File Ref.No.7652/GA - IV - J1/2012/CU

UNIVERSITY OF CALICUT

Abstract

General & Academic - Faculty of Science - MSc Applied Zoology programme (University teaching Department) under CCSS PG Regulations 2019 with effect from 2020 Admission onwards - Incorporating Outcome Based Education - Implemented - Subject to ratification of Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 5591/2021/Admn Dated, Calicut University.P.O, 26.05.2021

Read:-1. U.O.No. 11743/2019/Admn, Dated 30.08.2019

2. Item No. 1 of the minutes of the meeting of the Board of Studies in Zoology PG held on 27.02.2021.
3. Remarks of the Dean, Faculty of Science, Dated 10.03.2021.
4. Orders of the Vice Chancellor in the file of even no, Dated 12.03.2021.

ORDER

1. Orders were issued vide paper read (1) above, implementing the scheme and syllabus of M.Sc Applied Zoology Programme for Teaching Departments /Schools of the University of Calicut, under CCSS PG Regulations 2019 w.e.f 2019 admission onwards.
2. The meeting of Board of Studies in Zoology (PG) held on 27.02.2021 approved the existing syllabus of M.Sc Applied Zoology Programme (CCSS) incorporating Outcome Based Education (OBE) in in the existing syllabus, in tune with the new CCSS PG Regulations with effect from 2020 Admission onwards, vide paper read (2) above.
3. The Dean, Faculty of Science has approved to implement M.Sc Applied Zoology programme for Teaching Departments /Schools of the University of Calicut, (CCSS PG 2019) incorporating Outcome Based Education (OBE) in in the existing syllabus, in tune with the new CCSS PG Regulations with effect from 2020 Admission onwards, vide paper read (3) above.
4. Under these circumstances, considering the urgency, the Vice Chancellor has accorded sanction to implement scheme and syllabus of M.Sc Applied Zoology Programme for Teaching Departments /Schools of the University of Calicut (CCSS PG 2019) incorporating Outcome Based Education (OBE) in the existing syllabus, in tune with the new CCSS PG Regulations with effect from 2020 Admission onwards, subject to ratification by the Academic Council.
5. Scheme and syllabus of M.Sc Applied Zoology Programme for Teaching Departments /Schools of the University of Calicut, (CCSS PG 2019) incorporating Outcome Based Education (OBE) in the existing syllabus w.e.f 2020 admission onwards, is therefore implemented with effect from 2020 Admission onwards.
6. Orders are issued accordingly.
7. U.O.No. 11743/2019/Admn, Dated 30.08.2019 stands modified to this extent. (modified syllabus appended)

Ajitha P.P

Joint Registrar

To

HoD. Department of Zoology.

Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE V/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

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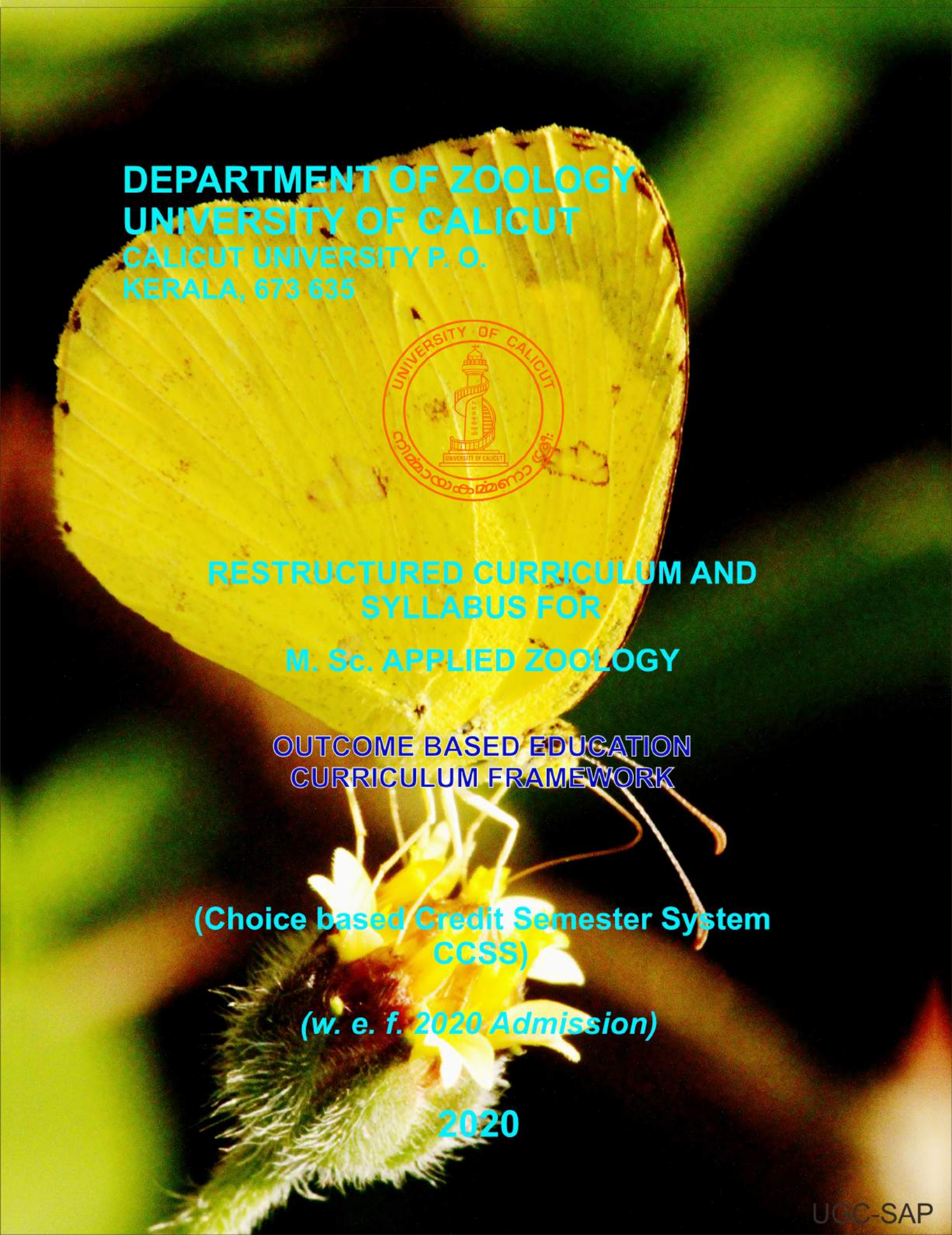
Section Officer



DEPARTMENT OF ZOOLOGY
UNIVERSITY OF CALICUT
CALICUT UNIVERSITY P. O.
KERALA, 673 635

RESTRUCTURED CURRICULUM AND SYLLABUS FOR

M. Sc. APPLIED ZOOLOGY

OUTCOME BASED EDUCATION CURRICULUM FRAMEWORK

(Choice based Credit Semester System CCSS)

(w. e. f. 2020 Admission)

2020

UGC-SAP

DEPARTMENT OF ZOOLOGY
UNIVERSITY OF CALICUT
CALICUT UNIVERSITY P. O.
KERALA, 673 635

RESTRUCTURED CURRICULUM AND SYLLABUS FOR

M. Sc. APPLIED ZOOLOGY

OUTCOME BASED EDUCATION CURRICULUM FRAMEWORK, CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS)

(w. e. f. 2020 Admission)

2020

C O N T E N T S

FOREWORD

1. The syllabus and curriculum of M. Sc. Applied Zoology course under the Choice based Credit semester System (CCSS) offered by the Department of Zoology, University of Calicut have been revised and restructured with effect from 2014 admissions.

2. The two-year Post Graduate Programme will be in the semester pattern. There will be four semesters in the entire course, with two semesters in each year. Each semester will have 90 instructional days with a minimum of 6 hours of instructions each day under the five-day system. End-semester examinations will be held within the 90 regular instructional days. The papers in the first two semesters will constitute the Core Courses only, in the third semester both Core and Elective Courses and in the fourth semester only Elective Courses are included. Entomology is the broad area of elective subjects offered in this Department for the time being.

3. Evaluation of all semester theory/ practical papers will be done in two parts namely by continuous internal evaluation and external evaluation.

4. Details of Choice based Credit Semester System (CCSS) implemented in the Teaching Departments/Schools of the University of Calicut are provided in the Regulations.

REGULATIONS FOR THE CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS) (PG) FOR THE TEACHING DEPARTMENTS / SCHOOLS OF THE UNIVERSITY OF CALICUT

(*See University Order No. GA I / J1 / 1373 / 08 dated Calicut University PO, 01.07.2008*)

1. SHORT TITLE

1.1 This regulation shall be called "Calicut University Regulations for Choice based Credit Semester System (CCSS) 2008."

2. SCOPE

2.1 The regulation provided herein shall apply to all regular post-graduate programmes conducted by the Teaching Departments/Schools of the University of Calicut with effect from the academic year 2008-2009.

2.2 The provisions herein supersede all the existing regulations for the regular post-graduate programmes conducted by the Teaching Departments/Schools of the University of Calicut unless otherwise specified.

2.3 The Department of Biotechnology and Department of Education may be allowed to follow the present system

3. DEFINITIONS

3.1 *'Academic Committee'* means the Committee constituted by the Vice-Chancellor under this regulation to manage and monitor the running of the post-graduate programmes under the Credit based Credit Semester System (CCSS).

3.2 *'Programme'* means the entire course of study and Examinations (traditionally referred to as course).

3.3 *'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; except for M. Ed. programme, for which the duration shall be 2 Semesters.

3.4 *'Semester'* means a term consisting of a minimum of 90 working days including examination days distributed over a minimum of 18 weeks each of 5 working days.

3.5 *'Course'* means a segment of subject matter to be covered in a semester (traditionally referred to as paper). Each course has an alpha numeric code number, title and credit.

3.6 *'Core Course'* means a course of a particular Degree Programme, which must be successfully completed by a student to receive the degree and which cannot be substituted by any other course. Core courses are offered by the Department conducting the programme.

3.7 *'Elective Course'* means a course, which can be substituted by equivalent course from the same or other Departments/Schools and which must be successfully completed by a student to receive the degree.

3.8 *'Audited Course'* means a course which the student can register without earning credits (zero credit course). Credit courses can be registered as zero credit courses if a student desires so.

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

3.10 *'Re-examination Course'* is a course registered by a student for improving his performance in that particular course.

3.11 *'Department/School'* means Teaching Departments/Schools instituted in the University as per the Statute and Act.

3.12 *'Parent Department/School'* means the Department/School which offers a particular degree programme.

3.13 *'Credit' (C)* of a course is a measure of the weekly unit of work assigned for the course. A theory class of one hour per week or a practical class of three hours per week shall be counted as one credit.

3.14 *'Grade Point' (G)* of a student in a course is the value obtained by dividing her/his % of marks in the course by 10. Grade point is expressed on a 10.0 point scale rounded off to the first decimal place and varies from 0.0 to 10.0. Grade point indicates the exact level of performance of a student in a course.

3.15 *'Letter Grade'* or simply *'Grade'* in a course is a letter symbol (e.g. A^+, A, B^+, B etc) which indicates a particular range of grade points (e.g. 8.0 to 10.0, 7.0 to 7.9, 6.0 to 6.9, 5.0 to 5.9 etc) and is used to refer to the broad level of performance of a student in a course.

3.16 *'Credit Point' (P)* of a course is the value obtained by multiplying the Grade point (G) by the Credit (C) of the course: $P = G \times C$.

3.17 *'Semester Grade Point Average'* (SGPA) is the value obtained by dividing the sum of credit points (P) obtained by a student in the various courses studied in a semester by the total number of credits taken by him/her in that semester. The grade points shall be rounded off to the first decimal place. SGPA determines the overall performance of a student at the end of a semester.

For instance, if a student has registered for 'n' courses of credits C_1, C_2, ……C_n in a semester and if she/he has scored credit points P_1, P_2, ……P_n respectively in these courses, the SGPA of the student in that semester is calculated using the formula

$$SGPA = \frac{P_1 + P_2 + \ldots\ldots + P_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

3.18 *'Cumulative Grade point average'* (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and is calculated based on the same formula given above. CGPA shall be rounded off to the first decimal place.

3.19 Words and expressions used and not defined in this regulation but defined in the Calicut University Act and Statutes shall have the meaning assigned to them in the Act and Statutes.

4. ACADEMIC COMMITTEE

4.1 There shall be an Academic Committee constituted by the Vice-Chancellor to manage and monitor the working of the CCSS.

4.2 The Committee consists of:

a) The Vice-Chancellor.

b) The Pro-Vice-Chancellor.

c) The Registrar.

d) The Controller of Examinations.

e) Deans of Faculties representing the subjects of the University Teaching Departments/Schools.

f) Syndicate member representing the University Teachers

g) One teacher other than Dean from each Department/School, nominated by the Department Council based on seniority and by rotation.

h) Student Syndicate member

i) Chairman, Department Students Union

4.3 The Vice-Chancellor shall be the Chairman of the Academic Committee and the Pro-Vice-Chancellor the Vice Chairman. A senior Professor nominated by the Vice-Chancellor from among the members of the committee shall be the Convener of the Academic Committee.

4.4 The normal term of the Academic Committee shall be two years. It is mandatory to reconstitute the committee before its term expires.

4.5 The Academic Committee shall meet at least twice in a semester.

4.6 The Academic Committee shall manage the activities starting from the conduct of admission of the students to the issuance of the final score sheet at the end of the course.

4.7 *Administrative Committee*: There shall be a 5-member Administrative Committee within the Academic Committee to look after the day-to-day affairs of the CCSS in consultation with the Vice-Chancellor. The Convener of the Academic Committee shall be the Convener of the Administrative Committee. The other members of the Administrative Committee shall be nominated by the Vice-Chancellor from among the members of the Academic Committee.

4.8 There shall be a separate Administrative Office for the management of the CCSS.

5. PROGRAMME STRUCTURE

5.1 The Programme shall include three types of courses, *viz.* Core Courses, Elective Courses and Audited Courses. Core Courses should be generally be offered by the parent Department/School concerned. Elective Courses and Audited Courses are offered by the parent Departments and/or other departments. A Department/School shall come forward to offer more and more Elective Courses and Audited Courses suitable for other Departments/Schools. There shall be a compulsory Project/Dissertation to be undertaken by all students.

5.2 No Course shall have more than 4 credits and for dissertation, for which the maximum credits shall be 8 and minimum 4. Audited Courses will not carry any credits.

5.3 A student is free to register for as many courses as she/he can manage if facilities permit, meeting the minimum credit requirements.

5.4 A student shall accumulate a minimum of 36 credits in the case of 2 semester programmes, 72 credits in the case of 4 semester programmes other than MBA as advised by the parent Department/School, for the successful completion of the programme. These credits shall be distributed among the Core Courses, Elective Courses and Project/Dissertation as stated below:

The minimum number of credits from Core Courses, Elective Courses and Project/ Dissertation shall be 24, 8 and 4 respectively for 2 semester programmes, 48, 16 and 8 respectively for 4 semester programmes other than MBA and 54, 16 and 8 respectively for MBA.

5.5 No student shall register for more than 24 credits (32 in the case of MBA) excluding re-examination and repeat courses and less than 16 (20 in the case of MBA) credits per semester.

5.6 The parent Department/School shall decide the core courses and appropriate elective courses for a specific programme.

5.7 The odd semester shall be from August to December and the even semester shall be from January to July excluding the April-May summer vacation. Each semester shall have a minimum of 90 working days inclusive of all examinations.

5.8 *Attendance:* The minimum requirement of attendance during a Semester shall be 75% for each course. Attendance shall be maintained by the course teacher. 10% condonation can be granted on the attendance requirements by the Chairman of the Academic Committee on genuine grounds, provided it is also recommended by the Department Council. A fee for this purpose may be collected as prescribed by the Academic Committee and approved by the Syndicate. Candidates who do not satisfy the required minimum attendance in a course shall be awarded zero grade point in that course.

5.9 The general structure of the programme shall be summarized as given below:

Sl. No.	**Programme Duration**	**4 semesters (MA/MSc/ MCom/MCJ)**	**4 semesters (MBA)**
1	Accumulated minimum credits required for successful completion of programme	72	80
2	Minimum credits required from Core Courses	48	56
3	Minimum credits required from Elective Courses	16	16
4	Minimum credits required from compulsory Project/Dissertation	8	8
5	Minimum and Maximum credits required to be registered in a semester	16-24	20-32
6	Minimum attendance required	75%	75%

6. BOARD OF STUDIES

6.1 The Department Council shall prepare the Syllabus for Choice based Credit Semester System and the same shall be reported to the respective Board of Studies.

6.2 The Department Council shall have the freedom to design and introduce new courses, to modify or re-design existing courses and replace any existing courses with new/modified/re-designed courses to facilitate better exposures and training for the students.

6.3 New/modified courses designed under the above clause shall be informed to the Academic Committee sufficiently in advance so that the information is available before the student is required to register for courses during the semester. The date of registration for courses during a semester shall be three weeks before the end of previous semester. It is desirable not to change the core courses once a programme gets started. However modified or new courses can be offered in the middle of a programme at the elective level, with such changes made available well in advance of the starting of a semester.

6.4 The Syllabus of a course shall include the title of the course, the number of credits and reference materials.

6.5 Each course shall have an alpha numeric code giving comprehensive information on the Department/School offering the course, the semester in which it is offered and a serial number.

6.6 The Department Council shall report the details of the courses designed/modified to the respective Board of Studies in the first sitting following such modifications.

6.7 Every Programme conducted under Credit Semester System in a Department/School shall be monitored by the Department Council.

7. ADMISSION

7.1 It is the responsibility of the Academic Committee to finalize the admission to all courses as per the rules and regulations of the University.

7.2 The admission shall be based on the marks scored by a student in the qualifying examinations.

7.3 Separate rank lists shall be drawn up for reserved seats as per the existing rules.

7.4 On admission to a particular programme, the student shall be assigned an admission number, which shall consist of 3 components: Department offering the programme, Year of admission and the serial number of the student in the admission list of the year (e.g. ZOO-2014-01).

7.5 The Academic Committee shall make available to all students admitted a Prospectus listing all the courses offered in various Departments/Schools during a particular semester. The information so provided shall contain title of the course, credits for the course, prerequisites, place and time of the classes and examination schedue.

7.6 There shall be a uniform calendar prepared by the Academic Committee for the conduct of the courses. The Academic Committee shall ensure that the calendar is strictly followed.

8. ELIGIBILITY FOR ADMISSION

8.1 The eligibility for admission shall be announced by the University from time to time.

9. REGISTRATION

9.1 Every Department/School shall have a Student Advisory Committee constituted by the Department Council comprising a maximum of 4 faculty members and a student representative of the batch concerned.

9.2 The student shall register for the course she/he plans to do during a semester three weeks prior to the end of the previous semester in consultation with the Student Advisory committee.

9.3 The first semester shall be dealing with only Core courses so that the student gets time to decide on the elective courses to be opted. Elective courses and other Core courses shall be distributed in the remaining semester(s).

9.4 The number of courses a student can take is restricted by the rules that govern the minimum and maximum credits she/he may earn during a semester.

9.5 The Department/School offering any course shall prescribe the maximum number of students that can be admitted taking into consideration the facilities available.

9.6 In a Department/School, preference shall be given to those students for whom the course is a Core course, if the demand is beyond the maximum prescribed

9.7 The student can reduce the number of credits by opting out if she/he has registered for more courses than she/he can handle, within 30 days of the commencement of classes.

10. EVALUATION AND GRADING

10.1 The evaluation scheme for each course shall contain two parts:

(a) Internal evaluation

(b) External evaluation

20% weightage shall be given to internal evaluation and the remaining 80% to external evaluation.

10.2 *Internal evaluation:* The internal evaluation shall be based on predetermined transparent system involving periodic written tests, viva-voce, seminars and attendance in respect of theory courses and based on written tests, viva-voce, lab skill/ records in respect of practical courses as detailed below:

Theory Paper	**Marks**	**Practical Paper**	**Marks**
Attendance*	3	Lab skill/Records	5
Seminar	5	Practical test	10
Test Paper	8	Viva-voce	5
Viva-voce	4		
Total	**20**	**Total**	**20**

*90% & above: 3 marks, 80 to 89%: 2 marks, 75 to 79%: 1 mark, below 75%: Nil

The details of executing the internal evaluation shall be decided by the concerned Department Council. To ensure transparency of the evaluation process, the internal assessment marks 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.

10.3 *External evaluation:* The external examination in theory courses is to be conducted by the question papers set by external examiners. The evaluation of the answer scripts shall be done by the teacher offering the paper and an external expert based on a well-defined scheme of valuation framed by them. The external examination in practical courses shall be conducted and evaluated by two examiners: one external and one internal.

10.4 The external evaluation shall be done in a Centralized Valuation Camp, to be held in the respective Department/School immediately after the examination under the supervision/control of the Academic Committee. It is desirable to have the semester results announced within 10 days of the conduct of the last examination of the semester.

10.5 Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny on request along with required fees within 7 days of publishing the results and revaluation/scrutiny of answer scripts shall be done as per the existing rules prevailing in the University.

11. GRADING SYSTEM

11.1 Based on the % of marks scored (external and internal marks put together), the students are graded in each course applying the following grading system:

% of Marks	Grade point	Letter grade
80 – 100	8.0 – 10.0	A+
70 – 79	7.0 – 7.9	A
60 – 69	6.0 – 6.9	B+
50 – 59	5.0 – 5.9	B
40 – 49	4.0 – 4.9	C (Lowest passing grade)
00 – 39	0.0	F (Failed)
Course incomplete	--	I

11.2 Each student shall be assigned a Grade Point and a Letter Grade in each course on the basis of the % of marks scored in the course (external and internal marks put together) as shown above. The minimum Grade point required for passing a course is 4.0. The Grade Point for marks in the range 0 to 39 is taken as 0.0.

11.3 The student is required to pass all core courses and the stipulated minimum number of elective courses in order to complete the programme successfully.

11.4 After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given under its definition. The minimum SGPA required for the successful completion of semester is 5.0. However, a student with SGPA less than 5.0 in a semester is permitted to proceed to the next semester.

11.5 The Cumulative Grade Point Average (CGPA) of the student is calculated at the end of the programme. For the CGPA computation only the best performed courses with the maximum credit points (P) alone shall be taken subject to the restrictions on the credits of the Core and Elective courses prescribed for a specific degree. The CGPA of a student determines the academic level of the student in a particular programme and is the criterion for ranking the students.

12. MARK / GRADE SHEET

12.1 The University under its seal shall issue to the students, a mark/grade sheet on completion of each semester, which shall contain the following information.

a) Name of the University.

b) Name of the Parent Department.

c) Title of the Post Graduate Programme.

d) Name of the Semester.

e) Name and Register number of student.

f) Code number, Title and Credits of each course opted in the semester.

g) Internal, external and Total marks out of 100, Grade Point (G), Letter grade and Credit point (P) in each course opted in the semester.

h) The Total credits, total credit points and SGPA in the semester.

12.2 The Final Mark/Grade sheet issued at the end of the final semester shall contain the details of all courses and project taken by the student including those taken over and above the prescribed minimum credits for obtaining the degree. The Final Mark/Grade sheet shall show the CGPA and the overall letter grade of a student for the entire programme.

13. AWARD OF DEGREE

13.1 The successful completion of all the courses (Core and Elective) and the compulsory project prescribed for the degree programme with CGPA of 5.0 shall be the minimum requirement for the award of the degree.

14. STUDENT EVALUATION OF THE COURSE AND THE TEACHERS

14.1 There shall be a questionnaire prepared by the Academic Committee to evaluate the specific courses and the concerned teachers confidentially by the students at the end of the courses in each semester. The required questionnaire shall be designed by the Academic Committee. These confidential reports shall be used positively to improve the quality of the courses and academic standards and should not be linked with the career advancement of teachers.

15. FAIRNESS OF THE EVALUATION

15.1 The Department Council has the responsibility to ensure fair evaluation of the students. Any complaints from the students about the conduct of courses and evaluation or any complaint from the teacher about the students shall be enquired into by the Department Council. If the Council fails to sort out such complaints, it shall be reported to the Academic Committee to be further enquired into by an Enquiry Committee duly

constituted by the Academic Committee. In case the Academic Committee also fails to resolve the issue, it shall be reported to the Vice Chancellor for further action and the Vice Chancellor's decision will be final.

16. TRANSITORY PROVISION

16.1 Notwithstanding anything contained in this regulation, the Vice-Chancellor shall, for a period of one year from the date of coming into force of this regulation, have the power to provide by order that this regulation shall be applied to any programme with such modifications as may be necessary.

17. REPEAL

17.1 The Regulations now in force in so far as they are applicable to programmes offered by the University Departments/Schools and to the extent they are inconsistent with this regulation are hereby repealed. In the case of any inconsistency between the existing regulations and these regulations relating to the Choice based Credit Semester System in their application to any course offered in a University Department/School, the latter shall prevail.

M.Sc. APPLIED ZOOLOGY (2014 admission onwards)

SUMMARY OF COURSE

Semester	Course Type	Course Mode	No. of Course	Credits/ course	Marks/ course	Total Credits	Total Marks
FIRST	Core	Theory	4	4	100	16	600
	Core	Practical	2	2	100	4	
SECOND	Core	Theory	4	4	100	16	600
	Core	Practical	2	2	100	4	
THIRD	Core	Theory	2	4	100	8	600
	Core	Practical	1	2	100	2	
	Elect	Theory	2	4	100	8	
	Elect	Practical	1	2	100	2	
FOURTH	Core	Project	1	8	200	8	600
	Elect	Theory	2	4	100	8	
	Elect	Practical	2	2	100	4	
Grand Total						**80**	**2400**

Total credits: Core course : Theory - 40; Practical - 10; Total - 50
Elective course : Theory - 16; Practical - 06; Total - 22
Project : 08
Grand total : 80

SEMESTER-WISE DETAILS

FIRST SEMESTER

Code No. & Course	Teaching Hours	Credits	Ext. Marks	Int. Marks	Total Marks
ZOO 1C 01 – BIOCHEMISTRY	80 hrs	4	80	20	100
ZOO 1C 02 – BIOPHYSICS & BIOSTATISTICS	80 hrs	4	80	20	100
ZOO 1C 03 – BIOSPHERE ECOLOGY	80 hrs	4	80	20	100
ZOO 1C 04 – SYSTEMATICS & ANIMAL BEHAVIOUR	80 hrs	4	80	20	100
ZOO 1C 05 – BIOCHEMISTRY, BIOPHYSICS & BIOSTATISTICS PRACTICAL	40 PS	2	80	20	100
ZOO 1C 06 – SYSTEMATICS, BEHAVIOUR & BIOSPHERE ECOLOGY PRACTICAL	40 PS	2	80	20	100
Total for First Semester		**20**	**480**	**120**	**600**

C - Core course, PS – Practical Session

SECOND SEMESTER

Code No. & Course	Teaching Hours	Credits	Ext. Marks	Int. Marks	Total Marks
ZOO 2C 07 – CYTOGENETICS & EVOLUTION	80 hrs	4	80	20	100
ZOO 2C 08 – MOLECULAR BIOLOGY	80 hrs	4	80	20	100
ZOO 2C 09 – BIOTECHNOLOGY	80 hrs	4	80	20	100
ZOO 2C 10 – ANIMAL PHYSIOLOGY & ENDOCRINOLOGY	80 hrs	4	80	20	100
ZOO 2C 11 – CYTOGENETICS, ANIMAL PHYSIOLOGY & ENDOCRINOLOGY PRACTICAL	40 PS	2	80	20	100
ZOO 2C 12 - MOLECULAR BIOLOGY & BIOTECHNOLOGY PRACTICAL	40 PS	2	80	20	100
Total for Second Semester		**20**	**480**	**120**	**600**

C - Core course, PS – Practical Session

THIRD SEMESTER

Code No. & Course	Teaching Hours	Credits	Ext. Marks	Int. Marks	Total Marks
ZOO 3C 13 – DEVELOPMENTAL BIOLOGY & ANIMAL ETHICS	80 hrs	4	80	20	100
ZOO 3C 14 – MICROBIOLOGY & IMMUNOLOGY	80 hrs	4	80	20	100
ZOO 3E 15 – GENERAL ENTOMOLOGY	80 hrs	4	80	20	100
ZOO 3E 16 – INSECT PHYSIOLOGY & BIOCHEMISTRY	80 hrs	4	80	20	100
ZOO 3C 17 – DEVELOPMENTAL BIOLOGY, MICROBIOLOGY & IMMUNOLOGY PRACTICAL	40 PS	2	80	20	100
ZOO 3E 18 – GENERAL ENTOMOLOGY, INSECT PHYSIOLOGY & BIOCHEMISTRY PRACTICAL	40 PS	2	80	20	100
Total for Third Semester		**20**	**480**	**120**	**600**

C - Core course; E - Elective course; PS – Practical Session

FOURTH SEMESTER

Code No. & Course	Allotted Hours	Credits	Ext. Marks	Int. Marks	Total Marks
ZOO 4C 19 – PROJECT	160 hrs	8	160	40	200
ZOO 4E 20 – AGRICULTURAL ENTOMOLOGY & ACAROLOGY*	80 hrs	4	80	20	100
ZOO 4E 21 – INSECT PESTS – CONTROL AND MANAGEMENT*	80 hrs	4	80	20	100
ZOO 4E 22 – ECOLOGY & ETHOLOGY OF INSECTS*	80 hrs	4	80	20	100
ZOO 4E 23 – MEDICAL, VETERINARY & FORENSIC ENTOMOLOGY*	80 hrs	4	80	20	100
ZOO 4E 24 – PRACTICAL ON 4E 20*	40 PS	2	80	20	100
ZOO 4E 25 – PRACTICAL ON 4E 21*	40 PS	2	80	20	100
ZOO 4E 26 – PRACTICAL ON 4E 22*	40 PS	2	80	20	100
ZOO 4E 27 – PRACTICAL ON 4E 23*	40 PS	2	80	20	100
Total for Fourth Semester		**20**	**480**	**120**	**600**

* Elective Courses (Any Two Theory course and its Practical is to be opted by the student)

Semester wise allotment of instructional hours per week

Course/ Activity	Hours allotted per Week				
	First Semester	**Second Semester**	**Third Semester**	**Fourth Semester**	**Total**
Core Theory	4 hrs X 4 courses = 16 hrs	4 hrs X 4 courses = 16 hrs	4 hrs X 2 courses = 8 hrs	--	40 hrs
Core Practical	2 Practical X 2 courses = 12 hrs	2 Practical X 2 courses = 12 hrs	2 Practical X 1 courses = 6 hrs	--	30 hrs
Elective Theory	--	--	4 hrs X 2 courses = 8 hrs	4 hrs X 2 courses = 8 hrs	16 hrs
Elective Practical	--	--	2 Practical X 1 course = 6 hrs	2 Practical X 1 course = 6 hrs	12 hrs
Seminar/ Assignment	2 hrs	2 hrs	2 hrs	2 hrs	8 hrs
Project/ Dissertation	--	--	--	14 hrs	14 hrs
Total hrs per week	**30 hrs**	**30 hrs**	**30 hrs**	**30 hrs**	

FIRST SEMESTER

ZOO 1C 01 BIOCHEMISTRY

Learning Outcomes:

CO1. Students will explain the structure and compare the role of bio-molecules in living systems and
CO2 Students will compare the chemistry of biomolecules (Carbohydrates, proteins, lipid and nucleic acids).
CO3 Student will describe the mechanism and pathways of synthesis and degradation of bio-molecules.
CO4. Students will explain the role of enzymes in biological system and understand the mechanism of enzyme action.
CO5.Students will explain the thermodynamic principles and appreciate their role in life processes

1. Introduction (4 h)

1.1. Structure of atoms, molecules and chemical bonds.

2. Water: its effect on dissolved bio molecules (6 h)

2.1. Water as an ideal biological solvent: Hydrogen bonds; Ionisation of water.

2.2. Weak acids and weak bases; Equilibrium constant; pH and pH scale. Problems involving the determination of pH and pKa .

2.3. Buffers and buffer action. Henderson-Hasselbalch equation; Phosphate and bicarbonate buffer system in biological system.

3. Enzymes (8 h)

3.1. Introduction, classification and nomenclature.

3.2. Specificity and regulation of enzymes

3.3. Enzyme kinetics and Michaelis-Menten equation, Lineweaver-Burk plot.

3.4. Factors influencing velocity of enzyme catalysed reactions.

3.5. Enzyme inhibition-reversible and irreversible (competitive and non-competitive) with examples. Enzyme inhibition in the treatment of AIDS.

3.6. Regulatory enzymes -Allosteric enzymes, Key enzymes.

3.7. Zymogens, Isozymes and Co-enzymes

3.8. Ribozymes

4. Bioenergetics (6 h)

4.1. Bioenergetics: Laws of thermodynamics and biological system, Entropy, Enthalpy, Concept of free energy. Standard Free energy change and equilibrium constant. Coupled reactions.

4.2. High-energy compounds. Role of ATP as a free energy carrier in the biological system.

5. Carbohydrates: Structure and Reactions (6 h)

5.1. Structure of Monosaccharides, Disaccharides, Oligosaccharides and polysaccharides (chitin, bacterial cell wall and glycogen)

5.2. Physical and chemical properties of monosaccharides: Isomerism and optical activity. Oxidation, reduction, ester formation, osazone formation.

6. Metabolism of Carbohydrates (7 h)

6.1. Glycolysis; Gluconeogenesis; HMP pathway; Glycogenolysis; Glycogenesis.

6.2. Regulation of glycogen synthesis and breakdown.

6.3. Citric acid cycle; Electron transport chain; Oxidative phosphorylation, Chemiosmotic hypothesis; Uncouplers; Inhibitors of electron transport chain.

7. Lipids: Structure and Reactions (6 h)

7.1. Classification of lipids, classification of fatty acids.

7.2. Physical and chemical properties of lipids: Reactions-Hydrolysis, Saponification, Rancidity. Iodine number.

7.3. Structural lipids in membranes, Sphingolipids in biological recognition.

8. Metabolism of Lipids (6 h)

8.1. Oxidation of fatty acids: Beta oxidation, alpha oxidation and omega oxidation. Ketone bodies.

8.2. Biosynthesis of fatty acids.

8.3. Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Biosynthesis of cholesterol.

8.4. Prostaglandins: structure, types, synthesis and functions.

9. Amino acids: Structure, Classification and Reactions (6 h)

9.1. Structure of different amino acids in proteins.

9.2. Classification of proteins

9.3. Physical and chemical properties of amino acids: Zwitter ions. Isoelectric point. Reactions of carboxyl group, amino group and side chains. Colour reactions of amino acids and proteins. Peptide bonds.

10. Metabolism of Amino acids (6 h)

10.1. Metabolism of amino acids: Synthesis of amino acids

10.2. Degradation of amino acids.

10.3. Transamination, decarboxylation and deamination reactions in the biological system.

11. Proteins structure and classification (6 h)

11.1. Structure of proteins. Ramachandran plot

11.2. Classification of proteins, Glycoprotein and proteoglycans.

11.3. Sequencing of proteins.

11.4. Nitrogen excretion & urea cycle.

12. Nucleic acids (7 h)

12.1. Structure of nucleic acids: Structure of DNA and RNA

12.2. Biosynthesis of nucleic acids

12.3. Degradation of nucleic acids.

12.4. Sequencing of DNA.

13. Vitamins: Classification, structure and functions (6 h)

13.1. Classification and structure of vitamins

13.2. Functions of vitamins

13.3. Role of B-complex vitamins as coenzymes.

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ZOO 1C 02 BIOPHYSICS & BIOSTATISTICS

PART A: BIOPHYSICS

Course outcome:

The course will provide an overview of the theoretical principles, instrumentation, applications and basic laboratory skills to perform experiments on various aspects of biophysical chemistry, radioactivity, electrophysiological methods, biophysical methods, and microscopic techniques and separation techniques.

CO. No.	Course outcome statements	K Level
CO1	To understand the working of pH meter, basic concepts and significance of colligative properties, diffusion, osmosis, viscosity and centrifugation.	K3
CO 2	Acquire the concepts of radioactivity, properties of isotopes used in biology, biological effects of radiations, use of different types of detection counters, molecular imaging techniques and safety guidelines.	K5
CO 3	To acquaint the instrumental principle and concepts of electrophysiological techniques.	K5
CO 4	Explore the principle and applications of various spectroscopic techniques such as UV-Vis, Fluorescence, NMR, ESR and mass spectrometry.	K3, K4
CO 5	Understand the principle of microscopy and the types of microscopy used to explore microtechnique knowledge.	K3
CO 6	Deals with the knowledge of different types of chromatographic techniques.	K3
CO 7	Learn the principles and applications of electrophoresis.	K3, K4
CO 8	Deals with the concepts and applications of laser, flow cytometry, hydrodynamic methods.	K3

1. Principles of Biophysical chemistry (5 h)

1.1. pH, buffer, Electrometric determination of pH

1.2. Colligative properties: relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure

1.3. Diffusion: Fick's law and diffusion coefficient, Stoke-Einstein's law, Application of diffusion processes in biology: hemolysis, cyclosis, plasmolysis

1.4. Osmosis: Vant Hoff's laws, Osmotic concentration, osmotic gradient, Electro-osmosis, Electrolytic and ionic balance in biological fluid

1.5. Viscosity: Factors affecting viscosity, Determination of viscosity of liquids, significance

1.6. Stratifications of cellular components against gravity

2. Radiation Biology (5 h)

2.1. Radioactivity, ionizing radiations, interaction of radiation with matter

2.2. Properties of different types of radioisotopes normally used in biology

2.3. Detection, measurement and incorporation of radioisotopes in biological tissues and cells

2.1.1 Radiation dosimetry

2.1.2 G.M. counter

2.1.3 Ionizing chambers

2.1.4 Autoradiography

2.1.5 Cerenkov radiation

2.1.6 Liquid Scintillation

2.2 Molecular imaging of radioactive material in nuclear medicine: MRI, FMRI, PET

2.3 Safety guidelines

3. Electrophysiological methods (4 h)

3.1 Single neuron recording

3.2 Patch-clamp recording

3.3 Electro Cardio Graphy (ECG)

3.4 Brain activity recording - Lesion and stimulation of brain

3.5 EEG, CAT

4. Biophysical methods (6 h)

4.1 Spectroscopy

4.1.1 UV/visible

4.1.2 Fluorescence

4.1.3 Circular dichroism

4.1.4 NMR and ESR spectroscopy

4.1.5 Multiwell spectrometry

4.2 Structure determination using X-ray diffraction and NMR

4.3 Analysis using light scattering: Static Light scattering

4.4 Different types of mass spectrometry

4.5 Surface Plasmon Resonance (SPR) methods

5. icroscopic techniques (7 h)

5.1 Resolving powers of different microscopes

5.2 Visualization of cells and subcellular components by light microscopy

5.3 Microscopy and detection of molecules in living cells

5.4 Phase contrast, Immunofluorescence and Confocal microscopy

5.5 Electron microscopy: Scanning and Transmission (SEM and TEM)

5.6 Freeze-etch and freeze-fracture methods for Electron Microscope

5.7 Cytophotometry

5.8 Micrometry

5.9 Different fixation and staining techniques

5.10 Cryotechnique

6. Chromatography **(5 h)**

6.1 Principle and applications:

6.2 Adsorption chromatography

6.3 Partition chromatography

6.4 Column chromatography

6.5 Paper chromatography

6.6 Thin layer chromatography

6.7 Gel-filtration

6.8 Ion-exchange chromatography

6.9 Gas chromatography

6.10 Affinity chromatography

6.11 HPLC

7. Electrophoresis **(5 h)**

7.1 Paper electrophoresis

7.2 Disc electrophoresis

7.3 PAGE - Two-dimensional PAGE

7.4 High voltage and immuno electrophoresis

7.5 Isoelectric focusing

8. Principles and applications of **(3 h)**

8.1 Laser

8.2 Flow cytometry

8.3 Hydrodynamic methods

PART B: BIOSTATISTICS

Course outcome:
At the end of the course, the student will be able to:

No.	Course outcome	Knowledge level
CO1	Acquire knowledge to use the proper methods to collect, organize and classify the data for relevant analyses and effectively present the interpretation	K1, K2
CO2	Understand the fundamental concepts with regard to descriptive and inferential biostatistics	K2, K3
CO3	Develop skills in tabulation and cross-tabulation, and the graphical representation of data	K3, K5
CO4	Select any inferential statistics for conducting hypothesis testing	K5, K6
CO5	Make easy and reliable decisions based on data, and formulate predictions	K3, K5, K6
CO6	Analyze the study data, assess any knowledgeable disciplines, and help to interpret the results in the field of research	K3, K4, K5

1. Introduction **(3 h)**

1.1 Sample and test biostatistics

1.2 Role of biostatistics in modern research

1.3 Descriptive and Inferential biostatistics

1.4 Limitations of statistical methods

1.5 Applications of biostatistics

1.6 Attributes and variables

2. Measures of Central tendency **(5 h)**

2.1 Characteristics

2.2 Arithmetic mean, Geometric mean and Harmonic mean

2.3 Correcting incorrect arithmetic mean

2.4 Combined arithmetic mean

2.5 Merits and demerits

2.6 Median

2.7 Mode

3. Measures of dispersion or variability **(5 h)**

3.1 Variability or dispersion

3.2 Importance of dispersion

3.3 Range

3.4 Mean deviation

3.5 Standard deviation

3.6 Quartile deviation

3.7 Variance

3.8 Standard error

3.9 Coefficient of variation

3.10 Lorenz curve – construction

4. Probability distribution (6 h)

4.1 Normal distribution

4.1.1 Skewness and Kurtosis

4.1.2 Nature of Skewness

4.1.3 Measures of Skewness

4.1.4 Fitting of normal curves

4.2 Binomial distribution

4.2.1 Properties and Fitting of binomial distribution

4.3 Poisson distribution

5. Statistical inference (7 h)

5.1 Test of significance

5.2 Test of hypothesis

5.3 Level of significance

5.4 Degree of freedom

5.5 Critical region

5.6 Parametric and Non-parametric test

5.7 Type I and Type II error

5.8 Types of t-test

5.9 Chi-square test

6. Analysis of Variance (4 h)

6.1 Assumptions and techniques of ANOVA

6.1.1 One-way classification

6.1.2 Two-way classification

6.2 Basic introduction to Multivariate statistics

7. Correlation and Regression analysis (5 h)

7.1 Types of correlation

7.1.1 Graphic methods – Scatter diagram, Simple graph, Correlogram

7.1.2 Mathematical methods – Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient

7.1.3 Tied ranks and Repeated ranks

7.1.4 Coefficient of concordance

7.2 Types of regression

7.2.1 Graphic method and Algebraic method

7.2.2 Regression lines

7.2.3 Regression equation

8. Methods in field biology (5 h)

8.1 Methods of estimating population density of animals and plants

8.2 Ranging patterns through direct, indirect and remote observations

8.3 Sampling methods

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ZOO 1C 03 BIOSPHERE ECOLOGY

Course Objectives:

- This course aims to make scientific awareness among the students about the surrounding environment and interrelation of abiotic and biotic components of the ecosystem.
- Understand basic and advance assessment of the impact of climate change and its mitigation, assessment biodiversity and environment impact assessment (EIA).

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course Outcome	Knowledge Level
CO 1	Describe and understanding about dynamics of population structure	K1, K2, K4
CO 2	Infer and explain the knowledge about different modeling tools used for ecosystem modeling	K1,K2,K5
CO 3	Create a scientific knowledge about the emergence and application of molecular ecology	K2, K3, K5
CO 4	Discuss the possibilities regarding ecosystem management	K2
CO 5	Review and justify the impact habitat degradation and fragmentation and sustainable development	K1, K6
CO 6	Rate awareness about global environmental issues	K2, K6
CO 7	Understanding and classify the details of soil texture, properties and conservation	K2, K3, K5
CO 8	Derive scientific knowledge regarding pollution, prediction and environmental impact assessment.	K4, K6
CO 9	Students understand the relevance of biodiversity indices and estimate various inventorying practices	K2, K3, K6
CO 10	Assessing the advancement in various cleaner technologies and explore the possibilities of evaluation of merits	K4, K5, K6

1. **Population Ecology** **(8 h)**
   - 1.1. Population growth –Chaotic systems, Catastrophic theory. Intrinsic rate of natural increase, r- and k-selection
   - 1.2. Human population growth – consequences and solutions
   - 1.3. Life tables and survivorship curves.
   - 1.4. Meta population dynamics
2. **Ecological modeling** **(3 h)**
   - 2.1 Introduction

2.2 Statistical Models

2.3 Non-statistical models

2.3.1 Analytical model

2.3.2 Simulation model

2.3 Validation of models

3. Molecular ecology (4 h)

3.1 Introduction to molecular ecology

3.2 Emergence of molecular ecology

3.3 Applications of molecular ecology in Agriculture

4. Ecosystem studies (9 h)

4.1 Ecology of Wetlands: Uses, threats and management

4.2 Ecology of Coral Reefs: Uses, threats and management

4.3 Ecology of Tropical Rain Forests: Vegetation structure, Productivity and nutrient cycling in forests, Uses, threats and management

5. Conservation Ecology (8 h)

5.1 Impact of major ecosystem process like habitat degradation and loss, fragmentation, over exploitation, species invasion and land use changes on biodiversity.

5.2 Restoration Ecology

5.3 Sustainable development

5.4 Ecological foot printing

6. Environmental issues (7 h)

6.1 Global environmental issues – Ozone hole, effects on human life

6.2 Human mediated Global climate change – Greenhouse effect and its impact

7. Soil Biology (4 h)

7.1 Mechanism of erosion

7.2 Soil conservation: Managing topography

8. Remote sensing as a tool for the study and the Management of ecosystems (5 h)

8.1 Physical basis for remote sensing

8.2 Role of remote sensing in ecological research

9. Pollution (8 h)

9.1 Environmental Impact Assessment

9.2 Brief account of Environmental laws

10. Taxasphere and inventorying (12 h)

10.1 Reason for undertaking inventorying, priority conservation area recognition

10.2 Indexing of world's known species, *species2000*

10.3 Evaluation of biodiversity indices – Shannon- Weiner indices, Similarity and dissimilarity index, Association index

11. Environmental Biotechnology (12 h)

11.1 Cleaner technologies: sewage treatment, Solid waste and soil pollution management, Bioremediation, Bioreactors for liquid waste treatment, Biofilters, Vermicomposting, Biomethanation, Removal of oil spills

11.2 Environmental monitoring and biomonitoring

11.3 Ecological impact of genetically modified plants and other organisms

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ZOO 1C 04 SYSTEMATICS AND ANIMAL BEHAVIOUR

PART A: SYSTEMATICS

Course Objectives:

- To provide a thorough knowledge on principles of classification
- To educate students on ethics in taxonomy and taxonomic publications.
- To highlight the new trends in systematics

Learning outcome:

The course will help students to understand the rules to be followed in insect classification. It will also give students knowledge on classification of insects.

CO.No.	Course outcome statements	K Level
Co 1	Provide a thorough knowledge on rules and regulations to be followed in Insect classification	K2, K3, K5
Co 2	Deliver information on newer trends in insect systematics and ethics to be followed in taxonomic studies and publications	K2, K3, K5

1. Definition and basic concepts in Systematics and Taxonomy (3 h)

1.1. Systematics and Taxonomy

1.2. Historical resume of Systematics

1.3. Levels of Taxonomy: Alpha, beta and gamma taxonomy

1.4. Place, importance and applications of taxonomy

1.5. Goals of taxonomy

2. Classification (4 h)

2.1. Practice of classification: purpose of classification

2.2. Use of classification: storage of data, recovery of data.

2.3. Theories of biological classification – hierarchy of categories.

2.4. Types of classification: evolutionary and phylogenetic classification- typological classification, phenetic classification, omnispective classification, horizontal and vertical classification.

2.5. Components of classification.

3. Taxonomic procedures (6 h)

3.1. Taxonomic collections: types of collections, value of collections.

3.2. Curation: preservation of collection in field and laboratory.

3.3. Recording of field data, storage of collection, labeling and cataloguing of collection.

3.4. Identification: methods of identification

3.5. Use of taxonomic keys: kinds, merits and demerits

3.6. Taxonomic descriptions: Presentation of findings.

3.7. Kinds of taxonomic publications.

4. Species concepts (4 h)

4.1. Species category: different species concepts: typological, nominalistic, biological, evolutionary, recognition, ontological (theoretical) and operational (epistemological) species concepts

4.2. Taxonomic diversity within species, different kinds of species, subspecies and other infraspecific categories, hybrids.

5. Taxonomic characters (9 h)

5.1. Different kinds of taxonomic characters.

5.2. Functions of taxonomic characters.

5.3. Taxonomic characters and classification.

5.4. Taxonomic characters and evolution.

6. Zoological nomenclature (10 h)

6.1. International Code of Zoological Nomenclature, development of Code of Zoological Nomenclature: its operative principles, interpretation and application of important rules in the formation of scientific names of various taxa.

6.2. Principle of priority: Homonymy and Synonymy.

6.3. Type method and its significance: Different kinds of types in descriptive taxonomy.

7. Newer trends in systematics (8 h)

7.1. Chemotaxonomy and serotaxonomy

7.2. Cytotaxonomy

7.3. Numerical taxonomy

7.4. Cladistics

7.5. Molecular systematics.

8. Ethics in taxonomy (3 h)

8.1. Ethics related to collections: Credit, Lending and borrowing of specimens, Loan of material, Exchange of materials, Collaboration and co-operation with co-workers, Use of language

8.2. Ethics related to taxonomic publication: Authorship of taxonomic papers, Correspondence, Suppression of data, Undesirable features of taxonomic papers

8.3. Taxonomists and user communities

9. Taxonomic impediments (3 h)

9.1. Impediments to build up taxonomic collections and maintenance

9.2. Shortage of man power, Lack of funding for taxonomic research, Lack of training in taxonomy, Lack of library facilities.

9.3. Impediments in publishing taxonomic work

9.4. Solutions to overcome the impediments: International co-operation, Development of taxonomic centers

9.5. Need for efficient international networking

9.6. The Desired end product

PART B: ANIMAL BEHAVIOUR

Course outcome:

After completing this course the learner will be able to:

No.	Course outcome	K level
CO1	Understand the knowledge of ethology and other schools of studies on animal behavior	K1, K2
CO2	Develop theoretical understanding of neural basis of behaviour	K2, K3
CO3	Interpret the relationship about the evolutionary tree of animals	K3, K4
CO4	Evaluate and review examples of how scientific knowledge has helped to improve the study of animal behaviour	K4, K5
CO5	Expand knowledge to equip with experimental methods demonstrating genetic basis of behavior	K1, K2, K3
CO6	Develop conceptual understanding on the present diversity with an emphasis on specific fauna	K1, K3, K5
CO7	Demonstrate the role of genes and environment in developing behaviour	K3, K4, K5

1. Mechanisms of animal behaviour (2 h)

1.1. Definition and Methodology

1.2. Ethology and its relation to other schools of studying animal behaviour.

2. Development of behavior (10 h)

2.1 Behavioural development – Genes and Environment

2.1 Environmental difference and Behavioural differences

2.2 Genetic differences and Behavioural differences

2.3 Single-Gene effects on behaviour

2.4 Experimental methods demonstrating genetic basis of behaviour

3. Nerve cells and behaviour (6 h)

3.1. Neural basis of behaviour

3.2. Stimulus filtering and behaviour

4. Physiology of behavior (5 h)

4.1. Hormonal influence on behaviour

4.2. Factors influencing effects of hormones on behaviour

5. Biological communications (4 h)

5.1. Pheromones in mammals: Lee Boot effect, Whitten effect, Bruce effect, Coolidge effect, Vandenbergh effect

6. Sociobiology (3 h)

6.1 Altruism and Kinship selection

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ZOO 1C 05 – BIOCHEMISTRY, BIOPHYSICS & BIOSTATISTICS PRACTICAL

BIOCHEMISTRY

Course Outcomes:

CO1. Students will gain skills in methods and techniques of biochemical assays.
CO2 Student will compare different biochemical assays
CO3. Students will appreciate the importance of biochemical assays

1. Comparison of the capacities of two buffers of the same pH.
2. Estimation of blood glucose.
3. Estimation of blood/serum cholesterol
4. Estimation of serum urea
5. Estimation of serum/blood bilirubin
6. Determination of alkaline phosphatase activity in serum
7. Estimation of total carbohydrates by phenol-sulphuric acid method.
8. Estimation of protein by Biuret method.
9. Estimation of protein by Bradford's method.
10. Isolation of casein from milk.
11. Saponification value of fat.
12. Estimation of total lipids in the serum
13. Determination of salivary amylase activity and effect of substrate concentration
14. Effect of pH on salivary amylase activity.
15. Electrophoresis (PAGE).
16. Determination of molecular weight of proteins by SDS-Polyacrylamide Gel Electrophoresis.
17. Two dimensional gel electrophoresis.

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BIOPHYSICS

Course Outcome:

CO. No.	Course outcome statements	K Level
CO 1	Determine the concentration of the unknown sample by applying Beer's law.	K3
CO 2	Separate aminoacids/sugars using chromatography	K3
CO 3	Understand the practical skills in microscopy, HPLC, pH meter and PAGE	K3

1. Absorption spectrum of potassium permanganate. Determination of absorption coefficient and concentration of unknown solutions by calibration as well as by absorption coefficient.
2. separation of mixtures of sugars and amino acids by paper/thin layer chromatography.
3. Measurement of size of microscopic objects using stage and ocular micrometers.
4. Demonstration of working principle of Light, Phase contrast and Fluorescence microscope, Camera Lucida and Photomicrographic equipment, HPLC.
5. Determination of coefficient of viscosity using Ostwald's Viscometer.
6. Determination of pH of biological fluids using pH meter.
7. Demonstration of cryosectioning.
8. Densitometric documentation of electrophoretogram - determination of protein concentration and molecular weight.

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BIOSTATISTICS

Course outcome:

At the end of the course, the student will be able to:

No.	Course outcome	Knowledge level
CO1	Understand and interpret Population mean and dispersion in the distribution	K2, K3
CO2	Develop the ability to plot graphs and charts	K3, K5
CO3	Understand various statistical methods to work on a research project	K3, K6
CO4	Able to design and develop appropriate research hypothesis	K2, K3
CO5	Explore the relationship between variables using correlation and regression analysis	K1, K5, K6

1. Computation of measures of central tendency and dispersion in anthropometric data of school children.
2. Simulation of binomial and Poisson distributions.
3. Estimation of the mean number of children per family from selected populations
4. Designing of an experiment for the comparison of efficacy of a few diets on different types of animals by the method of ANOVA.
5. Regression analysis and correlation analysis of a data of heights and weights of a group of students.
6. Data Analysis by SPSS.

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ZOO 1C 06 – SYSTEMATICS, BEHAVIOUR & BIOSPHERE ECOLOGY PRACTICAL

SYSTEMATICS

Learning Outcome:

- Achieve practical proficiency in classification of insects.

1. Preparation of dichotomous keys with reference to the following insect orders:
   1.1. ORTHOPTERA : Dichotomous key to selected families
   1.2. HEMIPTERA: Dichotomous key to selected families.
   1.3. COLEOPTERA : Dichotomous key to selected families
   1.4. DIPTERA: Dichotomous key to selected families
   1.5. HYMENOPTERA: Dichotomous key to selected families
2. Identification and classification of given 5 species of insects up to family level.

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ANIMAL BEHAVIOUR

Course outcome:

After completing this course the learner will be able to:

No.	Course outcome	K level
CO1	Demonstrate and identify various behaviours of animals	K1, K2
CO2	Develop practical skill to identify various patterns of behaviour	K2, K3
CO3	Understand the role of genes and environment in developing behaviour	K3, K4
CO4	Identify the role of neurons for developing behaviour	K4, K5
CO5	Gain knowledge in observing and documenting the behaviours of different animals	K1, K2, K3

1. Foraging behaviour of ants
2. Demonstration of Photo tactic behaviour in earthworms.
3. Field study on the identification and behaviour of birds (with emphasis on feeding behaviour)
4. Study of behaviour modifications in animals under stress.

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BIOSPHERE ECOLOGY

Course Outcomes (CO)

Create application knowledge regarding various environment assessments

No.	Course Outcome	K Level
CO 1	Develop practical knowledge about environmental quality assessment	K4, K5
CO 2	Hand own experience to design and interpret the results of environmental relevance	K4, K6
CO 3	Equipped the stakeholders to apply scientific knowledge to measure ecological index	K4, K5, K6
CO 4	Develop good laboratory practice in nutrient analysis	K4, K5
CO 5	Create adequate experience in waste management protocols	K5, K6

1. Determination of primary productivity in pond water-light and dark method.
2. Separation and Identification of soil micro arthropods applying Berlese funnel
3. Small scale field inventorying on biodiversity and calculation of richness and evenness: Simpson's diversity index
4. Demonstration of GPRS based land mapping
5. Tabulation and preparation of species diversity indices using field inventorying data.
6. Intertidal studies: rocky shores, sandy (marine) shore, muddy shore and estuaries.
7. Preparing a report on invasive plant species in your locality
8. Estimation of salinity, phosphates, chlorides and silicates in water samples.

9. BOD in polluted water
10. COD open reflex in two water samples
11. Methane index calculation in different substrates. E.g. starch, canteen waste, liquid waste
12. Volatile fatty acid (VFA) estimation in anaerobic fermenting system
13. Estimation of total organic and inorganic substance in solid waste
14. Estimation of total dissolved solids in waste water
15. Estimation of total suspended solids in waste water

***Study tour**: A study tour is to be conducted for the purpose of field observation of animals belonging to different niches other than local area and study of their actual habitat conditions and their behaviour. A report of the field study is to be included in the practical record to be submitted at the time of examination*

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SECOND SEMESTER

ZOO 2C 07 CYTOGENETICS AND EVOLUTION

PART A: CYTOGENETICS

Course outcome:

On completion of this course, the students will be able to:

No.	Course outcome	Knowledge level
CO1	Understand cell communication between and within the cells, and various pathways involved in signal transduction	K1, K2
CO2	Develop theoretical understanding of laws of inheritance, location of genes on chromosomes and linkage mapping	K2, K3
CO3	Figure out the effects of chromosomal aberrations in numerical and structural changes leading to genetic disorders	K2, K3, K5
CO4	Critically analyze the chemical basis of genes and their interactions at population level and its evolutionary significance	K3, K4
CO5	Identify with consequences and pathways of apoptosis, and how it differs from necrosis	K4, K5
CO6	Evaluate the effects of mutations on gene functions	K5, K6
CO7	Attain knowledge about gene manipulation and analysis by gene mapping techniques	K1, K2, K4
CO8	Interpret the relationship between transposons and host genome, and its role in genome evolution	K5, K6

1. Cellular communication (6 h)

1.1 Regulation of hematopoiesis

1.2 General principles of cell communication

1.3 Cell-cell interactions – cell adhesion and roles of different adhesion molecules

1.4 Extracellular matrix: Basal membrane and Laminin, Collagen, Proteoglycan, Fibronectin

1.5 Interaction of cells with extracellular matrix: Integrins. Focal adhesion and hemidesmosomes.

1.6 Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins, Adherens.

1.7 Neurotransmission and its regulation

2. Cell signaling (7 h)

2.1 Hormones and their receptors

2.2 Signal transduction

2.3 Concept of cell-signaling

2.4 Signaling through intracellular receptors

2.5 Signaling through cell surface receptors: G protein linked receptors; signaling via

cAMP, PKA, IP3, Ca^{2+}/calmodulin, PKC, Ca-MK, ion channels, Enzyme linked receptors, Receptor tyrosine kinase (RTK), signaling of growth factors, Tyrosine kinase associated receptors, JAK-STAT signaling pathway, Receptor protein tyrosine phosphatase (PTP), Receptor serine/threonine kinase, Receptor guanyl cyclase, cGMP, PKG, Histidine kinase associated receptors, bacterial chemotaxis and quorum sensing

2.6 Receptor desensitization

2.7 Signaling by nitric oxide, carbon monoxide

2.8 Signaling network

2.9 Impairment of signaling mechanism: Tumorigenesis: Role of oncogenes and oncoproteins, NIDDM: low level of receptors

3. Apoptosis and its significance (5 h)

3.1 Necrosis; Programmed and induced cell death

3.2 Process of apoptosis: Initiation, Execution: cytochrome C, caspases, Phagocytosis

3.3 Regulation of apoptosis - Extracellular and Intracellular

3.4 Apoptosis in *Caenorhabditis elegans*, Drosophila, mammals and bacterial population

3.5 Mechanism of cell death

3.6 Genes involved in apoptosis

3.7 Therapeutic interventions of apoptosis

4. Organization of genes and chromosomes (5 h)

4.1 Interrupted genes and gene families

4.2 Structure of chromatin and chromosomes

4.3 Unique and repetitive DNA

4.4 Heterochromatin and euchromatin

4.5 Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests

4.6 Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

5. Mendelian principles and extension of Mendelian principles (5 h)

5.1 Law of dominance, Law of segregation, Law of independent assortment, Non - Mendelian inheritance

5.2 Extension of Mendelian principles: Co-dominance, Incomplete dominance, Gene interactions, Pleiotropy, Genomic imprinting, Penetrance and Expressivity, Phenocopy

5.3 Linkage and crossing over – Coupling and repulsion theory, Cytological basis of crossing over – tetrad analysis

5.4 Sex linkage, sex limited and sex influenced characters

6. Gene mapping methods and Human genetics (7 h)

6.1. Genome maps: Linkage maps, Cytogenetic maps and physical maps, LOD score for linkage testing

6.2. Techniques of restriction mapping

6.3. Mapping with molecular markers: RFLPs, RAPDs, AFLPs, STS, Minisatellites, Microsatellites, Mapping by using somatic cell hybrids

6.4. Cytogenetic maps using molecular markers: PFGE microdissection, Radiation hybrids

6.5. FISH

6.6. Physical and transcript mapping: Low resolution and high resolution physical mapping, Physical maps using molecular markers: STS/EST based mapping, BAC/YAC based mapping, Integrated genomic maps

6.7. Quantitative Genetics: Polygenic inheritance, Heritability and its measurements, QTL mapping

6.8. Pedigree analysis

6.9. Karyotyping

6.10. Genetic disorders: Down's, Klinefelter's and Turner's syndromes

7. Chromosomal aberrations (5 h)

7.1 Deletion, duplication, inversion, translocation, ploidy and their genetic implications

7.2 Homologous and non-homologous recombination, transposition, site-specific recombination

8. Mutation (5 h)

8.1 Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function

8.2 Germinal and somatic mutants, insertional mutagenesis

9. Transposable genetic elements (5 h)

9.1 Classification of transposable elements: Class I and Class II

9.2 Transposons in bacteria – IS elements, Composite transposons, Tn family, medical significance

9.3 Transposons in eukaryotes – P elements in *Drosophila*

9.4 Retrotransposon type transposition – Yeast Ty elements, Alu family

PART B: EVOLUTION

Course Outcome

	Course Outcome	K Level
CO 1	Explain the Science of Evolutionary Biology and different theories of evolution	K2
CO 2	Explain molecular tools in phylogenic studies	K3
CO 3	Describe different mechanisms evolution of new species	K3, K4

1. Emergence of evolutionary thoughts (8 h)

1.1 Overview: Lamarckism, Darwinism, concepts of variation, adaptation, struggle, fitness and natural selection, Neo Darwinism

1.2 Evolutionary time scale; eras, periods and epoch

1.3 Major events in the evolutionary time scale; origins of unicellular and multicellular organisms

1.4 Evolution of major groups of plants and animals

2. Molecular Evolution (10 h)

2.1 Neutral theory of molecular evolution: Principles

2.2 Molecular divergence and molecular clocks

2.3 Molecular tools in phylogeny: protein, amino acid and nucleotide sequence analysis, Immunological techniques, DNA – DNA hybridizations, Repetitive DNA sequences, Restriction enzyme sites

2.4 Phylogenetic tree: Distance and Parsimony methods

2.5 Evolution of gene families, Molecular drive

2.6 Origin of new genes and proteins; gene duplication and divergence.

2.7 Micro and macro evolution

3. Mechanisms of evolution (12 h)

3.1 Variations: Phenotypic and Genetic

3.2 Population genetics: populations, gene pool, gene frequency

3.3 Hardy-Weinberg law, concepts and rate of change in gene frequency through natural selection

3.4 Migration and random genetic drift

3.5 Meiotic Drive

3.6 Adaptive radiation and modifications

3.7 Isolating patterns and mechanisms

3.8 Speciation: allopatric, parapatric and sympatric, recombinational

3.9 Convergent evolution; sexual selection; co-evolution.

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ZOO 2C 08 – MOLECULAR BIOLOGY

CO1. Students will explain the mechanism of DNA replication and the significance of DNA replication.
CO2. Student will describe restriction enzymes and their significance.
CO3. Student will explain the general features of genetic code and variations in genetic code.
CO4. Student will describe the mechanism of transcription, translation, post transcriptional and translational modifications.
CO5. Student will compare the regulation of gene expression in Phages, Bacteria, and in Eukaryotes.
CO6. Student will compare the antisense RNA strategies and role of si RNA and mi RNA in the regulation of eukaryotic gene expression and their applications.

1. Genes and genomes **(5 h)**

1.1 Genomes of prokaryotes and eukaryotes

1.2 Organelle genomes: Mitochondrial and Chloroplast

2. Topology of nucleic acids **(6 h)**

2.1 Different forms of DNA (A, B, C & Z)

2.2 Supercoiling and Topoisomerases.

2.3 Classification and mechanism of action of topoisomerases.

3. Replication of DNA **(8 h)**

3.1 Models of DNA replication: Semiconservative mode (Experiments of Messelson and Stahl; Cairns), rolling circle mode and D-loop mode of replication. Role of antisense RNA in replication initiation in plasmids

3.2 Okazaki fragments and semidiscontinuous synthesis.

3.3 Enzymes and accessory proteins involved in DNA replication.

3.4 Replication origin and replication fork, fidelity of replication and extra chromosomal replicons

4. Restriction and modification **(6 h)**

4.1 Restriction enzymes: Classification and nomenclature of restriction enzymes

4.1 Role of restriction enzymes in bacteria

4.3. Restriction fragment length polymorphism (RFLP)

5. DNA repair **(6 h)**

5.1 DNA repair mechanisms in bacteria and higher organisms. Base Excision repair, Nucleotide Excision repair. mismatch repair and SOS response

6. The Genetic code **(7 h)**

6.1 Characteristic features of the genetic code

6.2 Deciphering the code

6.3 Degeneracy of the code: Wobble hypothesis.

6.4 Reading frame and frame shift

6.5 Special feature of the genetic code in ciliates and mitochondria.

6.6 Mutations and the genetic code (frame shift, point and suppressor mutations)

6.7 Suppressor *t* – RNA and frame shift suppression.

6.7 Evolution of the genetic code

7. RNA synthesis and processing (8 h)

7.1 Transcription factors and machinery

7.2 Formation of initiation complex

7.3 Transcription activators and repressors

7.4 RNA polymerases, capping, elongation and termination

7.5 RNA processing, RNA editing, splicing, polyadenylation

7.6 Structure and function of different types of RNA

7.7 RNA transport

8. Protein synthesis and processing (6 h)

8.1 Ribosome - formation of initiation complex

8.2 Initiation factors and their regulation

8.3 Elongation and elongation factors, termination

8.4 Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase

8.5 Translational proof-reading, translational inhibitors

8.6 Post- translational modification of proteins

9. Regulation of gene expression in bacteria and phages (6 h)

9.1 The operon model. : *lac* operon, *lac* repressor negative and positive control

9.2 Constitutive mutants

9.3 Catabolite repression

9.4 Basic features of tryptophan operon: Operator-repressor regulation and attenuation regulation

9.5 Regulation of gene expression in phages

10. Regulation of gene expression in eukaryotes (6 h)

10.1 Interaction with RNA, DNA binding proteins, gene dosage, gene amplification, regulatory transcription factors, Histones, acetylation and deacetylation, epigenetic effects.

10.2 Regulation at transcriptional level: Activation of transcription, Repression of transcription

10.3 Regulation at translational level

10.4 Regulation by alternate pathways of transcript splicing.

10.5 Anti - sense RNA strategies for regulating gene expression.

10.6 si RNA, mi RNA

11. Characteristic features of eukaryotic genome (6 h)

11.1 Unique, moderately repetitive and highly repetitive DNA sequences

11.2 Reassociation kinetics of the above types of DNA

11.3 Cot value and complexity of the genome

11.4 Satellite DNA and selfish DNA.

12. Human genome (4 h)

12.1 Human genome mapping

12.2 Sequencing human genome, HGP

13. Molecular biology of Cancer (6 h)

13.1 Biology and causes of cancer

13.2 Gene Mutations in cancer and Genetic rearrangements in progenitor cells

13.3 Oncogenes and tumor suppressor genes

13.4 Virus-induced cancer

13.5 Alteration of cell cycle regulation in cancer

13.6 Metastasis and angiogenesis in cancer.

13.7 Therapeutic interventions of uncontrolled cell growth – Immunotherapy and Gene therapy

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ZOO 2C 09 BIOTECHNOLOGY

Course outcome:

After completing this course, the learner will be able to:

No.	Course outcome	K level
CO1	Recall the basic terms and understand the principles and practices in Biotechnology	K1, K2
CO2	Develop the knowledge on the primary tools and techniques in biotechnological processes	K2, K3
CO3	Outline the fundamental concepts with regard to various techniques in genetic engineering	K4
CO4	Acquire skills and choosing the apt conditions in PCR and blotting techniques	K4, K6
CO5	Demonstrate and design the techniques involved in isolation, sequencing and synthesis of genes	K3, K5
CO6	Generalize and practice the ethical and social implications of biotechnology	K2, K3
CO7	Classify, distinguish and apply the biological databases	K2, K3
CO8	Choose and interpret the basic bioinformatic tools and softwares	K3, K4

1. Introduction (2 h)

1.1. History, Scope and importance of biotechnology

2. Cloning and expression vectors (6 h)

2.1. Plasmids, phages, cosmids, transposons, P1, BACs, YACs, Binary and Shuttle vectors

2.2. Expression vectors for high level of expression of cloned genes (use of promoters and expression cassettes including Baculovirus)

3. Blotting and Hybridization techniques (6 h)

3.1. Southern, Northern and Western blotting techniques

3.2. Dot and Slot blots

3.3. Molecular probes and hybridization

4. Polymerase Chain Reaction (PCR) (8 h)

4.1. Basic PCR and its modifications: Inverse PCR, Anchored PCR, PCR for mutagenesis, Asymmetric PCR

4.2. Real time PCR and its applications

4.3. RACE

4.4. Applications of PCR in biotechnology and genetic engineering.

5. Cloning in bacteria and eukaryotes (8 h)

5.1. Steps in gene cloning, Restriction endonucleases, Construction of chimaeric DNA, Transfection, Selection and screening of the transformed cells, Blue-white screening, Colony hybridization methods, Reporter genes, Fusion proteins.

5.2. Construction and screening of genomic and cDNA libraries

7. Sequencing of whole genomes (7 h)

7.1. BAC/YAC Genomic libraries

7.2. DNA Sequencing methodology

7.3. Sequence assembly by the clone contig approach

7.4. Sequence assembly and analysis.

7.5. Next generation sequencing and direct sequencing of genomes

8. Genotyping techniques and its applications (7 h)

8.1. Polymorphic DNA

8.2. SNP analysis

8.3. DNA fingerprinting

8.4. PCR based genotyping

8.5. Clinical diagnosis

8.6. Prenatal diagnosis

8.7. Paternity/maternity testing

8.8. Forensic analysis

8.9. Molecular taxonomy

8.10. Phylogeny analysis.

9. Gene therapy and other molecular based therapeutic approaches (7 h)

9.1. Principles of molecular genetic based therapies

9.2. General gene therapy strategies

9.3. Therapeutics based on targeted inhibition of gene expression and mutation correction *in vivo*

9.4. Gene therapy for inherited disorders

9.5. Gene therapy for neoplastic and infectious diseases

9.6. Ethics of human gene therapy

9.7. Genetic counseling

9.8. Drug designing, delivery and targeting

10. Gene silencing techniques and Transgenic animals (6 h)

10.1. RNAi

10.2. DNAi

10.3. Intrabodies

10.4. Aptamers

10.5. Transgenic animals and Gene knockouts

10.6. Knockout vectors

10.7. Knockout mouse

11. Animal Tissue Culture, Hybridoma and Monoclonal antibodies (8 h)

11.1. Organ Culture, Cell cultures, Culture media, Initiation of cell cultures, Evolution of cell lines, Large scale culture of cell lines: Monolayer and suspension cultures

11.2. Hybridoma technology and the production of monoclonal antibodies

11.3. Antibody engineering using genetic manipulations

11.4. Alternatives to hybridoma technology

11.5. Production of human and humanized antibodies

11.6. Uses of monoclonal antibodies

12. Intellectual Property Rights (lPR) and Protection (IPP) (5 h)

12.1. Intellectual property rights

12.2. Patents

12.3. Trade secrets

12.4. Copyright

12.5. Trademarks

12.6. Choice of intellectual property protection

12.7. IPR and plant genetic resources (PGR)

12.8. GATT and TRIPs

12.9. Biosafety concepts and issues. General guidelines for recombinant DNA research activity.

13. Patenting of biological material (4 h)

13.1. International conventions and international cooperation

13.2. Obligations with patent applications

13.3. Implications of patenting

13.4. Patents for higher plants and higher animals

13.5. Patenting transgenic organisms and isolated genes

13.6. Patenting of genes and DNA sequences

13.7. Patentability of vectors

13.8. Patent of research tools

14. Bioinformatics **(7 h)**

14.1. Biological databases : DNA, RNA, Protein

14.2. Nucleic acids and amino acid codes used in database formats

14.3. Sequence alignment and its evolutionary basis

14.4. Searching the database for sequence similarity

14.5. Search programmes with special reference to FASTA, BLAST and CLUSTAL W

14.6. Application of bioinformatics in phylogenic analysis

14.7. Molecular phylogenic tree construction

14.8. Protein visualization and modeling

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ZOO 2C 10 ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

Course Outcomes (CO)

The course also has a strong laboratory component equipped its stakeholders for pursuing advance research in various field of animal physiology and strengthen the students for appearing various competitive examinations.

No.	Course Outcome	K Level
CO 1	Students get fundamental knowledge about evaluation of adaptation	K1, k2, K5
CO 2	Acquire fine features of shape and its relation with metabolism and cost of expenditure of live forms	K3,K4, K5
CO 3	Students gain fundamental knowledge of animal physiology related human nutrition and gastric control pathways	K1, K4, K5
CO 4	Outline human blood physiology and able to illustrate development of blood cells, cardiac control	K1, K3, K4
CO 5	Explain the importance of surfactants and regulation of respiration – respiratory centres, neural and chemical regulaion	K4, K6
CO 6	Describe and explain the basic concepts of excretion, ultra-structure and concept of plasma clearance	K1, K3, K4
CO 7	Explain nerve physiology and various disease	K1, K6
CO 8	Classify the sensory structures	K1, K3,
CO 9	Generate knowledge in movements and principals of microscopic, ultra-structure and molecular organization of muscle	K1, K4, K5
CO 10	Illustrate scientific information related to sports physiology	K1, K3
CO 11	Memorize fundamental knowledge related to endocrinology	K1, K2
CO 12	Infer knowledge about endocrine disruptors in the environment	K4,

1. The Nature and levels of Adaptation (6 h)

1.1 Comparative, environmental, and evolutionary physiology

1.2 The meaning of ‘environment’, ‘adaptation’

1.3 Comparative methods to detect adaptation

2. The problem of Size and Scale (6 h)

2.1 Principle of similarity: isometric scaling

2.2 Allometric Scaling

2.3 Scaling of metabolic rate

2.4 Scaling of locomotion

3. Nutrition, Digestion and Absorption (8 h)

3.1. Adaptations to special dietary pattern, ruminant and non ruminantherbivory

3.2. Nutritional disorders – obesity, starvation, Anorexia, vitamin deficiency.

3.3. Neuronal and hormonal regulation of nutritional intake, secretion of digestive enzymes, hunger drive, thirst, glucostatic and hepatostatic theories of hunger drive.

3.4. Adaptation of gut to metabolic rates and diets. Balanced diet- a human perspective

3.5. Physiology of gastro-intestinal disorders- ulcer, constipation

4. Circulation (6 h)

4.1. Haemopoiesis, Blood buffers, Blood groups and Rh factor.

4.2. Cardiac cycle and ECG, Neurohormonal and chemical regulation of cardiac amplitude and frequency, Myocardial infarction, Atherosclerosis, Cerebral circulation, blood brain barrier and cerebrospinal fluids, Placental circulation

5. Respiration (5 h)

5.1. Respiratory muscles, surfactants.

5.2. Regulation of respiration – respiratory centres, neural and chemical regulating respiration.

6. Excretion (7 h)

6.1. Mechanism of tubular reabsorption and secretion, Regulation of urine formation,

6.2. Composition of human urine, Concept of plasma clearance

6.3. Kidney disorders – acute renal failure, chronic renal failure - glomerulonephritis, pyelonephritis, nephritic syndromes and kidney stones, artificial kidney.

7. Nerve physiology (6 h)

7.1. Synaptic transmission, Mechanism of excitatory and inhibitory pathway (AchE, GABA)

7.2. Electrical and chemical transmission

7.3. Parkinson's disease, Epilepsy, Schizophrenia, Alzheimer's syndrome, Dyslexia.

8. Sensory and effector physiology (5 h)

8.1. Structural and functional classification, modality intensity exteroceptors, interoeceptors, secondary sense cells, relationship between stimulus, intensity and response, sensory coding.

8.2. Mechanoreceptors-hair cell, organs of equilibrium, vertebrate ear.

9. Muscle (5 h)

9.1. Amoeboid movement and ultrastructure of cilia

9.2. Skeletal muscle, ultrastructure and molecular organization of muscle, protein components of muscle (mechanism and theory), energetic of muscle contraction.

10. Sports physiology (6 h)

10.1 Muscles and exercise

10.2 Respiration and cardiovascular system in exercise

10.3 Dope test, drug abuse.

11. Endocrinology (5 h)

11.1 Morphology and anatomy of major human endocrine glands

11.2 Classification, biosynthesis, secretion and function of hormones

11.3 Regulation of hormone secretion

12. Functional Endocrinology (10 h)

12.1. Hormones as signal transducers

12.2. Hormones in developmental process

12.3. Role of hormones in behaviour of animals

12.4. Control of chromatophores: Pituitary, pineal

12.5. Role of hormones in reproduction of seasonal breeders and continuous breeders

12.6. Hormone therapy in reproductive impairments

13. Disorders of hormonal imbalance (3 h)

13.1. Lipid abnormality

13.2. Weight gain

14. Endocrine disruptors in the environment (2 h)

14.1. Chemical disruptors

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ZOO 2C 11 – CYTOGENETICS, ANIMAL PHYSIOLOGY & ENDOCRINOLOGY PRACTICAL

CYTOGENETICS

Course outcome:

On completion of this course, the students will be able to:

No.	Course outcome	Knowledge level
CO1	Understand the basic principles of chromosome disorders	K1, K2
CO2	Develop practical skill on the preparation of chromosomes	K2, K3
CO3	Identify and interpret clinical features of chromosomal abnormalities	K2, K3, K5
CO4	Attain knowledge in different staining techniques and slide preparations	K1, K2, K4
CO5	Achieve professional knowledge in several cytogenetic techniques	K5, K6

1. Gene mapping of *Drosophila melanogaster,* using text book problems
2. Preparation of chromosomes from rat or mouse bone marrow or human or any other lymphocyte cultures.
3. Analysis of metaphase chromosomes from rat or mouse bone marrow or any other suitable material by means of G and C banding.
4. Preparation of human karyotype from photographs of chromosome spreads – Normal and abnormal
5. Identification of human blood cell types and demonstration of drumstick on neutrophils, employing any suitable stain.
6. Staining of human buccal epithelial smear to demonstrate Barr body.
7. Preparation and analysis of salivary gland polytene chromosomes of *Drosophila* larvae.

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ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

Course Objectives (CO)

To provide a thorough practical knowledge on various aspect of animal physiology

Course Outcomes (CO)

On the successful completion of the course, students will be able to

No.	Course Outcome	K Level
CO 1	To support to do experiments on advance animal physiology	K5, K6
CO 2	Hands on experience in various instruments and handing of human and animal samples	K5, K6
CO 3	Acquire knowledge regarding experiment designing and data collection and processing	K5, K6

1. Detection of digestive enzymes in the hepatopancreas of crab.
2. Effect of temperature on salivary amylase activity.
3. Diffusion of substances through the chick intestine.
4. Demonstration of osmotic stress on human RBC.
5. Estimation of haemoglobin by Sahli's method
6. Determination of haemolymph ammonia concentration of crab with ambient temperature fluctuation.
7. Effect of osmotic stress on rate of respiration.
8. Determination of ventilatory response in fish.
9. Estimation of ammonia level in human blood.
10. Determination of oxygen consumption in fish.
11. Staging of fish chromatophores and effect of adrenaline *in vivo* and Acetylcholine *in vivo*.
12. Blood sugar regulation in the crab- role of eye stalk.
13. Identification of human endocrine gland (histological examination).
14. Laboratory Measurement of T4, T3
15. Laboratory estimation of FSH

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ZOO 2C 12 - MOLECULAR BIOLOGY & BIOTECHNOLOGY PRACTICAL

MOLECULAR BIOLOGY

Course Outcomes:

CO1. Students will gain skills in methods and techniques of Nucleic acid isolation
CO2. Students will gain skills in methods of quantification nucleic acids
CO3. Students will apply the skills in manipulating the DNA for the desired purpose

1. Estimation of DNA by diphenyl amine method/ UV absorption
2. Estimation of RNA by orcinol method/ UV absorption
3. Estimation of Protein by Lowry's method.
4. *E. coli* growth curve.
5. Isolation of plasmid DNA from bacterial culture
6. Isolation of genomic DNA
7. Isolation of RNA from Yeast.
8. Preparation of restriction fragments and their separation by electrophoresis
9. Transformation of *E.coli* with plasmids.
10. Gene cloning

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BIOTECHNOLOGY

1. Separation of DNA by electrophoresis.
2. Cloning in plasmid.
3. Bacterial transformation
4. α- Complementation
5. Southern blotting
6. Northern blotting
7. Western blotting
8. Dot and Slot blotting
9. PCR amplification
10. Cell immobilization.
11. Search databases for getting nucleotide sequence of genes and amino acid sequence of proteins.
12. BLAST search to compare gene sequences.
13. Multiple sequence alignment and construction of phylogenetic tree

REFERENCES

1. Ausubel, F. M., Brebt, R., Kingston, R. E., Moore, D. D., Seidman, J. G., Smith, J. A. and Struht, K. (2002). Short Protocols in Molecular Biology. John Wiley and Sons Inc.
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THIRD SEMESTER

ZOO 3C 13 DEVELOPMENTAL BIOLOGY & ANIMAL ETHICS

Course Outcomes

No	Course Outcome	K Level
CO 1	Explain different phases of Development. Asexual and sexual reproduction, single cell to multicellular animals, Hereditary transfer through generation	K2, K3
CO 2	Understand mechanism of gametogenesis, fertilization, Cleavage, Organised cellular movements, fixation of fate Cellular differentiation and development.	K2
CO 3	Enumerate cell to cell interaction processes and neural and mesoderm induction, antero-posterior and dorso-ventral axis specification in insects, amphibian and chick	K2
CO 4	Understand stem cell therapy, learn use of stem cells to treat various disorders, Pluripotent stem cells and their role in regeneration	K2, K3, K4
CO 5	Describe Bioethics and animal protection laws and rules. Learn Good laboratory practices	K3

1. Gametogenesis and Fertilization (12 h)

1.1. Origin, migration and fate of primordial germ cells

1.2. Spermatogenesis, Factors controlling spermatogenesis, Gamete specific gene expression and genomics, Male infertility

1.3. Oogenesis , Vitellogenesis (Insects and Amphibians) Gene activity (Insects and Amphibians)

1.4. Hormonal Control of gametogenesis

1.5. Biology of Sex determination and sex differentiation

1.6. Fertilization - Biochemical and Physiological aspects, Egg – sperm interactions, Species specific binding of gametes, Cortical reactions, Polyspermy and prevention of polyspermy, Activation of egg, Embryo Transfer (ET) and *In Vitro* Fertilization (IVF) in Humans and Livestock, superovulation and embryo culture

2. Cleavage, Blastulation and Gastrulation (8 h)

2.1. Creating multicellularity, Cleavage types, mechanisms and influence of yolk

2.2. Chemical changes associated with cleavage

2.3. Cytoskeletal mechanisms of cleavage, Midblastula transition

2.4. Morphogenetic movements of cells and epithelia, Exogastrulation

2.5. Metabolic events during gastrulation.

3. Cell interactions (8 h)

3.1. Concept of Primary organizer, embryonic induction and competence, neural induction: regional specificity, double gradient model, secreted protein from the organizer, molecular correlates of neural induction, Nieuwkoop centre, Default model of neurulation, inductive cascades

3.2. Mesodermal induction

3.3. Growth factors

4. Cell interactions at a distance (3 h)

4.1. Amphibian Metamorphosis

4.2. Insect Metamorphosis

5. Morphogenetic determinants (6 h)

5.1 Germ cell determinants

5.2 Regulation of cell determination by ooplasmic determinants, Mosaic development

5.3 Cell position and gradients in development, Regulative development

6. Cell differentiation (8 h)

6.1 Equivalence of nuclei and genome constancy

6.2 Transcriptional regulation of gene expression

6.3 Translational control of gene expression

6.4 Levels of differentiation, dedifferentiation, hormones and differentiation

7. Stem cells (5 h)

7.1 Embryonic stem cells

7.2 Adult stem cells

7.3 Medical application

8. Genetics of axis formation (8 h)

8.1. Genetics of axis specification in *Drosophila*, maternal effect genes, determination of dorso-ventral and anterior-posterior axis, zygotic gene activity in development

8.2. Patterns of homeotic gene expression, Homeobox concept in different phylogenic groups

8.3. Axis specification in amphibian and chick

9. Regeneration (5 h)

9.1 Regenerative ability in various groups of animals

9.2 Histological and biochemical changes in regeneration of various invertebrates and vertebrates

9.3 Epimorphic regeneration

9.4 Determination of Polarity and role of gradients in regeneration, neural and endocrine influences

10. Ageing (2 h)

10.1. Cellular ageing: Senescence genes, role of free radicals, hormones and ageing

10.2. Extracellular ageing

11. Teratogenesis (2 h)

11.1. Teratological effects of xenobiotics

12. Animal Ethics (13 h)

12.1 Bioethics, GLP and Bioethics,

12.2 Ethical principles: Beneficence, Least Harm, Respect for Autonomy

12.3 Theories on animals and ethics: Deontology, Utilitarianism, Casuist ethical theory, Virtue ethical theory, Rights Theory

12.4 Animals as Property and Food; Animals in entertainment

12.5 Animals in Research: Experimenting on animals, Specism, Methods to reduce animal numbers in research, Animal Rights and Human Animal repression - Activism and Advocacy

12.6 Animal welfare: Bioethics, Environmental ethics and Government ethics

12.7 Animal protection: Laws and Rules; IAEC – Rules and Regulation

12.8 Ethics on cloning and stem cell research

12.9 CPCSEA Guidelines for Laboratory Animal Facility, Veterinary care, Animal procurement, Quarantine, Sterilization and separation, Surveillance, diagnosis, treatment and control of disease

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ZOO 3C 14 – MICROBIOLOGY AND IMMUNOLOGY

PART A: MICROBIOLOGY

Course outcome:

After completing this course, the learner will be able to:

No.	Course outcome	K level
CO1	Define, discuss and distinguish the general organization of the human immune system	K1, K2
CO2	Explain and illustrate the process of immune cell synthesis and maturation	K2, K3
CO3	Illustrate and differentiate the antigen receptor structure and the mechanisms of antigen recognition by B-cell and T-cells.	K3, K4
CO4	Analyze, interpret and generalize the relationship between cellular and humoral immune responses	K4, K5, K6
CO5	Expand knowledge to understand the complement system and MHC molecules and their role in immunity.	K1, K3
CO6	Describe, distinguish and compare the concepts on the autoimmunity and immunodeficiencies	K1, K2, K4
CO7	Demonstrate the role of vaccines in immune development	K3
CO8	Infer, categorize and assess the applications of antigen-antibody reactions in laboratory diagnostics	K4, K5, K6

1. History and scope of microbiology (2 h)

1.1. Discovery of microorganisms

1.2. Discovery of microbial effects on organic and inorganic matter

1.3. The composition of microbial world

1.4. The scope and relevance of microbiology

2. Microbial taxonomy (5 h)

2.1 Major characteristics

2.2 Genetic analysis and molecular characteristics

2.3 Numerical taxonomy

2.4 Phylogenetic studies

2.5 Phenetic classification and Bergey's manual

2.6 The kingdom of microorganisms

3. Prokaryotic cell structure and function (8 h)

3.1 Plasma membrane and internal systems: Cytoplasmic matrix, Inclusion bodies,

Ribosomes, Nucleoid

3.2 Bacterial cell wall: Peptidoglycan structure, Gram positive and gram negative cell wall, Mechanism of Gram staining

3.3 Components external to cell wall: Pili and fimbriae, Capsule and slime layers, Flagella and motility

4. Microbial nutrition and growth (8 h)

4.1. Common nutrient requirement.

4.2. Autotrophs and heterotrophs.

4.3. Culture media and types of media.

4.4. Microbial growth: Growth curve, Rearrangement of microbial growth, Continuous culture of microorganisms, Influence of environmental factors on growth.

4.5. Control of microorganisms using physical agents: Heat, Filtration and Radiation

4.6. Control of microorganisms using chemical agents: Phenolics, Alcohols, Halogens, Quaternary ammonium compounds, Aldehydes and Sterilizing gases

4.7. Detection of effect of antimicrobial agents.

5. Virology (5 h)

5.1. Morphology and classification of viruses.

5.2. DNA viruses.

5.3. RNA viruses

5.4. Enveloped viruses.

5.5. Virus-host interactions.

5.6. Lytic and lysogenic life cycles

6. Microbial diseases (4 h)

6.1. Recognition of the role of microbes in diseases.

6.2. Major human microbial diseases: bacterial, viral, fungal

7. Use of microbes in industry and agriculture (8 h)

7.1. Isolation and culture of micro-organisms

7.2. Production of organic compounds by microbial fermentation (ethanol, acetone, butanol, gluconic acid, etc.)

7.3. Production of enzymes by micro-organisms (alpha amylases, proteases, lipases)

7.4. Production of antibiotics by micro-organisms

7.5. Bioreactors (Fermenters)

7.6. Microbial transformations

7.7. Single cell proteins (SCP) from micro organisms

7.8. Biohydrometallurgy and biomineralization

7.9. Biofertilizers

7.10. Bioinsecticides

7.11. Energy and fuel using micro-organisms: Hydrogen production using hydrogenase and nitrogenase, Hydrocarbon production

7.12. Genetically Engineered Microbes

PART B: IMMUNOLOGY

1. Overview of immune system (3 h)

1.1. Types of immunity: Innate and acquired, Active and passive

1.2. Cells and organs of immune system: haematopoiesis, lymphoid organs

1.3. Cell mediated and humoral immunity

2. Antigens and MHC molecules (6 h)

2.1. Characteristic features of antigens and super antigens

2.2. Factors affecting antigenecity

2.3. Antigen processing and presentation- Endogenous and Exogenous pathways

2.4. Structure and function of Class I and II MHC molecules

2.5. Regulation of MHC expression

3. Antibodies and Generation of Antibody diversity (8 h)

3.1. Different classes: Structure and functions

3.2. Organization of immunoglobulin genes

3.3. VD (J) rearrangements

3.4. Expression and secretion of Immunoglobulin

3.5. Monoclonal antibodies and applications

4. Complement System (3 h)

4.1. Components of complement system

4.2. Complement activation: Classical, Alternate and Lectin pathways**,** Formation of Membrane Attack Complex

4.3. Functions of complements

5. Immune Effector Mechanisms (4 h)

5.1. Inflammatory cells

5.2. Types of Inflammation – Acute and Chronic

5.3. Cytokines and their role in immune system

5.4. Properties and functions of cytokines

5.5. Therapeutic applications of cytokines

6. Hypersensitivity reactions (3 h)

6.1. Type I, II and III hypersensitivity

6.2. Delayed type hypersensitivity

7. Vaccines (2 h)

7.1. Principle of vaccination

7.2. Different types: Live attenuated vaccines, Recombinant vaccines, Peptide vaccines, DNA vaccines.

8. Transplantation immunology (4 h)

8.1. Immunologic basis of graft rejection

8.2. General and specific immunosuppressive therapy

8.3. Transplantation antigens

9. Auto immunity and Immunodeficiency (3 h)

9.1. Organ specific and systemic autoimmune diseases with examples

9.2. Treatment of autoimmune diseases

9.3. Primary and secondary immunodeficiency diseases with examples

10. Antigen-Antibody interactions and applications (4 h)

10.1. Antigen – Antibody interaction: Primary and secondary

10.2. Agglutination and Precipitation reactions with examples

10.3. Other diagnostic tests: ELISA, RIA, Immunoprecipitation, Immunofluorescence, Immunoelectrophoresis, FACS, Western blotting.

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ZOO 3E 15 – GENERAL ENTOMOLOGY

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Course outcome:

The course will imbibe the knowledge on insect's diversity and classification of orders up to family level. It will equip the students to have a better understanding of insect pest control.

CO.No.	Course outcome statements	K Level
CO 1	Understand the fundamental knowledge of the insect morphology for taxonomic identifications. As correct identification is essential for further scientific studies especially for insect pest control	K3
CO 2	Acquire knowledge of insect reproduction, the general pattern of insect embryonic development, and their special modes of reproduction.	K4
CO 3	Classify insect species based on the morphological and anatomical features. Acquaint knowledge on the life cycle of insects.	K3

1. Insect Morphology (25 h)

1.1. Division and segmentation of body

1.2. Morphology of head, thorax and abdomen.

1.3. Mouth parts – various modifications, feeding mechanisms.

1.4. Antennae – structure, various types and modifications

1.5. Locomotion - Movement on or Through a Substrate, Walking, Jumping, Crawling and Burrowing, Movement on or Through Water, Surface Running, Swimming by means of Legs.

1.7 Wings – structure, venation, pteralia, wing coupling, wing movements and flight, wing modifications.

1.8 Sound-producing organs - Stridulatory structures in various insects, auditory tympanum.

2. Insect reproduction and development (15 h)

2.1. Reproductive system – morphology, structure and diversity of male and female external genitalia and genital organs.

2.2. Eggs – structure and adaptation.

2.3. General pattern of embryonic development.

2.4. Causal analysis of insect embryogenesis – Growth & development

2.5. Viviparity

2.6. Polyembryony, Parthenogenesis, Paedogenesis.

3. Taxonomy and biology of insects (40 h)

3.1. Objectives of classification

3.2. General classification with diagnostic features of subclasses, divisions and orders

3.3. Classification of orders up to and including families with diagnostic features and biology of orders, superfamilies and families (only important families):

3.3.1 Collembola

3.3.2 Protura

3.3.3 Diplura

3.3.4 Microcoryphia

3.3.5 Zygentoma

3.3.6 Ephemeroptera

3.3.7 Odonata

3.3.8 Plecoptera

3.3.9 Embioptera

3.3.10 Dictyoptera

3.3.11 Isoptera

3.3.12 Grylloblattodea

3.3.13 Dermaptera

3.3.14 Phasmida

3.3.15 Mantophasmatodea

3.3.16 Orthoptera

3.3.17 Psocoptera.

3.3.18 Phthiraptera

3.3.19 Hemiptera

3.3.20 Thysanoptera

3.3.21 Mecoptera

3.3.22 Diptera

3.3.23 Siphonaptera

3.3.24 Trichoptera

3.3.25 Lepidoptera

3.3.26 Megaloptera

3.3.27 Raphidioptera

3.3.28 Neuroptera

3.3.29 Coleoptera

3.3.30 Strepsiptera

3.3.31 Hymenoptera

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ZOO 3E 16 INSECT PHYSIOLOGY AND BIOCHEMISTRY

Course outcome:

After completing this course the learner will be able to:

No.	Course outcome	K level
CO1	Identify and describe the general organization of the insect body and organ system organization	K1, K2
CO2	Recognize, illustrate and sketch the structure and functioning of various organ systems in insects	K2, K3, K4
CO3	Interpret and assess the relationship between biochemistry and physiology in insect homeostasis	K3, K6
CO4	Compare the mechanism of sensory perception in insects with higher organisms	K4
CO5	Expand knowledge to understand the insect neuroendocrine system, and the physiological responses to the environment	K1, K2, K3
CO6	Develop conceptual understanding on the effects of organic and inorganic xenobiotics in the ecosystem	K1, K3, K5
CO7	Demonstrate and distinguish the role of enzymes in the detoxification mechanisms of insects	K3, K4
CO8	Examine, summarize and conclude the correlation between physiological adaptations and successful survival of insects in the world	K4, K5, K6

1. Insect integument **(7 h)**

1.1. Organization of insect integument

1.2. Major components of insect cuticle

1.3. Moulting

1.4. Sclerotisation and melanisation of insect cuticle

2. Digestive system **(7 h)**

2.1. General structure of alimentary canal: foregut, midgut, hindgut and their modifications

2.2. Digestive enzymes and physiology of digestion

2.3. Specialized digestion: Digestion of wood, keratin wax and silk, Extra-intestinal digestion

2.4. Role of micro flora/ fauna in insect digestion

2.5. Assimilation.

3. Circulatory system **(8 h)**

3.1. General structure: Heart, dorsal and ventral vessels, pulsatile organs

3.2. Composition and functions of haemolymph

3.3. Heart beat rate and control of heart beat

3.4. Course of circulation of haemolymph

4. Respiratory system (6 h)

4.1. Structure and modification of respiratory system

4.2. Closed and open tracheal system

4.3. Physical gill and plastron respiration

4.4. Diffusion, ventilation, control of ventilation, cyclic release of carbon dioxide

4.5. Respiratory pigments

5. Excretory system (6 h)

5.1. Malpighian tubules, Nephrorectal complex and labial glands

5.2. Physiology of excretion

5.3. Synthesis of uric acid and formation of excreta

6. Nervous system (12 h)

6.1. General structure and organization of central and peripheral nervous system

6.2. Anatomy and histology of brain, ganglia and nerves

6.3. Reception of stimuli and transmission of nerve impulses, transmission at synapse

6.4. Sense organs – anatomy, histology and physiology of mechanoreceptors, chemoreceptors and photoreceptors.

7. Muscular system (5 h)

7.1 Histomorphology of insect muscles

7.2 Neuromuscular junctions

7.3 Excitation of muscle fibres, activation of muscle fibres, role of fast and slow axons

8. Fat body and Intermediary Metabolism (6 h)

8.1. Structure of fat body - anatomy, histology and development

8.2. Role of fat body in storage of reserves

8.3. Intermediary metabolism - Glycolysis, Glycerol phosphate shuttle, Trehalose biosynthesis

9. Endocrine system (7 h)

7.1 Histomorphology of neurosecretory cells and major endocrine glands (corpora cardiaca, corpora allata and prothoracic glands)

7.2 Types of insect hormones and their functions

7.3 Mechanisms of hormone action

10. Insect Toxicology (8 h)

10.1. Chemical insecticides: General classification

10.2. Nerve poisons and their effects on acetyl choline esterase, membrane receptors, synapses, nerve axons

10.3. Metabolic poisons

10.4. Other inhibitors

10.5. Inhibitors of chitin synthesis

11. Detoxification mechanism in insects (8 h)

11.1. Phase I reactions – mixed function oxidases, reduction, hydrolysis, epoxide hydrases, DDT dehydrochlorinase

11.2. Phase II reactions – glutathione conjugation, glucoside formation, amino acid conjugation, sulfate conjugation, other conjugations

11.3. Role of detoxification enzymes in insecticide resistance

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ZOO 3C 17 - DEVELOPMENTAL BIOLOGY, MICROBIOLOGY & IMMUNOLOGY PRACTICAL

Course Outcomes

No	Course Outcome	K Level
CO 1	Describe early development of Drosophila and Frog, cleavage, gastrulation, fate map and embryonic induction	K2
CO 2	Experimentally prove the role of thyroxine in Amphibian metamorphosis	K4, K5
CO 3	View Chick embryo and early embryonic development using vital staining methods. View and whole mount embryos of different age groups	K3, K4
CO 4	Experiential learning of how the cutting plain changes tail regeneration	K3
CO 5	Explain different larval forms of invertebrates	K3

DEVELOPMENTAL BIOLOGY

1. Hormonal Control of Amphibian metamorphosis: Effect of thyroxine
2. Removal of blastoderm and preparation of stained whole mounts
3. Vital staining experiments on chick embryos employing the window method and tracing the development of stained parts.
4. Collection, identification and study of invertebrate/vertebrate larval forms
5. Histological preparations of stained slides of chick and amphibian embryos

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MICROBIOLOGY AND IMMUNOLOGY

1. Preparation and sterilization of media
2. Preparation of broth and agar media and agar slants
3. Antibiotic sensitivity test – Disc diffusion method
4. Isolation of bacteria using pour plate method and spread plate method
5. Streak plate method for isolation of pure culture
6. Maintenance of *E. coli* culture (Shake and surface cultures) and quantitative evaluation (number of cells/ml) of a given sample of culture by dilution and plating.
7. Aseptic transfer of microorganisms
8. Staining techniques – Gram staining, spore staining
9. Motility testing using semi-solid medium and hanging drop method
10. Oxidase and Catalase tests
11. Oxidation/fermentation (O/F) test
12. Estimation of bacterial load in a given sample
13. Water quality testing using MPN coliforms
14. Biochemical estimation of fermentation food by-products
15. Microbial degradation of xenobiotic pollutants
16. Blood group determination using agglutination reaction
17. WIDAL test
18. VDRL test
19. Complement fixation test
20. Radial immunodiffusion - Mancini method
21. Double immunodiffusion - Ouchterlony method
22. Immunoelectrophoresis
23. ELISA

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ZOO 3E 18 - GENERAL ENTOMOLOGY & INSECT PHYSIOLOGY BIOCHEMISTRY PRACTICAL

GENERAL ENTOMOLOGY

Course Outcome:

CO. No.	Course outcome statements	K Level
CO 1	Acquaint knowledge on the general anatomical and morphological, structural organization of different insect orders.	K3
CO 2	Develop skills in the collection, mounting and preservation of insects.	K3, K4

1. Dissection and display of organ systems (digestive, nervous and reproductive) of available specimens belonging to different orders.
2. Dissection of different types of mouth parts.
3. Dissection and comparison of legs of different insects.
4. Dissection of sound-producing organs of Orthopterans.
5. Preparation of whole mounts of spiracles, gills, siphons, external genital organs in different insects.
6. Preparation of whole mounts of air sac, pulsatile organs, dorsal aorta, malpighian tubules, mandibular glands, ovarioles, accessory sex glands, rectal pads/ papilla in different insect groups.
7. Preparation of keys for identification of insects up to family level (common families of Orders Orthoptera, Homoptera, Heteroptera and Coleoptera).
8. Collection and preservation of insects. {Students shall submit insects belonging to 50 families (including 10 whole mounts) at the time of practical examination}.
9. A study tour for the purpose of collecting insects belonging to different ecological niches other than local is required with a report of the field study which is to be included in the record of drawing for evaluation at the practical examination.
10. Use of Y-tube olfactometer to study responses to olfactory cues.

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INSECT PHYSIOLOGY AND BIOCHEMISTRY

1. Preparation of stained slides of insect haemolymph and identification of haemocytes.
2. Estimation of digestive carbohydrases in the alimentary canal of insect.
3. Analysis of the uptake of dye by the insect malpighian tubules.
4. Estimation of total protein in the body of insects from different orders.
5. Effect of corpora cardiaca extract on the lipid release from the fat body of insects – dose response.
6. Qualitative and quantitative estimation of total free amino acids in the haemolymph / fat body of insects from different orders.
7. Estimation of glucose content in the body of insects from different orders.
8. Estimation of amino transferase activity in the insect haemolymph.
9. Estimation of catalase activity in the insect haemolymph.
10. Preparation of stained serial section of various organs from different insects.

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FOURTH SEMESTER

ZOO 4C 19 COMPULSORY PROJECT / DISSERTATION

ZOO 4E 20 AGRICULTURAL ENTOMOLOGY & ACAROLOGY

Course outcome:

- The course will provide comprehensive knowledge on insect's pest diversity of plantations and acquaint with the information of beneficial and other destructive pests.
- It also provides information on agricultural acarology and beneficial mites.

CO. No.	Course outcome statements	K Level
CO 1	Gain knowledge on the basics of insect pests and types.	K5
CO 2	Familiarize with the concepts on insect pest outbreak.	K5
CO 3	Understand the various insect collection methods, insect population essentials, and sampling methods	K1
CO 4	Obtain knowledge on the assessment of the damage caused by insect pests.	K1
CO 5	Acquaint with the insect pests of agriculturally and economically important crops and their pest control measures.	K3, K6
CO 6	Acquire information on the other destructive insect pests and their control methods.	K3
CO 7	Understand the types of insect injuries on crops and allelochemicals importance in insect-plant interactions.	K1, K3
CO 8	Acquire knowledge of economically important and beneficial insects.	K3, K4
CO 9	Provide introductory basics of agricultural acarology.	K2
CO 10	Develop to identify beneficial mites and assimilate the significance of integrated mite management.	K1

1. Insect Pests **(4 h)**

1.1. Kinds of insect pests (major and minor) - Sporadic pests, endemic pests, exotic pests, seasonal pests, occasional pests, regular pests, persistent pests.

2. Pest outbreak **(5 h)**

2.1. Causes of pest outbreak: Destruction of forests, Favourable weather conditions, Large scale monoculture practices-extensive and intensive cultivation of crops, Improved agronomic practices, Introduction of new crops, Introduction of new pests, Indiscriminate use of pesticides, Destruction of natural enemies

2.2. Pest resurgence (pest flare back) and replacement (secondary pest outbreak)

2.3. Causes and Management of resurgence and replacement

2.4. Forecasting pest outbreaks and surveillance: Short-term and long-term forecasting, Forecasting based on observations – climatic and empirical factors.

3. Insect population (5 h)

3.1. Methods of assessment of insect population, Stage to be counted, nature of sample

3.2. Methods of collection – net sweeping, sudden trapping, screen traps, narcotized collections, light traps, water traps, suction traps, sight counting, crop samples, emergence cages – marking and recapture

3.3. Methods of sampling and number and size of samples

4. Estimation of damage caused by insect pests to crops (4 h)

4.1. Estimates from general observation.

4.2. Estimates based on survey.

4.3. Estimates from experimental plots.

4.4. Other methods such as cage experiments.

5. Insect pests of agricultural and other economically important plants. (15 h)

5.1. Diagnosis, nature of damage and control measures of the pests of paddy, vegetables, pulses, oil seeds, fibre crops, sugarcane, fruit crops, spices and condiments, plantation crops, insect pests of stored foods and grains

6. Other destructive insects (5 h)

6.1. Locusts and their control – diagnosis, life history, damage, methods of control.

6.2. Termites and their control – diagnosis, damage, control measures, protective measures for furniture and other wooden structures, fence, posts etc.

7. Types of insect injury to crops (6 h)

7.1. Injury by chewing insects, Injury by piercing and sucking insects- yellowing, silvering, wrinkling, curling, injury by internal feeders.

7.2. Galls – types of galls, gall formation and gall forming insects.

7.3. Role of allelochemicals in insect plant interaction.

8. Productive, useful and beneficial insects (15 h)

8.1. Honey bees, lac insects, silkworm moths.

8.2. Apiculture, sericulture, lac cultivation

8.3. Insect pollinators, dung beetles.

8.4. Other insects of use.

9. Agricultural Acarology (13 h)

9.1. Introduction

9.2. Mite pests of agricultural importance-Spider mites, false spidermites, Eriophyid mites, Tarsonemid mites.

9.3. Diagnosis, nature of damage and control measures of important mite pests of cereals, millets, pulses, vegetables, sugarcane, oil seeds and horticultural plants.

10. Beneficial mites. (8 h)

10.1. Mites as predators and parasites of insect/mite pests.

10.2. Mites as biocontrol agents of weeds.

10.3. Mites in biodegradation-direct and indirect role of mites in enhancement of soil fertility.

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ZOO 4E 21 – INSECT PESTS – CONTROL AND MANAGEMENT

Course outcome: The course provides an overview of the fundamentals of insect pest control methods.

CO. No.	Course outcome statements	K Level
CO 1	Acquire knowledge on the introductory basics of insect pests and their types.	K2
CO 2	Provide the concepts on insect pest outbreak.	K2
CO 3	Analyze the major pest species of agriculturally and economically important crops and their proper control measures.	K2, K3
CO 4	Provide an overview of the concepts of pest control methods.	K1
CO5	Gain familiarity with the chemical control, classification of chemical insecticides, insecticide appliances, insecticide formulations and insecticide hazards.	K1
CO 6	Understand the potentiality of biopesticides and their importance in pest control.	K1, K6
CO 7	Acquaint on the knowledge of behavioural control principles and their pest control applications.	K1, K6
CO 8	Provide insight into the principles and strategies of biological control measures and the importance of insects as biological control agents.	K1, K6
CO 9	Know about the microbial control methods, their merits and demerits.	K4
CO 10	Attain information on the biological control of weeds.	K4
CO 11	Acquire thorough information on integrated pest management program and knowledge for implementing appropriate pest control management methods.	K4, K6

1. Insect Pests (4h)

1.1. Kinds of insect pests (major and minor)- Sporadic pests, endemic pests, exotic pests, seasonal pests, occasional pests, regular pests, persistent pests

2. Pest outbreak (4 h)

1.1. Causes of pest outbreak

2.2. Pest resurgence and replacement (secondary pest outbreak). Causes and Management of resurgence and replacement.

3.3. Forecasting pest outbreak and surveillance: Short-term and long-term forecasting, Forecasting based on observations –climatic and empirical factors.

3. Insect pests of agricultural and other economically important plants (13 h)

1.1. Diagnosis, nature of damage, life history and control measures of important insect pests of paddy, vegetables, cotton, oilseeds, fruit crops, plantation crops

4. Methods of pest control (8 h)

1.1. Natural and Artificial - Physical, Mechanical, Cultural, Legal, Chemical, Biological, Microbial, Behavioural and Biotechnological.

5. Chemical control (10 h)

1.1. Chemical insecticides – natural, synthetic, inorganic and organic

2.2. Insecticide appliances and application.

3.3. Insecticide formulations.

4.4. Insecticide hazards – Resistance, resurgence and residue – pesticides in the environment.

6. Biopesticides (4 h)

1.1. Plant based insecticides.

2.2. Allelochemicals, allomones, synomons and their importance in pest control.

7. Principles of behavioural control (10 h)

1.1. Pheromonal considerations, orientation.

2.2. Theories of orientation.

3.3. Use of hormone analogues and other insect growth and behaviour regulators in insect control programmes.

4.4. Use of repellants and antifeedants.

5.5. Autocidal control – use of chemosterilants and radiations.

8. Biological control (9 h)

1.1. History and principles of biological control, ecological basis of biological control

2.2. Strategies in biological control

3.3. Biological control of pests-. Importance of parasitic Hymenoptera, and other parasitic insects in biological control.

4.4. Different types of parasitism, phoresy, behaviour of parasitioids.

9. Microbial control (8 h)

1.1. Bacteria, viruses, fungi – merits and demerits

10. Biological control of weeds (2 h)

1.1. Major examples of successful biological control projects

11. Pest management strategies (8 h)

1.1. Concepts of economic levels, Concepts of pest management, definition and characteristics of pest management

2.2. Pest management strategies and techniques.

3.3. Development of pest management programmes: Integrated Pest Management.

4.4. Ecological management of crop environment

5.5. Ecological backlash and its management.

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ZOO 4E 22 – ECOLOGY & ETHOLOGY OF INSECTS

Course outcome:

The course will help students to understand how insect behaviour can be manipulated to manage insect pests. It will also give students hands on experience on rearing and use of parasitoids for insect pest control.

CO.No.	Course outcome statements	K Level
CO 1	Provide a thorough knowledge on insect behaviour, insect-plant interaction and the field application of behavioural based ecofriendly insect pest management methods.	K5
CO 2	Deliver information on parasitoid behaviour and their role in insect pest control	K3
CO 3	Make available field experience on ecosystem services offered by insects. Will equip students in parasitoid mass culture methods for insect pest control in the field.	K5

1. Scope of Insect Ecology and Ethology **(3 h)**

2. Multitrophic interactions **(10 h)**

2.1 The trophic level concept

2.2 Plant characteristics that effect enemy-prey interactions: Secondary metabolites, Nutritional resources, Morphology

2.3 Intraguild predation

2.4 Trophic cascades

3. Herbivory **(10 h)**

3.1 Types and Patterns of Herbivory: Herbivore Functional Groups, Measurement of Herbivory, Spatial and Temporal Patterns of Herbivory

3.2 Effects of Herbivory: Plant Productivity, Survival and Growth Form, Community Dynamics, Water and Nutrient Fluxes

4. Pollination **(9 h)**

4.1 Types and Patterns of Pollination: Pollinator Functional Groups, Measurement of Pollination, Spatial and Temporal Patterns of Pollination

4.2 Effects of Pollination

4.3 Floral scent, olfaction, and scent-driven foraging behaviour

5. Seed Predation and Seed Dispersal **(8 h)**

5.1 Types and Patterns of Seed Predation and Dispersal: Seed Predator and Disperser Functional Groups, Measurement of Seed Predation and Dispersal, Spatial and Temporal Patterns of Seed Predation and Dispersal

5.2 Effects of Seed Predation and Dispersal

6. Pheromone-mediated communication in parasitoids (10 h)

6.1 Pheromones and sexual behavior: Volatile sex attractants, Female-derived courtship pheromones, Male-derived courtship pheromones, Marking pheromones, Putative alarm and appeasement pheromones, Aggregation pheromones, Anti-aggregation pheromones

7. Insect dispersal and migration (7 h)

7.1 Factors Affecting Dispersal Behaviour: Life History Strategy, Crowding, Nutritional Status, Habitat and Resource Conditions, Mechanism of Dispersal

7.2 Insect invasions

8. Chemical ecology of insect natural enemies (7 h)

8.1 Essential elements in parasitoid chemical ecology

8.2 Manipulation of the population levels of natural enemies bysemiochemicals

8.3 Recruitment of predators and parasitoids by herbivore-injured plants

8.4 The use of synthetic HIPVs in pest management

8.5 Arthropod pest management strategies used in organic farming

9. Behavioural Ecology (7 h)

9.1 Patterns of behaviour

9.2 Mating and courtship

9.3 Oviposition strategies in terrestrial and aquatic insects

9.4 Food finding mechanism

9.5 Evolution of feeding behaviour

10. Introduction to Insect Diversity Conservation (9 h)

10.1 Ethical foundation for insect conservation;

10.2 Mapping, inventorying, and monitoring insect diversity;

10.3 Insects and the conservation of ecosystem processes;

10.4 Insects and the Climate Change: Process patterns and implications for Conservation

10.5 Responses by insects to changes in land use, degradation and fragmentation of Ecosystems

10.6 Conserving and Managing Insect Diversity: Methods, approaches, and Prioritization

10.7 Impediments in insect conservation

10.8 Insects for food security, livelihood and Environment

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ZOO 4E 23 – MEDICAL, VETERINARY AND FORENSIC ENTOMOLOGY

Course Outcomes

	Course Outcome	K Level
CO 1	Explain the characteristics of Medical, Veterinary and Forensic Entomology, Medically important insects and impact of insect vectors, Different types of insect vectors, Biology and life cycle.	K2
CO 2	Understand other dipterans of medical, veterinary and forensic importance, different groups, their role on transmission of diseases	K2, K3
CO 3	Describe major vector borne diseases, history and background of diseases, understand the knowledge on diseases vectors, transmission of diseases, epidemiology, and control of both disease vectors and vector borne diseases	K3
CO 4	Understand veterinary important insects, biology and life cycle, important animal diseases and their treatment	K3
CO 5	Describe forensically important flies and beetles and Tools in Forensic entomology	K3, K4

1. Medical Entomology (30 h)

1.1. Introduction – History, definition, objectives, training; importance of insects as vectors, feeding mechanisms and modifications of insect mouth parts.

1.2. Evolution of tissue feeding and pathogen transfer by insects

1.3. Origin of parasitism.

1.4. Adaptations of vectors: Morphological, Reproductive and Biochemical.

1.5. Biology of important vectors: Mosquitoes, Simuliids, Ceratopogonids, Tabanids, Fleas, Tsetse flies, Syrphids, Chloropids, Houseflies, Bird lice, Head lice and Body lice

1.6. Diagnostic and clinical features and epidemiology of various arthropod-borne diseases: Malaria, filariasis, dengue fever, Japanese encephalitis, yellow fever, chickungunya, trypanosomiasis, plague, typhus, pink eye disease and onchocerciasis.

1.7. Other insects of medical importance – bugs, bees, ants, wasps, lepidopterans and beetles. Clinical features of their bites and stings; treatment.

2. Veterinary Entomology (25 h)

2.1. Introduction – Insects as vectors of animal diseases

2.2. Insect groups of veterinary importance

2.3. Taxonomy and Biology of insects of veterinary importance: Lice, Tabanids, Hippoboscids,Calliphorids, Sarcophagids, Stomoxydidae, Oestridae, Pulicidae

2.4. Important diseases of domestic animals – clinical features, treatment.

2.5. Myiasis – definition, insects causing myiasis, different types of myiasis and treatment

3. Forensic Entomology (25 h)

3.1. Introduction: Insects of forensic importance

3.2. Insects as tools in forensic science.

3.3. Crime detection using entomological science.

3.4. Taxonomy & Biology of forensically important insects

3.4.1. Coleoptera – General characters, taxonomy and biology of Silphidae (carrion beetles), Staphylinidae (rove beetles), Histeridae (clown beetles), Dermestidae (hide & skin beetles).

3.4.2. Diptera - General characters, taxonomy and biology of Calliphoridae, Sarcophagidae, Phoridae, Muscidae, Fannidae.

3.5. Ecology of forensically important flies and beetles

3.6. DNA techniques in forensic entomology

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ZOO 4E 24 AGRICULTURAL ENTOMOLOGY & ACAROLOGY PRACTICAL

Course outcome:

CO. No.	Course outcome statements	K Level
CO 1	Understand the insect pest diversity of local crops, and their taxonomic classification up to the species level.	K6
CO 2	Acquaint with the overall conceptual understanding and familiarize the preparation of taxonomic keys.	K3

1. Collection, identification and preservation of pests of local crops. The collection should include a minimum of 25 crop pests. The collection has to be submitted during the practical examination.
2. Preparation and submission of wet collections of pest damaged portions of crop plants (at least5 collections are to be submitted for examination).
3. Preparation of dichotomous keys to any 5 species of insect pests.
4. Study of salient features of any 10 major insect pests.
5. Study of life histories of insect pests (at least two) and the damages caused by them.
6. Study of stained sections of normal and galled leaves.
7. Morphological description of any one species of insect pests.
8. Collection, preservation and preparation of slide mount of 5 species of mite pests.
9. Preparation of dichotomous key to any 5 species of major mite pests.

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ZOO 4E 25 INSECT PESTS – CONTROL AND MANAGEMENT PRACTICAL

Course Outcome:

CO. No.	Course outcome statements	K Level
CO 1	Understand the insect pest diversity of local crops, and their taxonomic classification.	K3
CO 2	It will equip the students to have a better understanding of insect pest control.	K6

1. Collection, identification and preservation of pests of local crops. The collection should include a minimum of 20 pests and has to be submitted during practical examination.
2. Study of the external morphology of at least two economically important parasitoids.
3. Study of various insecticides (Natural and synthetic) and their mode of action on their target pests.
4. Study of various insecticide appliances and their applications in the field.
5. Whole-mount preparation of at least 10 insect pests of agricultural importance
6. Role of IGRs and their influence in the morphology of pest.
7. Study of life histories of insect pests (at least two) and the damage caused.
8. Visit an organic farm, and the report on the activities is to be included in the record and has to be submitted during practical examination.

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ZOO 4E 26 ECOLOGY & ETHOLOGY OF INSECTS PRACTICAL

Course Outcome:

CO. No.	Course outcome statements	K Level
CO 1	Acquaint knowledge on insect courtship and mating behaviour	**K3**
CO 2	Achieve practical proficiency on setting of different insect traps for collecting insects	**K3**
CO 3	Demonstrate practical skills on insect culture rearing for biological control measures.	**K3**
CO 4	Foster students to have field experience on understanding insect pollination.	**K6**

1. Study of courtship and mating behaviour in insects
2. Managing pheromone traps
3. Setting up and collection of insects with Malaise trap, Pitfall traps, Light trap, Sweep net, Yellow pan trap
4. Insect culture methods (Hosts, parasitoids and predators)
5. Field observation on insect pollination on any focal plant
6. Dissection and display of pollen gathering apparatus in hymenopterans
7. Use of Y-tube olfactometer to study responses to olfactory cues in insects
8. Feeding preference studies in some common pests

REFERENCES

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6. Martin, R., Speight, Mark D., Hunter, Allan and Watt, D. (2008) Ecology of Insects: Concepts and Applications. Wiley- Blackwell

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ZOO 4E 27 MEDICAL, VETERINARY, FORENSIC ENTOMOLOGY PRACTICAL

Course Outcomes

	Course Outcome	K Level
CO 1	Explain keys for identification of major species of mosquitoes	K4
CO 2	Explain Blood feeding adaptations of the mouth parts of insects. Differentiate Male and female mouth parts in details.	K3, K4
CO 3	Explain population surveillance	K3
CO 4	Explain ectoparasite, collect, storage and whole mounting of insects	K2
CO 5	Hands on experience in collection and storage of medically, veterinary and forensically important insects	K4

1. Preparation of keys for the identification of major species of mosquitoes
2. Collection and identification of eggs/larvae of mosquitoes (Genus level).
3. Mounting of mouth parts of blood feeding insects.
4. Collection of insects associated with carcasses. Write brief write-ups of the different life stages of these insects
5. Dichotomous keys for the identification of families belonging to the orders : Coleoptera and Diptera.
6. Population density studies (mosquitoes/houseflies/Tabanids)
7. Preparation of whole mounts of animal ectoparasites.
8. Students are required to submit a collection of a minimum of 25 specimens of medical/veterinary/forensically important arthropods

REFERENCES

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2. Gennard, D. E. (2007) Forensic Entomology – An Introduction. John Wiley.
3. Richards, O. W. and Davies, R. G. G. (1977). Imm's General Text Book of Entomology. Chapman & Hall, London.
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FIRST SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 1C 01 – BIOCHEMISTRY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Glycolysis and its regulation.
2. Kinetics and regulation of Enzyme action.
3. Role of B-complex vitamins.
4. Fatty acid oxidation

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Separation and purification of proteins
6. Regulation of glycogen synthesis and degradation.
7. Role of ATP as a free energy carrier.
8. Sequencing of DNA.
9. Prostaglandins

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Isozymes.
11. Ribozymes.
12. Chemiosmotic hypothesis.
13. Buffers
14. Enthalpy
15. Vitamin E
16. Disaccharides
17. Transamination

FIRST SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 1C 02 – BIOPHYSICS & BIOSTATISTICS

Time: Three Hours Maximum: 80 Marks

Part A - Biophysics

I. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

1. Explain the principle,procedure andapplication of UV spectroscopy.
2. General account of electrophoresis.

II. Write short essays on any *TWO* of the following: (2 X 8 = 16 marks)

3. Magnetic resonance imaging.
4. Affinity chromatography.
5. Liquid scintillation counter and its applications.
6. Immuno fluorescence microscopy.

III. Write short notes on any *THREE* of the following: (3 X 3 = 9 marks)

7. X- Ray diffraction.
8. EEG.
9. Fick's law and diffusion coefficient.
10. HPLC.
11. Electro osmosis.

Part B - Biostatistics

IV. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

12. One-way and two-way classification of ANOVA.
13. Properties of normal distribution and fitting of normal curves.

V. Write short essays on any *TWO* of the following: (2 X 8 = 16 marks)

14. Write a brief account on mathematical methods of correlation.
15. Mention the role of biostatisitics in modern research.
16. Chi square test.
17. What is sampling. Add a note on the methods of sampling.

VI. Write short notes on any *THREE* of the following: (3 X 3 = 9 marks)

18. Attributes
19. Quartile deviation
20. Skewness
21. Degree of freedom
22. Type I and Type II error

FIRST SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 1C 03 – BIOSPHERE ECOLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Importance of coral reefs, threats faced by the coral reefs and conservation strategies.
2. With proper illustration elaborate on the different models of energy flow
3. Global warming and its impacts
4. Write an essay on cleaner technologies in waste management

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Habitat fragmentation and its impact
6. Ecological applications of remote sensing
7. Sustainable development
8. Ecological impact of genetically modified crops
9. Environmental Impact Assessment

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Conservation tillage
11. Vermicomposting
12. Types of life table
13. Metapopulation
14. r and k selection
15. Biofilters
16. Simulation model
17. Species 2000

FIRST SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 1C 04 - SYSTEMATICS AND ANIMAL BEHAVIOUR

Time: Three Hours Maximum: 80 Marks

Part A – SYSTEMATICS

I. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

1. Different kinds of taxonomic characters used in the discrimination of taxa.
2. International Code of Zoological nomenclature and the rules for naming taxa.

II. Write short essays on any *TWO* of the following: (2 X 10 = 20 marks)

3. History of taxonomy
4. Taxonomic procedures
5. Types of Zoological classification
6. Taxonomic key

III. Write short notes on any *FIVE* of the following: (5 X 3 = 15 marks)

7. Taxonomic publications
8. Cladistics
9. Types of classification
10. Molecular systematics
11. Chemotaxonomy
12. Phonetic classification
13. Alpha taxonomy

Part B – ANIMAL BEHAVIOUR

IV. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

14. Give an account how hormones influence behavior and the factors influencing hormonal effects on behaviour.
15. Discuss how genes and environment influence behaviour .

V. Write short notes on any *FIVE* of the following: (5 X 3 = 15 marks)

16. Lee Boot effect and Whitten effect
17. Brief account of altruism
18. Stimulus filtering
19. Give examples of experimental origin to demonstrate genetic basis of behaviour
20. Brief account of neural basis of behaviour
21. Imprinting
22. Circadian rhythm

SECOND SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

APPLIED ZOOLOGY (CCSS)

ZOO 2C 07 – CYTOGENETICS & EVOLUTION

Time: Three Hours Maximum: 80 Marks

PART A - CYTOGENETICS

I. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

1. Transposons in bacteria
2. Apoptosis in *Caenorhabditis elegans* and the genes involved in it

II. Write short essays on any *TWO* of the following: (2 X 10 = 20 marks)

3. Signal transduction
4. Neurotransmission and its regulation
5. Extrachromosomal inheritance
6. Cytological basis of crossing over

III. Write short notes on any *FIVE* of the following: (5 X 3 = 15 marks)

7. Mutation
8. P elements
9. Down's syndrome
10. Ploidy
11. Co-dominance
12. Euchromatin
13. cAMP
14. Linkage

PART B - EVOLUTION

IV. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

15. Molecular divergence in evolution and molecular clocks
16. Stages in human evolution

V. Write short notes on any *FIVE* of the following: (5 X 3 = 15 marks)

17. Genetic drift
18. Adaptive radiation
19. Hardy-Weinberg equilibrium
20. Neutral hypothesis
21. Speciation
22. Natural selection
23. Co-evolution

SECOND SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

APPLIED ZOOLOGY (CCSS)

ZOO 2C 08 – MOLECULAR BIOLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Models of DNA replication and Enzymes associated with DNA replication.
2. Transcriptional regulation of gene expression
3. DNA repair mechanism and Importance of DNA repair.
4. Characteristic features of Genetic code.

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Gene therapy.
6. RNA Splicing.
7. Organelle genomes.
8. Interrupted genes.
9. SOS response.

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Promoter
11. Wobble hypothesis
12. Pesudogenes.
13. Replicons
14. Telomere.
15. Restriction endonuleases
16. Okazaki fragments
17. Antisense RNA.

SECOND SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

APPLIED ZOOLOGY (CCSS)

ZOO 2C 09 – BIOTECHNOLOGY & BIOINFORMATICS

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Distinguish different types of blotting procedures
2. Genotyping techniques and its applications
3. Hybridoma technology, production and uses of monoclonal antibodies
4. Patenting of biological forms

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Applications of bioinformatics tools in phylogenetic analysis
6. Cloning vectors
7. Polymerase Chain Reaction
8. Molecular probes in hybridization
9. Transgenic systems

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Real time PCR
11. Intellectual Property Rights
12. BLAST
13. Chimeric DNA
14. DNA fingerprinting
15. Expression vectors
16. Reporter genes
17. Dot and Slot blots

SECOND SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 2C 10 – ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Describe endocrine disruptors in the environment
2. Explain blood buffering and gas transport
3. Mechanism of urine formation, tubular reabsorption, secretion and counter current.
4. Describe ultra-structure and functional mechanism of skeletal muscle.

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Placental circulation.
6. Hormones as signal transducers
7. Role of hormones in developmental process
8. Allometric and isometric scaling.
9. Myocardial infarction.

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Anorexia
11. Regulation of hormone secretion
12. Parkinson's disease
13. Blood brain barrier.
14. Surfactants
15. Role of pituitary and pineal body in chromatophores expression
16. Hormones in behaviour of animals
17. Kidney stones

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 3C 13 – DEVELOPMENTAL BIOLOGY & ANIMAL ETHICS

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Discuss the role of hormones and senescence genes in cellular ageing.
2. Give an account of gamete specific gene expression and factors controlling oogenesis
3. Morphogenetic movements
4. Describe types of cleavage and associated chemical changes

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Cell position and gradients in development
6. Mesodermal induction
7. Explain the theories on animal ethics
8. Physiological aspects of fertilization
9. Proximate cell interractions

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Regulative development
11. Mesodermal induction
12. Xenobiotics
13. Specism
14. Human Animal repression
15. Epimorphic regeneration
16. Embryonic stem cells
17. IVF

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 3C 14 – MICROBIOLOGY AND IMMUNOLOGY

Time: Three Hours Maximum: 80 Marks

Part A - Microbiology

I. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

1. The structure of prokaryotic cell wall and mechanism of Gram staining.
2. Describe the control of microorganisms using physical and chemical agents.

II. Write short essays on any *TWO* of the following: (2 X 8 = 16 marks)

3. Influence of environmental factors on microbial growth.
4. Microbial growth and food spoilage.
5. Major types of culture media.
6. Uses of microbes in agriculture.

III. Write short notes on any *THREE* of the following: (3 X 3 = 9 marks)

7. Pasteurization.
8. Numerical taxonomy.
9. Fermented foods.
10. Capsules and slime layers.
11. Reproduction in animal viruses

Part B - Immunology

IV. Write an essay on any *ONE* of the following: (1 X 15 = 15 marks)

12. Complement activation pathways.
13. Structure and functions of immunoglobulin.

V. Write short essays on any *TWO* of the following: (2 X 8 = 16 marks)

14. Hypersensitivity reactions.
15. Monoclonal antibodies and applications.
16. Autoimmune diseases.
17. MHC molecules.

VI. Write short notes on any *THREE* of the following: (3 X 3 = 9 marks)

18. ELISA
19. Vaccines and vaccination.
20. VD(J) rearrangements.
21. Primary lymphoid organs.
22. Cytokines

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 3E 15 – GENERAL ENTOMOLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Write an essay on general structure and modifications of insect mouthparts with appropriate diagrams
2. Giving diagnostic features classify the order Embioptera
3. Sound producing mechanisms in insects
4. With suitable diagrams give an account of diversity of external reproductive organs in insects

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Wing coupling mechanism
6. Types of antennae
7. Give diagnostic characters of five families of Order Coleoptera
8. Give an account of diversity of wing venation in Order Hymenoptera
9. Insect embryogenesis

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Jumping apparatus in Collembola
11. Parthenogenesis
12. Give a brief account of objectives of classification
13. Modifications for predatory forms of life in Mantoidea
14. Economic importance of family Scarabaeidae
15. Secondary segmentation
16. Adaptations in insect eggs
17. Characteristics of Order Phasmida

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, JANUARY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 3E 16 - INSECT BIOCHEMISTRY AND PHYSIOLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Explain the mechanism of detoxification in insects.
2. Describe the composition and biochemistry of insect cuticle.
3. Write an essay on insect hormones and their role.
4. Structure and physiology of insect photoreceptors.

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Insect haemocytes and their functions.
6. Digestive enzymes in insects.
7. Moulting and sclerotization in insects.
8. Describe the significance of insect fat body.
9. Physiology of insect muscles.

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Physical gill and plastron respiration.
11. Insect chemoreceptors.
12. Glycerol phosphate shuttle.
13. Slow and fast axons.
14. Acetyl cholinesterase inhibitors.
15. Extra intestinal digestion.
16. Insect excretion.
17. Metabolic poisons.

FOURTH SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 4E 20- AGRICULTURAL ENTOMOLOGY & ACAROLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Reasons and remedies for insect pest upset.
2. Biology and management of important insect pests of paddy in India.
3. Important groups of phytophagous mites.
4. Types of honey bee and methods in bee keeping.

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Factors governing insect pest outbreaks.
6. Techniques in insect pests damage assessment.
7. Important borer pests of vegetables.
8. Types of insect damage to plants.
9. Damage caused by termites and control measures.

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Sericulture.
11. Plant galls and insects.
12. Role of mites in biodegradation.
13. Insect pollinators.
14. Classification of insect pests based on occurrence.
15. Lac insect.
16. Predatory mites.
17. Light trap.

FOURTH SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 4E 21 – INSECT PESTS – CONTROL AND MANAGEMENT

Time: 3 hours Maximum: 80 marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Illustrate strategies in biological control and importance of parasitic insects.
2. Give an account of microbial formulations for control of insect pests.
3. Concepts of pest management and characteristics of pest management.
4. Write an account on pest resurgence, replacement and the management of these.

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Forecast of pest outbreak.
6. Behavioral manipulation of insect pest for the pest control programme.
7. Different strategies of pest management.
8. List out five major insect pests of oilseeds, its bionomics, damage & control measures.
9. Chemical insecticides, formulations & its hazards.

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Ecological backlash
11. Repellents
12. Plant based insecticides
13. Antifeedants
14. Chemosterilents
15. Vegetable pests
16. Causes of pest outbreak
17. Kinds of insect pests

FOURTH SEMESTER M. Sc. DEGREE EXAMINATION, JULY 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 4E 22 – ECOLOGY AND ETHOLOGY OF INSECTS

Time: 3 hours Maximum: 80 marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. With suitable examples give an account pheromones mediated communication in parasitoids
2. Comment on nitrogenous and non-nitrogenous defense in plants
3. Give an account of pollination in plants
4. Write an essay on food finding mechanism in insects

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Effects of herbivory
6. Role of HIPVs in recruitment of insect natural enemies
7. Mechanism of seed dispersal and advantages
8. Oviposition strategies in terrestrial and aquatic insects
9. Factors affecting insect dispersal

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Intraguild predation
11. Insect response to fragmentation of ecosystems
12. Ethics in insect conservation
13. Pest management strategies used in organic farming
14. Pitfall trap
15. Chemicals influencing feeding behaviour
16. Invasive insects
17. Trophic cascades

FOURTH SEMESTER M. Sc. DEGREE EXAMINATION, JUNE 2020

(CCSS)

APPLIED ZOOLOGY

ZOO 3E 23 – MEDICAL, VETERINARY & FORENSIC ENTOMOLOGY

Time: Three Hours Maximum: 80 Marks

I. Write an essay on any *TWO* of the following: (2 X 15 = 30 marks)

1. Explain epidemiology, clinical aspects and treatment of malaria.
2. Methods in control of mosquitoes
3. Morphological adaptations of insect vector
4. DNA techniques in forensic entomology

II. Write short essays on any *THREE* of the following: (3 X 10 = 30 marks)

5. Treatment and preventive measures of Trypanosomiasis
6. Explain the use of insects as tools in forensic science
7. Insects of veterinary importance
8. Describe the taxonomy and biology of Tabanids
9. Different types of Myasis and its treatment.

III. Write short notes on any *FIVE* of the following: (5 X 4 = 20 marks)

10. Mechanical and biological vectors
11. Microfilariae
12. Dengue fever
13. Pink eye disease
14. Sleeping sickness
15. Japanese encephalitis
16. Maggot therapy
17. Pharmacological aspects of insect toxins