Lysosomes .

13. Extra cellular messengers.

14. Briefly explain the mechanism of gene regulation in *E. coli*.

15. G- protein coupled receptor pathway.

16. Molecular motors.

17. What are hemidesmosomes.

18. Immunotherapy. **(6 x2 = 12 Wt)**

Part C-Long Essay Questions.

Answer any 2 questions. Each question carries weight 5.

19. Write an account on cell membrane surface modifications . Comment on molecules involved in cellular interactions.

20. Write an essay signaling pathways. .

21. Translation in Eukaryotes. What are post translation modifications.

22. Give the organization of Cytoskeleton. .

SEMESTER III

PG3ZOOC11 MICROBIOLOGY AND BIOTECHNOLOGY

72 Hours

(4hrs/week) **Credit- 4**

Course Outcome

CO No.	Course outcome	Cognitive level	PSO No.
1	Apply the knowledge to understand the microbial physiology and to identify the microorganisms.	R, U, Ap, An, E	1,3,4,5,8
2	Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.	R, U, Ap, An, E, C	1,3,4,5,8
3	Apply the knowledge gained in different control measures in life	R, U, Ap, An, E, C	3,4,5,8
4	Evaluate the pros and cons of application of Microbiology and Biotechnology in life	R, U, Ap, An, E, C	1,3,4,5,8
5	Understand the different techniques in Microbiology and Biotechnology	R, U, Ap, An, E	1,3,4,5,8
6.	Create a rationale thinking about the occurrence and control of different diseases	R, U, Ap, An, E	1,3,4,5,8
7.	Justify the ethics in Biotechnology	R, U, Ap, An, E	1,4,5,8

PSO-Program Specific outcome; CO-Course Outcome

Cognitive Levels: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

SEMESTER III

PG3ZOOC11 MICROBIOLOGY AND BIOTECHNOLOGY

72 Hours **Credit- 4**

Unit/Module	Contents	Content Mapped to CO No	Hours
Unit1 Microbiology Module-1.	**General characters of microorganisms- Bacteria, virus, fungi.** **1.1** .Outline classification of micro organisms • Functional Anatomy of Prokaryotic Cells -Cell structure, plasma membrane, cytoskeleton, cytoplasm, nucleoid, cytoplasmic inclusions. • The prokaryotic cell envelope, peptidoglycan structure, gram positive and negative cell walls. • Components outside the cell wall: capsules, slime layers, pili and fimbriae, flagella and motility. **1.2.Virology** • Properties of viruses, structure and chemical composition, genetic composition, eclipse, host interaction and specificity. • Classification- RNA virus, DNA virus, plant virus, animal virus, bacteriophage, lysis and lysogeny, Viral replication. Viroid and prions. Nature and significance. • Pathogenic virus, oncovirus, Emerging viral threats	**1,2,3,6.**	**8 Hours**

2	**Microbial Metabolism** **2.1**. Energy acquisition by chemotrophs and phototrophs, glycolysis (Embden-Meyerhof pathway). **2.2** .Fermentation, anaerobic oxidations, chemosynthesis. **2.3**.Photosynthesis, carbon assimilation. **2.4**. Regulation of metabolism.	**1,2,3.**	**4 Hrs**
3	**Microbial Growth and Interactions** **3.1**. Nutrient requirements, growth factors, uptake of nutrients by the cell. **3.2**. Growth curve. **3.3** .Physical requirements for bacterial growth and influence of environmental factors on growth. **3.4** .Symbiosis, Commensalism, Mutualism between microbes, microbes and plants, microbes and animals. Cooperation, competition, predation, antagonism. Parasitism, plant parasites, animal parasites. **3.5** .Microbial communication system-Quorum sensing, Biofilms	**1,2,3.**	**8 Hrs**
4	**Applied Microbiology** **4.1.** Bacteria of air, water and soil. **4.2**.Microbes associated with food production and spoilage, microbiology of milk and dairy products **4.3.**Epidemiology of human diseases,	**1,2,3,4,5,6.**	**10 Hrs**

	Mechanismof microbial pathogenicity. **4.4.**Normal microbial population on human body, microbial diseases, Nosocomial infections, Drug resistance in Bacteria **4.5.**Medical mycology. **4.6.**Control of microorganism- physical, chemical and antimicrobial agents. **4.7.**Biological weapons and bioterrorism.		
Unit-2 Biotechnology **5**	**Tools and Techniques in Recombinant DNA Technology** **5.1**.Vectors: cloning and expression vectors - Plasmids, Ti and Ri plasmids, cosmids, phasmids, phagemids, bacteriophage, SV40. • Vectors with combination features; PUC19 and Blue-script vectors. • Shuttle vectors, viral vectors. • BAC and YAC vectors. **5.2**.Restriction enzymes and DNA modifying enzymes. **5.3.**Polymerase chain Reaction- Types (Inverse PCR, Anchored PCR, Asymmetric PCR, Real time PCR, Solid Type PCR) and applications. **5.4**.Chromosome walking, chromosome jumping, DNA foot printing. **5.5**.Molecular Markers -SNP, VNTR, RAPD, RFLP, SSR, STMS, FISH and GISH. **5.6**.Molecular Probes-Production labelling and application **5.7**.DNA sequencing methods-	**1,5.**	**15 Hrs**

	• Maxam and Gilberts chemical degradation method. • Sanger and Coulson method, • Automated DNA sequencers. • Site directed mutagenesis, • molecular chimeras. **5.8.**Cloning Methodologies – • Gene isolation: Shot gun method, • Genome libraries, cDNA libraries, • Chemical synthesis. Splicing and integration of isolated gene-cohesive end ligation, homopolymertailing,extending linkers. • Methods of rDNA transfer to host cells- CaCl2 treatment, Virus delivery. • Selection and screening of the transformed cells, Blue-white screening, Colony hybridization methods, Reporter genes, Fusion proteins. **5.9**. Gene silencing technique-Antisense RNA, RNAi		
6	**Animal Biotechnology** **6.1**.Animal cell and tissue culture –Culture media -natural and artificial **6.2**.Culture methods –Primary ex-plantation technique, Various methods of cell and tissue culture **6.3**.Tissue and organ culture,	**2,3,5.**	**10 Hrs**

	Tissue engineering: strategies and developments in tissue engineering, **6.4**.Transfection Methods: CaPO4 precipitation, Short Gun, Electroporation, Lipofection, Microinjection, Agrobacterium mediated gene transfer. **6.5**.Somatic cell nuclear transfer-reproductive cloning and therapeutic cloning. Gene knockout and knockin technology. Applications of transgenic animals. **6.6.** Stem cell culture: General and historical aspects, properties and types of stem cells, advantages and disadvantages, stem cell niche, application of stem cell technology in medicine		
7	**Biotechnology Application** **7.1. Healthcare** • Disease prevention – DNA vaccines. • Disease diagnosis - Probes, • Monoclonal antibodies, • Detection of genetic disorders. • Disease treatment - Therapeutic proteins, • Hormones and growth factors. RNAi, • Drug targeting, Gene therapy. • Forensic medicine. • Biosensors-different types, • Applications - medical and non medical. • Introduction to Biochips and their application in modern sciences.	**1,3,4,5.**	**13 Hrs**

	7.2. Environment • Pollution control- Cleaner technologies, • Toxic site reclamation, • Removal of oil spill, • Reduction of pesticide and fertilizers, • Biosensors, Biomonitoring • Restoration of degraded land – • Reforestation using micro propagation, • development stress tolerant plants **7.3. Industry and Agriculture** • Metabolite production. Antibiotics, Organic acids, Amino acids, Vitamins, • Upstream processing, downstream processing. • Microbial enzymes and bio transformation. • Microbial production of enzymes, fermentation, • Enzyme engineering and applications. Food industry- Single cell protein, probiotics. • Transgenic plants- Plants with resistance to Pests, plants with increased shelf life. • Biofertilizers and microbial inoculants. • Biotechnology of nitrogen fixation, biocontrol agents, biopesticides, bioinsecticides. • Terminator gene technology -concept and basics.		
8	**Intellectual Property Rights, Biosafety and Bioethics** **8.1**. Introduction to Intellectual Property	**1,4,5,7.**	**4 Hrs**

	Rights, • Types of IP: Patents, • Trademarks, Copyrights. • Basics of Patents, Types of patents; • Indian Patent Act 1970; • Recent Amendments, • Protection of New GMOs. • IPs of relevance to Biotechnology and few Case Studies (Rice, Neem, Curcumin). **8.2.** Introduction to History of GATT, WTO, WIPO and TRIPS. **8.3.** Biosafety concepts and issues. • General guidelines for recombinant DNA research activity. • Biosafety protocol 2000 8.4. Bioethics: • Principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. • Ethics in post genomic era -genetic testing and genetic screening.		

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PG3ZOOC11 MICROBIOLOGY AND BIOTECHNOLOGY

Unit/Module	**Hrs Allotted**	**Part A Weight 1 8/10**	**Part B Weight 2 6/8**	**Part C Weight 5 2/4**	**Total questions**
Unit 1 Module 1	8	1	1	1	**3**
2	4	1	-	--	**1**
3	8	2	2	-	**4**
4	10	1	1	1	**3**
Unit 2 5	15	1	1	1	**3**
6	10	1	1	-	**2**
7	13	1	1	1	**3**
8	4	2	1	-	**3**
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER- III M.Sc. ZOOLOGY

PG3ZOOC11 MICROBIOLOGY AND BIOTECHNOLOGY

Time: 3 hrs **Max.Weight -30**

Part A - Short Answer Questions

I. Answer any 8 questions. Each question carries wt 1

1. Bioweapons
2. What is a Phagemid
3. Distinguish between pili and fimbriae
4. Explain Alcoholic Fermentation
5. Biochips
6. Intellectual Property Right
7. Explain any 2 positive interactions in microbes
8. TRIPS
9. Culture media
10. What is Electroporation

(8x1=8 wt)

Part B - Short Essay Questions

II. Answer any 6 questions. Each question carries wt 2

11. Comment on Transgenic Animals
12. Nosocomial Infections
13. Give a short account on DNA modifying enzymes
14. Explain the growth curve in Bacteria
15. Comment on the nutritional requirements of a cultural media
16. What is gene therapy
17. Explain Baltimore system of Classification of Virus
18. Explain the Bioethics in Biotechnology

(6x2=12 wt)

Part-C Long Essay Questions

III. Answer any two questions. Each question carries wt 5

19. Explain the Ultra Structure of Bacteria
20. Give a detailed account on molecular markers
21. Write an essay on the control of Microorganism
22. Describe the application of Biotechnology in the field of Health care

SEMESTER III

PG3ZOOC12- IMMUNOLOGY

Total: 54 Hours.
(3hrs./ week) **Credit- 3**

Course outcomes

CO No.	*Expected Course Outcomes* Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Provide an intensive and in-depth knowledge to the students in immunology.	R	4,5,8
2	Examine the advanced molecular- theoretical approach in Understanding antigen and antibodies and the interactions between them.	Ap	4,5,8
3	Understand the organisation, expression and regulation of Major Histocompatibility Complex	U	4,5,8
4	Create intensive and in-depth knowledge in immunological pathways like, complement system, inflammations, hypersensitivity etc.	C	4,5,8
5	Understand the role of immune system in human health and well-being and familiarize the students the new development in immunology.	U	4,5,8
6	Understand the advanced techniques in immunological diagnosis and other immunological techniques	U	4,5,8

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U- Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Creat

SEMESTER III

PG3ZOOC12- IMMUNOLOGY

Total: 54 Hours. **Credit- 3**

Module	Course Description	Hrs	CO. No.
1	**IMMUNOLOGY** **Overview of the Immune System** **1.1.**Types of Immunity- Innate and acquired, Passive and active. **1.2** Cells, tissues and organs involved in immune system. **1.3**.Humoral and cell-mediated immune responses. **1.4**. Haematopoiesis. B-cell and T-cell maturation and differentiation. **1.5**. Pattern recognition receptors- scavenger receptors and Toll – like receptors.	**3hrs**	**1**
2.	**Antigens and Antibodies** **2.1**. Antigen-structure and properties, Haptens, Adjuvants, Epitopes. **2.2.** Immunoglobulins-structure, classes and functions. **2.3.** Antigen processing and presentation. **2.4**. Monoclonal antibodies and abzymes. **2.5**.Multi- gene organization of Ig genes. Variable region gene arrangements. **2.6**. Generation of antibody diversity. Expression of Ig genes and regulation of Ig genes transcription. **2.7**. Antibody genes and antibody engineering.	**8 hrs**	**1,2.**
3	**Antigen –Antibody Interactions** 3.1. Types of antigen-antibody reactions - Cross-reaction, Precipitation, Agglutination. 3.2. Biological consequences of antigen-antibody reaction.	**2 hrs**	**1,2,4.**

4	**The Complement System** **4.1**. Terminal sequence of complement activation (MAC). Classical, Alternate and Lectin Pathways. **4.2.** Complement activation, Regulation of complement system.	**5 hrs**	**1,4.**
	4.3.Biological consequences of complement activation. Complement deficiencies.		
5	**Immune Effector Mechanisms** Inflammatory Cells. Types of Inflammation- acute and chronic. Chemokines. Role of cytokines in immune system Properties and functions of Cytokines. Therapeutic uses of cytokines.	**5 hrs**	**1,5.**
6	**Hypersensitivity** 6.1.Allergy and hypersensitivity. Types of Hypersensitivity 6.2. Genetics of allergic response in humans.	**4hrs**	**1,5.**
7	**Major Histocompatibility Complex** **7.1**. General organization and inheritance of MHC. **7.2.** MHC molecules and genes. Genomic map of H-2 Complex in the mouse. **7.3**. HLA Complex in humans. MHC-peptide interaction. **7.4**. Expression of MHC molecules on different cell types. **7.5**. Regulation of MHC expression. MHC and graft rejection. MHC and disease susceptibility. **7.6**. Biological significance of MHC. HLA typing	**8 hrs**	**1,3,5.**
8	**Immunity in Health and Disease** **8.1**. Immune response during bacterial (tuberculosis), Parasitic (Malaria) and viral (HIV) infections **8.2**.Congenital immunodeficiency diseases (SCID, WAS, CVI, Ataxia, CGD, LAD).Acquired Immunodeficiency Disease (AIDS). **8.3**.Autoimmunity. Organ- specific autoimmune diseases. Systemic auto-immune diseases.	**15 hrs**	**1,5,6**.

	8.4.Evidences implicating $CD4^+$ T cell, MHC and TCR in autoimmunity. Induction of autoimmunity. Treatment of autoimmune diseases. **8.5**.Transplantation immunology. Immunologic basis of graft rejection. Clinical manifestation of graft rejection. **8.6**. General and specific immunosuppressive therapy. Clinical transplantation. **8.7**. Tumour immunology. ***8.8***.Vaccines, Whole organism vaccines, Purified macromolecules as Vaccines. 8.9. Recombinant vector vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines.		
9	**Immunological Techniques** **9.1.** Serological Reactions. **9.2**. Radio-allergosorbent Test (RAST).Immunoprecipitation. **9.3.**Immunofluorescence. Flow cytometry and fluorescence. **9.4**.Immunoelectron microscopy.	**4**	**1,5,6.**

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PG2ZOOC12- IMMUNOLOGY

Module	Hrs Allotted	Part A Weight 1 8/10	Part B Weight 2 6/8	Part C Weight 5 2/4	Total Questions
1	3	1	1	-	2
2	8	2	1	1	4
3	2	-	1	-	1
4	5	-	-	1	1
5	5	2	1	-	3
6	4	1	1	-	2
7	8	1	1	1	3
8	15	2	1	1	4
9	4	1	1	-	2
Total	**72**	**10**	**8**	**4**	**22**

SEMESTER-III

COURSE PG3ZOOC12-IMMUNOLOGY

Time: 3 Hrs **Max. Weight: 30**

Part A- Very Short Answer Questions.

Answer any 8 questions. Each question carries Wt 1

1. Distinguish between active and passive immunity.
2. Define hapten. Give an example .
3. What are abzymes?
4. Write a short note on inflammatory response.
5. What are chemokines.
6. Write a short account on mediators of hypersensitivity.
7. Write a short note on cellular distribution of MHC molecules.
8. Write a brief note on organ specific autoimmune diseases.
9. Comment on peptide vaccines.
10. Write a short note on RAST.

(8 x 1 = 8 Wt)

Part B- Short essay type questions.

Answer any 6 questions. Each question carries Wt 2.

11. Give a brief account on secondary lymphoid organs.
12. Give an account on monoclonal antibodies.
13. Describe antigen-antibody reactions
14. Highlight the functional properties of cytokines.
15. Describe delayed type hypersensitivity reactions.
16. Briefly describe HLA complex in human.
17. What are autoimmune diseases? Explain.
18. Write an account on immunoelectron microscopy. **(6 x 2 = 12 Wt)**

Part C- Long Essay Questions

Answer any 2 questions. Each question carries Wt 5.

19. Explain structure ,classes and functions of immunoglobulins,
20. Write an account on the pathways of antigen processing and presentation.
21. Discuss the structure and role of M H C class 1 and class 11 molecules.
22. Give a detailed account of various type of vaccines **(2 x 5 = 10 wt)**

SEMESTER III

PRACTICAL III

PG3ZOOP03: CELL AND MOLECULAR BIOLOGY, MICROBIOLOGY AND BIOTECHNOLOGY

90 Hours (4hrs. /week) **Credit-2**

Cell and Molecular biology and Biotechnology

- Squash preparation of grasshopper testis to study meiotic stages.
- Squash preparation and identification of salivary gland chromosomes in *Drosophila* / Chironomus larva.
- Determination of mitotic index in the squash preparation of onion root tip.
- Effect of drugs on cell division (Colchicine or any other inhibitor)
- Preparation of Microtome section, spreading and histochemical staining of Carbohydrates (PAS), Protein (Bromophenol blue), Lipids (Sudan Black), DNA (Fuelgen stain).
- Cell fractionation and Differential Centrifugation to isolate mitochondria and nuclei
- Isolation of genomic DNA using Agarose gel electrophoresis
- Isolation of Plasmid DNA.

Microbiology

- Sterilization, disinfection and safety in microbiological laboratory.
- Preparation of culture media

(a) liquid media – nutrient broth , peptone water

(b) Solid media – Nutrient Agar, Mac Conkey' Agar.

(c) Semi solid agar

(d) Firm agar.

- Culturing of microorganism –
- broth culture

- pure culture techniques- streak plate, pour plate culture, lawn culture, stab culture

Serial dilution and standard plate count, calculation of Cfu/ml in water samples.

- Isolation and preservation of bacterial culture.

- Identification of microorganisms-

(a) Staining techniques- gram staining of mixed cultures, negative staining

- Antibiotic sensitivity (different natural fluids)

- Oxidase test
- Catalase test
- Oxidation/fermentation (O/F) test
- Staining and enumeration of microorganisms:
  using haemocytometer

Environmental sample analysis.

a) Isolation and enumeration of soil bacteria

b) Identification of symbiotic bacterioids from root nodules of leguminous plants

c) Bacteriological analysis of milk- methylene blue reductase test.

M.SC. ZOOLOGY

III SEMESTER CSS PRACTICAL EXAMINATION,

PRACTICAL III - PG3ZOOP03: CELL & MOLECULAR BIOLOGY, MICROBIOLOGY AND BIOTECHNOLOGY

Time 4 hrs. **Total Weight: 15**

PART-A (4x1=4 wt)

1. Demonstrate sectioning and spreading of the given tissue using microtome

2. Identify any two mitotic/meiotic stages and give reasons. (provide diagram/ actual preparations)

3. Write the principle and flow chart of the histochemical staining of carbohydrate/protein/lipid/DNA (No choice for the centre)

4. Demonstrate the culturing of microorganism by streak plate technique/ lawn culture/stab culture.

PART-B (3x2=6 wt)

1. Determine the quality of the milk sample provided using methylene blue reductase test. (provide one sample) Preparation-wt I, Result and discussion - wt 1

2. Demonstrate the presence of protein/ lipid/carbohydrate in the given tissue (Flow chart is not required) Preparation-wt 2

3. Identify the given bacteria using Gram staining method/ negative staining. Principle-wt 1, Preparation and result-wt 1

PART C (1x4=4 wt)

1. Make a neat Squash preparation of grass hopper testis. Identify 3 stages, sketch and label. (Testis isolation & Squash preparation - wt 2, Identification - wt1 , Sketch and label-wt 1)

Certified record: wt 1

SEMESTER III

PRACTICAL IV

PG3ZOOP04: ANIMAL PHYSIOLOGY AND IMMUNOLOGY

90 Hrs (5hrs. /week) **Credit-2**

Animal Physiology

- Rate of salivary amylase activity on starch at different concentration (colorimetry)
- Effect of different pH on salivary amylase activity (colorimetry)
- Influence of temperature on salivary amylase activity – Calculation of Q 10

- Effect of drugs on the heartbeat of cockroach (Result with graphical representation corresponding to different concentration and time intervals expected)

- Oxygen consumption in fish (normal and stressed).Graphical representation and interpretation. Kymograph: working principle and applications.

Virtual Practicals in Physiology

- (Use of PhysioEX 9.0 : *Laboratory Simulations in Physiology* by P.Zao.,T.Stabler., L.A.Smith and E .Griff. 2011.is suggested) for muscle and nerve physiology practical for class room training and for practical examination in order to replace Frog as per UGC guidelines).
- Any four of the following:

(1) Muscle Twitch and the Latent Period -The effect of stimulus Voltage on Skeletal Muscle Contraction
(2) Tetanus
(3) Fatigue
(4) Receptor Potential
(5) The Action Potential Threshold
(6) Importance of Voltage –Gated Na+ Channels

- Total count of Human RBC and WBC
- Haematocrit and ESR of Human blood
- Feeding activity of paramecium

- Effect of different concentration of NaCl solution (0.1%-2%) on the diameter of RBCs

(preferably human) and determination of the concentration , which is isotonic to the blood from a plot of diameter of RBC against concentration of NaCl

Immunology

- Separation of lymphocytes from whole blood.
- Separation of T and B lymphocytes
- Blood Typing in Man.
- WIDAL Test.
- Western Blotting –Demonstration
- ELISA -Demonstration
- Rocket Immuno electrophoresis- Demonstration

M.SC ZOOLOGY

III SEMESTER CSS PRACTICAL EXAMINATION

PRACTICAL IV- PG3ZOOP04: ANIMAL PHYSIOLOGY & IMMUNOLOGY

Time 4 hrs **Total Weight: 15**

PART-A (4x1=4 wt)

1. Comment on the principle and use of the instrument -kymograph

2. Demonstrate the feeding activity in paramecium

3. Determine the Blood group and Rh antigen and comment on its immunological aspects.

4. Identify and comment on the principle and use of the given test- (Provide Kit or diagrams)

(WIDAL test/(ELISA/ Rocket Immunoelectrophoresis/ Western blotting)

PART-B (3x2=6 wt)

1.Demonstrate the effect of drug (2 concentrations) on the heart beat of cockroach. (Normal+2 concentrations) Experiment-wt 1, Result and comment-wt 1

2. Make a neat preparation of human blood smear and find out the differential count of WBC cells

Preparation-wt 1, Calculation-wt1, Procedure-wt 1

3. Determine the influence of multiple stimuli on muscle twitch and muscle tension using Physio Ex 9. Complete the post test and save the result as PDF. Experiment - 1wt, Test-I wt

PART C (1x4=4 wt).

1. Determine the rate of O, consumption of a fish under normal and stressed conditions using Winkler's method. Write the principle and comment on the result. (Provide initial burette reading)

Principle and experiment - wt 2 Calculation and comment- wt 2

Certified record: wt - 1

SEMESTER IV

PG4ZOOC13- ELECTIVE: ENTOMOLOGY I MORPHOLOGY AND TAXONOMY

90 Hours
(5 hrs/week) **Credit -4**
Course Outcomes

CO No.	Course outcome	Cognitive level	PSO No.
1	Understand the insect diveristy and its significance, identify common insects.	U,C,R.	**1,.5**.
2	Learn the economic and medical importance of insects and their control.	Ap,An,E.	**5,6,7.**
3	Learn the structural peculiarities & divisions of body for their mode of life.	U,E.	**1,3**
4	Create skills for scientific study of insects, embryological development and their classification.	C,U.	**7,6.**
5	Analyse the evolutionary basis of insects.	An, U.	**2,8.**

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: RRemember; U- Understanding; Ap-Apply; An-Analyze; E-Evaluate

SEMESTER IV

PG4ZOOC13- MORPHOLOGY AND TAXONOMY

90 Hours **Credit -4**

Module	Content	Content mapped to CO	Hrs
1	**Insect Morphology** **1.1 Introduction** : Scope and importance of insects • Origin and evolution of insects (including theories) • Fossil insects.	**1, 5.**	**4 hrs**
2	**2.2 Segmentation and division of the body**: • General morphology of head (Opisthognathus, Prognathus,Hypognathus). Head segmentation; Head skeleton; Tentorium; Modifications in head capsule; • **Cephalic appendages**; Antennae – Structure functions and types. • **Mouth parts** –various modifications, feeding mechanisms. **2.3 General morphology of thorax** • Thoracic segmentation, thoracic skeleton and thoracic appendages. • **Wings**– Structure, Venation, Wing articulation,Wing coupling apparatus, Wing modifications. • **Legs**-structure and adaptive radiation of legs, Locomotion. **2.4 Morphology of abdomen and its appendages**. • **External genitalia**-structure and diversity of male and female genitalia. eg. Grasshopper, Drosophila, Cockroach ,Dragonfly. **2.5 Sense Organs** – Structure and classification of sense	**3,4**.	**26 hrs**

	organs (Hair organs, Plate organs, Campaniformorgans).		
3	**3.1 General characters**, **Biology, Habits**. and **Classification** up to families of the following orders of insects with special emphasis on economically important insects **3.2 Apterygota**- Protura Collembola, Diplura, and Thysanura. **3.3. Exopterygota-** Odonata, Ephemeroptera, Plecoptera, Embioptera Phasmida,Orthoptera, Dermaptera, Isoptera, Blattaria, Mantodea, Zoraptera, Psocoptera, Mallophaga, Anopleura, Thysanoptera, Homoptera, Heteroptera. **3.4.Endopterygota**- Coleoptera, Strepsiptera, Neuroptera Mecoptera, Diptera, Siphonaptera , Trichoptera, Lepidoptera, Hymenoptera	**1,3,4,5**.	**36 hrs**
4	**Social Organisation and Behaviour** **4.1 Social organisation and behaviour:** with reference toTermites, Ants and Honey Bees. **4.2 Study of Gall forming insects**: features, Gall formation, Types of Galls –open and Closed, Common Gall pests, adaptations for Gall making habits. Economic importance. a. **Leaf mining insects** – features, forms of leaf mines, feeding habits, Ecological aspects of leaf mining. b. **Communication** – Acoustic, Visual, Tactile and chemical methods. **c. Adaptations of parasitic and predatory insects** d. **Study of aquatic insects**: factors influencing the aquatic life, food capture – modifications, anchorage, locomotion, respiration, oviposition and adaptations of swimming forms.	**1,2,4**.	**16 hrs**

	4.3 Insect- host resistance **4.4 Insect pollinator** – plant interaction. Modern findings.		
5	**Insect Development** **5.1. Egg**-Types, structure, egg cases and adaptations of eggs Diapause. **5.2.** General pattern of embryonic development, Polyembryony, Parthenogenesis, Paedogenesis. **5.3.** Types of Metamorphosis, different types of larvae and pupae.	**1,4.**	**8 hrs**

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PG2ZOOC13- ELECTIVE: ENTOMOLOGY I

MORPHOLOGY AND TAXONOMY

Module	**Hrs Alloted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	**4**	1	-	-	**1**
2	**26**	2	2	1	**5**
3	**36**	3	3	2	**8**
4	**16**	2	2	1	**5**
5	**8**	2	1	-	**3**
Total	**90**	**10**	**8**	**4**	**22**

PG4ZOOC14 -ELECTIVE: ENTOMOLOGY I -MORPHOLOGY AND TAXONOMY

Part A- Very Short Answer Questions.

Time: 3 Hrs Answer any 8 questions. Each question carries Wt 1 Max. Weight:. 30

1. Fossil insects.

2. Classify insect head based on position of mouthparts.

3. Give the names of any four gall pests.

4. Explain polymorphism in insects with an example.

5. Types of eggs in insects.

6. What is haltere? How does it help the insect?

7. Give the salient features of Strepsiptera.

8. Name the different types of pupae in insects.

9. Mention the adaptations found in Anoplurans.

10. Insect host interactions. **(8 x 1 = 8wt)**

Part B- Short essay questions.
Answer any 6 questions. Each question carries Weight 2

11. Sclerites and sutures of insect head .

12. Discuss the taxonomic position of Lepisma.

13. Embryonic development.

14. Write the salient features of Siphonaptera.

15. Write notes on leaf mining insects.

16. Social organization in Termites.

17. Explain the different types of ovarioles in insects.

18. Describe the structure of an insect leg. What are the functional modifications?

Part C- Long essay questions

Answer any **2** questions. Each question carries **weight 5**.

19. Write an essay on vectors of human diseases belonging to order Diptera.

20. Write an essay on wing venation in insects. Add notes on wing modifications and wing coupling.

21. Explain social organization in insects.

22. Give the salient Features of Diptera. Classify upto families with examples. **(5x2= 10 wt)**

SEMESTER- IV

PG4ZOOC14 ELECTIVE: ENTOMOLOGY II ANATOMY AND PHYSIOLOGY

90 Hours
(5hrs/week) **Credits-4**

CO No.	Course Outcome (Expected)	Cognitive level	PSO No.
1	Establish a firm foundation in insect morphology, physiology, and biodiversity.	R,U, E	1,4,6,7,8
2	Build a comprehensive knowledge of all the organ systems present in insects	R, U, An	1,4,6,8
3	Understand the insect communication system.	R,U	1,3,4,8
4	Learn the adaptations of organ systems in insects and environmental interactions.	R, U, An	3,4,6,7,8
5	Understand reproduction in insects which can aid in the control of harmful insects or in the use of non-harmful insects as biological controls.	R,U, Ap, An, C	4,7,8

PSO – Programme Specific Outcome, CO-Course Outcome; Cognitive Levels:

R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

PG4ZOOC14 - ANATOMY AND PHYSIOLOGY

90 Hours **Credits-4**

Module	Course description	Hours	Content mapped to CO
1	**Integumentary system** 1.1 .Anatomy and histology, Physical and chemical properties 1.2. Moulting and sclerotisation, Role of hormones.	**4hrs**	**1,3,4**
2	**Digestive system** 2.1 .Anatomy, histology and modifications of gut (filter chamber). 2.2 .Physiology of digestion and assimilation 2.3 .Digestion of wood, keratin, wax and silk. 2.4 .Extra intestinal digestion and role of microbes in digestion.	**10hrs**	**1,2,4**

3	**Circulatory system** 3.1. Anatomy and histology of dorsal vessel, dorsal and ventral diaphragms. Accessory pulsatile organs. 3.2. Composition and cellular elements in haemolymph; functions. 3.3 Course of circulation and control of heart beat.	**8hrs**	**1,2**
4	**Respiratory system** 4.1. Anatomy and histology of trachea, trachiole, spiracles and air- sacs. 4.2 Modifications of respiratory system-cutaneous respiration, diffusion, ventilation, control of ventilation, cyclic release of CO_2. 4.3 Respiratory pigments.	**10hrs**	**1,2,4**
5	**Muscular system** 5.1. Histo-morphology of muscles, skeletal muscles and visceral muscles. 5.2. Neuromuscular junctions. 5.3. Excitations of muscle fibres, role of fast and slow axons.	**8hrs**	**1,2**
6	**Fat body and intermediary metabolism** 6.1. Structure of fat body. 6.2. Role of fat body in storage of reserves. 6.3. Intermediary metabolism-Glycolysis, Glycerol phosphate shuttle, Trehalose-biosynthesis.	**8hrs**	**1**
7	**Excretory system** 7.1. Anatomy and histology of Malpighian tubules (Hemiptera, Coleoptera, Lepidoptera) 7.2. Nephro-rectal complex and accessory excretory organs. 7.3. Physiology of excretion. Absorption of water and ions, reabsorption of essential materials. 7.4. Synthesis of uric acid, formation of excreta.	**10hrs**	**1,2,4**
8	**Nervous system** 8.1. Anatomy and histology of brain, ganglia and nerves. 8.2. Physiology-reception and transmission of stimuli, production and conduction of nerve impulses.	**12hrs**	**1,2,3,4**

	8.3. Anatomy and histology of mechanoreceptors, photoreceptors and chemoreceptors. 8.4. Sound production and light production.		
9	**Endocrine system** 9.1. Histo-morphology of neurosecretory cells and endocrine glands (corpora cardiaca, corpora allata and prothoracic glands). 9.2. Hormones and their functions. 9.3. Types of pheromones and behavioral patterns. Pheromonal communications-allelochemicals; allomones, kairomones and synomones.	**12hrs**	**1,2,3,4.**
10	**Reproductive system** 10.1. Reproductive system in male insects. 10.2. Reproductive system in female insects. 10.3 .Fertilization and oviposition 10.4 .Polyembryony, pedogenesis, viviparity, oviparity, eclosion	**8hrs**	**1,2,4,5.**

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SEMESTER IV

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PG4ZOOC14 -ELECTIVE: ENTOMOLOGY II
ANATOMY AND PHYSIOLOGY

Module	**Hrs Allotted**	**Part A** Weight 1 8/10	**Part B** Weight 2 6/8	**Part C** Weight 5 2/4	**Total questions**
1	4	1	-	-	1
2	10	1	1	1	3
3	8	-	1	-	1
4	10	2	-	1	3
5	8	1	-	-	1
6	8	-	1	-	1
7	10	1	1	-	2
8	12	1	2	1	4
9	12	2	1	1	4
10	8	1	1	-	2
Total	**90**	**10**	**8**	**4**	**22**

SEMESTER- IV

PG4ZOOC14 -ELECTIVE: ENTOMOLOGY II-ANATOMY AND PHYSIOLOGY

Time: 3 Hrs **Max. Weight: 30**

Part A -Short Answer Questions

Answer any 8 questions. Each question carries weight 1

1. Features of Hemipteran Malpighian tubules.
2. Kairomones.
3. Spiracles.
4. Mechanoreceptors.
5. Allelochemicals.
6. Respiratory pigments.
7. Differentiate oviparity and viviparity with examples
8. Filter chamber.
9. Sclerotisation.
10. Role of slow and fast axons in muscular system of insects. (8 x1=8)

Part B Short Essay Questions

Answer any six questions. Each question carries weight 2

11. Explain the structure of brain and ganglia.
12. Discuss nerve transmission in insects.
13. Assess the role of microbes in digestion.
14. Explain the composition of haemolymph.
15. Write a brief account on endocrine glands.
16. Give a brief account of the reproductive system in male insects.
17. Describe the structure and anatomy of Malpighian tubules
18. Give an account of intermediary metabolism. **(6 X 2 = 12)**

Part C
Long Essay Questions
Answer any two questions. Each question carries weight 5

19. Explain the anatomy and histology of insect gut.
20. Write an essay on the respiratory system in insects.
21. Explain pheromonal communications.
22. Describe anatomy and histology of receptors in the nervous system. **(2 X 5 = 10)**

SEMESTER IV

PG4ZOOC15 ELECTIVE : ENTOMOLOGY III

APPLIED ENTOMOLOGY

90 Hours
(5hrs/week) **Credit - 4**
Course Outcome

CO No.	Course outcome	Cognitive level	PSO No.
1	Learn how insects become pests.	R, U	1,6,7,8
2	Aquaint with the common pests of our crops and the damage caused.	R, U, Ap, An,	1,6,7,8
3	Learn various methods to control the pests.	R, U, Ap,	6,7,8
4	Aquire skills to manage the pest outbreak.	R, U, Ap, An,E,C	6,7,8
5	Familiarise with the insecticide appliances.	R, U, Ap,	6,7
6	Learn the importance of insects in medical and veterinary fields.	R, U, Ap,	6,7
7	Understand insecticide resistance , degradation and its impact on environment	R, U, Ap,An	3,6,8

PSO-Program Specific outcome; CO-Course Outcome

Cognitive Levels:R-Remember;U-Understanding; Ap-Apply; An-Analyze;E-Evaluate;C-Create

SEMESTER IV

PG4ZOOC15 : APPLIED ENTOMOLOGY

90 Hours **Credit - 4**

Unit/Module	Contents	Content Mapped to CO No	Hours
1	**Insect Pests** 1.1 Classification of Insect pests Key pests, Potential pests, Occasional pests, Sporadic pests, Seasonal pests, Regular pests, Persistent pests (Based on occurrence) 1.2. Causes of pest outbreak Pest resurgence and replacement (secondary pest outbreak) Causes and management of resurgence and replacement 1.3.Pest surveillance and Forecasting pest outbreaks (Short term and long term forecasting) Forecasting based on observations – climatic and empirical factors. 1.4 Types of damage caused by insect pest to crops (Injury by chewing, piercing, sucking insects, internal feeders, subterranean insects, to stored products and indirect effect of feeding) 1.5 Concept of Economic levels Economic	**1,2,3**	**10 hrs**

	injury level and Economic threshold level Estimation of damage caused by insect to crops		
2	**Insect Pests of Crops** Identification, Life history, nature of damage and control measures of major pests of **2.1 PADDY** (Major pests including stem borers, army worm, rice thrips, gall midge, mealy bug, BPH, green & white leaf hoppers, rice caseworm, rice leaf roller, rice hispa, rice earhead bug, root weevil, rice grass hoppers- Any **10**) **2.2 SUGARCANE** (Major pests including shoot, internode & top borers, white grub, leaf hopper, sugarcane scale, mealy bug, whiteflies, Termites, Black winged bug) **2.3 COTTON** (Major pests - Aphid, leaf hopper, thrips, whitefly, Pink, spotted and American boll worms, stem weevil, Red and Dusky cotton bugs, leaf roller) **2.4. COCONUT** (7 pests - Rhinoceros beetle, red palm weevil, black-headed caterpillar, white grub, Scale insect, Lace wing bug, coconut skipper) **2.5.PULSES** (8 pests - Gram pod borer, plume moth, red gram pod fly, pod borer, spotted pod borer,	**1,2,3**	**20hrs**

	Blue butterflies, bean aphid, white fly) **2.6**.Pests of Fruit trees Mango,Cashew,Citrus and Banana **2.7** . Pests of Spices (Specify any two of each) Pepper,Cardamom,Turmeric and Ginger **2.8** . Pests of other crops Coffee, Tea, Tapioca, and Rubber, **2.9** Pests of vegetables Brinjal,Gourd,Tomato, and Bhend **2.10**.Identification, nature of damage & control of insect pests of stored products: (Rice weevil, sweet potato weevil, Lesser grain borer, tobacco beetle, Drug store beetle, Pulse beetle, Angoumois grain moth, Potato tuber moth, Red flour beetle, Rice moth) **2.11**..Locusts –life history and migration, damage and methods of control **2.12**. Termites– life history, damage and control measures.		
3	**Principles of Insect pest management** **Ecology based pest management** **3.1**. Prophylactic methods • Curative methods • Cultural methods, • Mechanical methods • Physical methods • Legal methods • Biological control **3.2**. History of biological control, ecological	**1,2,3,4,5**	**15hrs**

	basis of biological control **3.3**.Natural enemies (Parasites, Parasitoids, Predators), Feasibility of biocontrol **3.4.**Applied biological control (Conservation and enhancement, Importation and colonization, Mass culture and release) **3.5**.Importance of Systematics, Advantages and disadvantages **3.6**. Important biocontrol projects undertaken in India by employing Parasites and predators. **3.7**. Autocidal control - Sterile male technique and other methods, Chemosterilants, Methods of sterilization, Application, Dynamics, Advantages and disadvantages Examples of autocidal control **3.8.** Insect growth regulators (IGRs) – Brief note on Insect growth hormones and mimics (JH mimic & ecdysone agonists) and chitin synthesis inhibitors as insect control agents **3.9**.. Behavioural (pheromonal) control (Brief note on Trial, Alarm, Aggregation and sex pheromones and the behavior produced, Mode of application, Pest management with pheromones, Advantages and disadvantages, Examples **3.10**. Insect attractants: definition, types of attractants, applications in insect pest mangement, examples, advantages and disadvantages **3.11**. Insect repellents: definition, desirable		

	features of good repellent, types of repellents, applications in insect pest management, examples, advantages and disadvantages **3.12**. Insect antifeedants: definition, examples, applications in insect pest management, advantages and disadvantages **3.14**. Microbial control of crop pests by employing Bacteria, Virus and Fungi – Classification of entomophagus Bacteria, Virus, Fungi, Mode of action, formulation, Application, Examples **3.15**. Integrated Pest Management- Definition, IPM in Agroecosystem, Kinds of pest, (Key pests, Occassional pests, Potential pests, Migrant pests) Establishing the need to take action, Guidelines for developing IPM, Tactics in IPM, IPM of Rice		
4	**ChemicalControl** **4.1.**Insecticide formulation • (Brief note on Emulsifiable concentrates, Water-miscible liquids, Wettable powders, Water soluble powders, Oil solutions, Flowable powders, Aerosoles, Granulars, Fumigants, Ultra-low volume concentrates, Fogging concentrates, Dusts, Poison bates and Slow release insecticides) • Classification of insecticides 1. Based on mode of entry 2. Based on mode of action	**3**	**20 hrs**

	3. Based on chemical nature • Chemistry, toxicology & mode of action of following class of insecticides; mention examples for each class . **4.2.**Synthetic Organic compounds • Organochlorine insecticides (DDT, BHC,.Cyclodiene group (special reference to endosulfan; examples:heptachlor, aldrin) • Organophosphorous insecticides (examples: TEPP, Dichloros, monocrotophos, parathion) • Carbamates (special mention of carbofuran and Carbaryl) • Inorganic compounds as insecticides - arsenic compounds, fluorides, sulphur compounds **4.3.**Fumigants – definition, examples, methods of fumigation, hazards of fumigation, advantages and precautions 4.4 . Botanical insecticides- chemical properties, mode of action and toxicity of the following : Nicotine, Rotenone, Pyrethrum and Neem 4.5. Synthetic pyrethroids – definition, uses as insecticides, mode of action (examples:Pyrethrin, allethrin) 4.6.Insecticide synergists – definition, types of synergism, mode of action & examples		
5	**Insecticide Application Technology** **5.1.**Dusting and dusters	**5**	**8hrs**

	5.2. Spraying and sprayers – syringes, knapsack sprayers, foot pump-sprayers, rocker sprayer pneumatic hand sprayers, pneumatic knapsack sprayers, hand atomizer, hydraulic sprayers **5.3.**Aerosols. **5.4.**Other equipments (mist blower, fog generators smoke generators, aerosol bombs)		
6	**Insecticides and Environment** **6.1.**Insecticide resistance -Genetic, Physiological and biochemical mechanism **6.2.**Pesticides and the environment- its impact on wildlife and human health **6.3.**Microbial and environmental degradation of pesticides	**7**	**7hrs**
7	**Insecticides and Environment** 7.1.Insecticide resistance -Genetic, Physiological and biochemical mechanism 7.2.Pesticides and the environment- its impact on wildlife and human health 7.3.Microbial and environmental degradation of pesticides	**7**	**7 hrs**
8	**Medical and Veterinary Entomology** **8.1.**Identification, nature of attack & control of Insect pests of domestic animal- Cattle (any five pests) Fowl (any three pests) Dog & Goat (any two pests) **8.2.**Ticks and Mites of Medical importance – Morphology, biology and control measures	**1,3,4,6**	**10hrs**

	8.3. Major arthropod vectors of human diseases (Malaria, Lymphatic Filariasis, Yellow Fever, Dengu Fever, West Nile Disease , Chickungunia,Japanese Encephalitis, Zika, Kala-azar, African sleeping disease Plague, Typhus, Kyasanur Forest Disease, Scabies) .		

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SEMESTER IV

BLUE PRINT

PG4ZOOC15 ELECTIVE : ENTOMOLOGY III

APPLIED ENTOMOLOGY

Unit/Module	**Hrs Allotted**	**Part A** **Weight 1** **8/10**	**Part B** **Weight 2** **6/8**	**Part C** **Weight 5** **2/4**	**Total questions**
1	10	2		1	**3**
2	20	1	2	1	**4**
3	15	1	2	1	**4**
4	20	3	1		**4**
5	8	1	1		**2**
6	7	1	1		**2**
7	10	1	1	1	**3**
Total	**90**	**10**	**8**	**4**	**22**

SEMESTER- IV M.Sc. ZOOLOGY
PG4ZOOC15 -ELECTIVE: ENTOMOLOGY III
APPLIED ENTOMOLOGY

Time: 3 Hrs **Max. wt: 30**

Part A- Very Short Answer Questions
Answer any 8 questions. Each question carries wt 1.

1. Role of Chemosterilants in pest control.
2. Name two IGRs and their functions
3. Emulcifiable concentrate
4. Insecticide synergists
5. Antifeedants
6. Identification ,nature of damage and control measures of Oryctes rhinoceros.
7. Differentiate parasites and parasitoids
8. Differentiate between economic injury levels and economic threshold levels
9. Give the common and scientific names of 4 major pests of paddy.
10. Write damages caused by
    a. two pests of cotton b. two pests of pulses ? **(8x1=8 wt)**

Part B -Short Essay questions

Answer any Six questions. Each question carries wt 2

11. Write a brief note on autocidal control.
12. What are the components of IPM
13. Discuss about fumigants and its merits and demerits .
14. Give a brief account of life history and damage caused by two major insect pests of stored products.
15. What are synthetic pyrethroids ?write on its mode of action .
16. Write a note on arthropod vectors of human diseases.
17. Write about pest resurgence and replacement
18. Discuss different types of insecticide formulations (6x2= 12 wt)

Part C- Long Essay Questions.
Answer any 2 questions. Each question carries wt 5

19. Enlist major dipteran vectors of human diseases , diseases transmitted by them and their control measures
20. Write an essay on types of crop damages caused by insect pests
21. Write briefly the biology, nature of damage and control aspects of major pests of paddy in Kerala.
22. Write an essay on the major steps of biological control and its merits and demerits.

SEMESTER IV

PRACTICAL V

PG4ZOOP05 ELECTIVE: ENTOMOLOGY III MORPHOLOGY, ANATOMY AND TAXONOMY

90 hours.
(5 hrs./week) **Credit- 2**

- Study of mouthparts in insects (Grasshopper, plantbug, mosquito, honeybee, house fly) Study of different types of antennae, genitalia and legs.
- Sting apparatus –honeybee
- Wings and wing venation in insects of 5 orders. Study of sexual dimorphism in insects
- Preparation of dichotomous keys with reference to various insect orders
- Dissection of alimentary canal and associated glands of different insects (plant bug, honey bee, oryctes, grasshopper.
- Dissection of nervous system in different insects (plantbug, honeybee, oryctes, grasshopper) Dissection of reproductive system in insects (cockroach, oryctes ,grasshopper, Plant bug) Dissection of stomatogastric nervous system –cockroach
- Collection and preservation of insects (students are required to submit an insect collection belonging to 50 families-dry collection,wet collection, whole mounts and slides) at the time of practical examination.
- **Field Study Report:**

Visit to two institutions engaged in entomology research and different ecological niches other than local area for collection of insects. The field study is for 3-4 days. Report the study conducted and submit a 10 page write up/ print out giving the dates, day wise itinerary, methodology, results and references. Include photographs of the activities. Group and individual assignments shall be preferred.

SEMESTER IV

PRACTICAL V- ELECTIVE COURSE: ENTOMOLOGY

Model Quesytion paper

- PG4ZOOP05 Morphology, Anatomy and Taxonomy

Time: 4 Hrs. **Total weight:15**

PART A. 4 wt. (any one)

1. Dissect and display the Nervous system of Oryctes grub/ Grasshopper/ Plant bug. (Dissection - 3 wt., Display-1 wt)

PART B 2 wt. (2x2=4 wt)

1 Mount the mouth parts of the two given insects. Comment on their functional similarities and dissimilarities (Mounting - 1 wt, Comments - 1 wt)

2. Prepare a dichotomous taxonomic key to identify the two given insects up to orders (1+1=2wt)

PART C. 1 wt. (3x1=3 wt)

1. Mount the genitalia of the given insect. (Iwt.)

2. Mount the hind/ fore wing of the given insect. Sketch and comment on the venation (1 wt.).

3. Determine the sex of the 2 insects given. Make suitable preparations of the morphological parts to justify the identification (1 wt.)

PART D. Insect collection submitted. (2wt.)

PART E

Field study Report (1wt.)

Certified record: wt. 1

SEMESTER IV

PRACTICAL VI

PG4ZOOP06 ELECTIVE: ENTOMOLOGY III

INSECT PHYSIOLOGY AND APPLIED ENTOMOLOGY

90 Hours

(5 Hours/week) **Credit-2**

- Survey of digestive enzymes –amylase,invertase,protease and lipase in different parts of the gut in cockroach,grasshopper, dragonfly

- Dye transport by Malpighian tubule using dyes

- Identification of free aminoacids (at least 3) in haemolymph by paper chromatography. Haemocytes –staining and identification.

- Collection and identification of insect pests of different crop plants,fruit trees,vegetables and stored products

- Collection and identification of insect vectors of man and domestic animals.

- Collection and preservation of economically important insects, their life stages, products, damaged parts.

- Collection and identification of insect damages to crop plants. Insecticide appliances.

- Determination of LC_{50} using probit analysis.

- Collection – Students are expected to submit a collection consisting of insect pest of different crops, stored products, domestic animals and man. Useful insects, their life stages and products, parasites and predators.

M.Sc ZOOLOGY (SEMESTER IV) PRACTICAL EXAMINATIONS

PG4ZOOP06 : APPLIED ENTOMOLOGY

Model Question paper

Practical II Insect Physiology, Biochemistry and Applied Entomology

Time: 4 Hrs. **Total weight:15**

PART A. 4 wt (1x4= wt)

1. Analyze the digestive enzymes in the given extract of the alimentary canal of the insect. Tabulate the result. Assesss the feeding habit of the insect with reasons. 4 wt (Amylase, Protease, Lipase, Invertase-2 wt. Tabulation-1 wt., Feeding habit and Justification-1 wt.)

PART B. 2 wt. (2x2=4 wt)

1. Make a neatly stained smear preparation of the haemolymph of the insect provided and identify any three different types of haemocytes. (Prepartion-1 wt. Haemocytes-1wt)

2. Observing the damaged materials, identify the causative pest and explain its life cycle and comment on the damage. (any two item) (Identification and comment I wt, Life cycle 1 wt.)

PART C. 1 wt. (4x1=4 wt)

1. Demonstrate the dye transport mechanism in Malpighian tubules. (1 wt.)

2. Identify and comment on the two pesticide appliances given. (1wt)

3. Identify and comment on the two items (give vectors/ Parasites). (1Wt)

4. Identify and comment on the two items (give useful insects/products).(1Wt)

PART D

Insect Collection Submitted- - (2wt)

Certified record: wt. 1

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