FYUGP

ZOOLOGY HONOURS/ RESEARCH

FOR UNDER GRADUATE COURSES UNDER RANCHI UNIVERSITY

Upgraded & Implemented from 3rd Semester of Academic Session 2022-26
& From 1st Semester of Session 2023-27 Onwards

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Table of Content

Students are Instructed to

Refer Syllabus of Allied/ Opted Subjects from R.U. Website

HIGHLIGHTS OF REGULATIONS OF FYUGP

PROGRAMME DURATION

- The Full-time, Regular UG programme for a regular student shall be for a period of four years with multiple entry and multiple exit options.
- The session shall commence from **1st of July**.

ELIGIBILITY

- The selection for admission will be primarily based on availability of seats in the Major subject and marks imposed by the institution. Merit point for selection will be based on marks obtained in Major subject at Class 12 (or equivalent level) or the aggregate marks of Class 12 (or equivalent level) if Marks of the Major subject is not available. Reservation norms of The Government of Jharkhand must be followed as amended in times.
- UG Degree Programmes with Double Major shall be provided only to those students who secure a minimum of overall 75% marks (7.5 CGPA) or higher.
- Other eligibility criteria including those for multiple entry will be in light of the UGC Guidelines for Multiple Entry and Exit in Academic Programmes offered in Higher Education Institutions.

ADMISSION PROCEDURE

- The reservation policy of the Government of Jharkhand shall apply in admission and the benefit of the same shall be given to the candidates belonging to the State of Jharkhand only. The candidates of other states in the reserved category shall be treated as General category candidates. Other relaxations or reservations shall be applicable as per the prevailing guidelines of the University for FYUGP.

VALIDITY OF REGISTRATION

- Validity of a registration for FYUGP will be for maximum for Seven years from the date of registration.

ACADEMIC CALENDAR

- An Academic Calendar will be prepared by the university to maintain uniformity in the CBCS of the UG Honours Programmes, UG Programmes, semesters and courses in the college run under the university (Constituent/Affiliated).
- **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
- **Semester:** The Odd Semester is scheduled from **July to December** and the Even Semester is from **January to June**. Each week has a minimum of 40 working hours spread over 6 days.
- Each semester will include – Admission, course work, conduct of examination and declaration of results including semester break.
- In order to undergo 8 weeks' summer internship/ apprenticeship during the summer camp, the Academic Calendar may be scheduled for academic activities as below:
  a) Odd Semester: **From first Monday of August to third Saturday of December**
  b) Even Semester: **From first Monday of January to third Saturday of May**
- An academic year comprising 180 working days in the least is divided into two semesters, each semester having at least 90 working days. With six working days in a week, this would mean that each semester will have 90/ 6 = 15 teaching/ working weeks. Each working week will have 40 hours of instructional time.
- Each year the University shall draw out a calendar of academic and associated activities, which shall be

strictly adhered to. The same is non-negotiable. Further, the Department will make all reasonable endeavors to deliver the programmes of study and other educational services as mentioned in its Information Brochure and website. However, circumstances may change prompting the Department to reserve the right to change the content and delivery of courses, discontinue or combine courses and introduce or withdraw areas of specialization.

PROGRAMME OVERVIEW/ SCHEME OF THE PROGRAMME

- Undergraduate degree programmes of either 3 or 4-year duration, with multiple entries and exit points and re-entry options within this period, with appropriate certifications such as:
  - UG Certificate after completing 1 year (2 semesters) of study in the chosen fields of study provided they complete one vocational course of 4 credits during the summer vacation of the first year or internship/ Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.,
  - UG Diploma after 2 years (4 semesters) of study diploma provided they complete one vocational course of 4 credits or internship/ Apprenticeship/ skill based vocational courses offered during first year or second year summer term in addition to 9 credits from skill-based courses earned during first, second, and third semester,
  - Bachelor's Degree after a 3-year (6 semesters) programme of study,
  - Bachelor's Degree (Honours) after a 4-year (8 semesters) programme of study.
  - Bachelor Degree (Honours with Research) after a 4-year (8 semesters) programme of study to the students undertaking 12 credit Research component in fourth year of FYUGP.

CREDIT OF COURSES

The term 'credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. The workload relating to a course is measured in terms of credit hours. It determines the number of hours of instruction required per week over the duration of a semester (minimum 15 weeks).

a) One hour of teaching/ lecture or two hours of laboratory /practical work will be assigned per class/interaction.
   One credit for Theory = 15 Hours of Teaching i.e., 15 Credit Hours
   One credit for Practicum = 30 Hours of Practical work i.e., 30 Credit Hours

b) For credit determination, instruction is divided into three major components:
   Hours (L) – Classroom Hours of one-hour duration.
   Tutorials (T) – Special, elaborate instructions on specific topics of one-hour duration
   Practical (P) – Laboratory or field exercises in which the student has to do experiments or other practical work of two-hour duration.

CALCULATION OF MARKS FOR THE PURPOSE OF RESULT

- Student's final marks and the result will be based on the marks obtained in Semester Internal Examination and End Semester Examination organized taken together.
- Passing in a subject will depend on the collective marks obtained in Semester internal and End Semester University Examination both. However, students must pass in Theory and Practical Examinations separately.

PROMOTION CRITERIA

First degree programme with single major:

i. The Requisite Marks obtained by a student in a particular subject will be the criteria for promotion to the next Semester.
ii. No student will be detained in odd Semesters (I, III, V & VII).
iii. To get promotion from Semester-II to Semester-III a student will be required to pass in at least 75% of Courses in an academic year, a student has to pass in minimum 9 papers out of the total 12 papers.
iv. To get promotion from Semester-IV to Semester-V (taken together of Semester I, II, III & IV) a student has to pass in minimum 18 papers out of the total 24 papers.
v. To get promotion from Semester-VI to Semester-VII (taken all together of Semester I, II, III, IV, V & VI) a student has to pass in minimum 26 papers out of the total 34 papers.
vi. However, it will be necessary to procure pass marks in each of the paper before completion of the course.

First degree programme with dual major:

vii. Above criterions are applicable as well on the students pursuing dual degree programmes however first degree programme will remain independent of the performance of the student in dual major courses.
viii. To get eligible for taking ESE, a student will be required to pass in at least 75% of Courses in an academic year.
ix. A student has to pass in minimum 3 papers out of the total 4 papers.
x. It will be a necessity to clear all papers of second major programme in second attempt in succeeding session, failing which the provision of dual major will be withdrawn and the student will be entitled for single first degree programme.

PUBLICATION OF RESULT

- The result of the examination shall be notified by the Controller of Examinations of the University in different newspapers and also on University website.
- If a student is found indulged in any kind of malpractice/ unfair means during examination, the examination taken by the student for the semester will be cancelled. The candidate has to reappear in all the papers of the session with the students of next coming session and his one year will be detained. However, marks secured by the candidate in all previous semesters will remain unaffected.
- There shall be no Supplementary or Re-examination for any subject. Students who have failed in any subject in an even semester may appear in the subsequent even semester examination for clearing the backlog. Similarly, the students who have failed in any subject in an odd semester may appear in the subsequent odd semester examination for clearing the backlog.

Regulation related with any concern not mentioned above shall be guided by the Regulations of the University for FYUGP.

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COURSE STUCTURE FOR FYUGP **'HONOURS/ RESEARCH'**

Table 1: Credit Framework for Four Year Undergraduate Programme (FYUGP) under State Universities of Jharkhand [Total Credits = 160]

Level of Courses	**Semester**	**MJ**; Discipline Specific Courses – Core or Major (80)	**MN**; Minor from discipline (16)	**MN**; Minor from vocational (16)	**MDC**; Multidisciplinary Courses [Life sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc.] (9)	**AEC**; Ability Enhancement Courses (Modern Indian Language and English) (8)	**SEC**; Skill Enhancement Courses (9)	**VAC**; Value Added Courses (6)	**IAP**; Internship/ Dissertation (4)	**RC**; Research Courses (12)	**AMJ**; Advanced Courses in lieu of Research (12)	**Credits**	**Double Major (DMJ)**
1	2	3	4	5	6	7	8	9	10	11	12	13	14
100-199: Foundation or Introductory courses	**I**	4	4		3	2	3	4				**20**	4+4
	II	4+4		4	3	2	3					**20**	4+4
	Exit Point: Undergraduate Certificate provided with Summer Internship/ Project (4 credits)												
200-299: Intermediate-level courses	**III**	4+4	4		3	2	3					**20**	4+4
	IV	4+4+4		4		2		2				**20**	4+4
	Exit Point: Undergraduate Diploma provided with Summer Internship in 1st or 2nd year/ Project (4 credits)												
300-399: Higher-level courses	**V**	4+4+4	4						4			**20**	4+4
	VI	4+4+4+4		4								**20**	4+4
	Exit Point: Bachelor's Degree												
400-499: Advanced courses	**VII**	4+4+4+4	4									**20**	4+4
	VIII	4		4						12	4+4+4	**20**	4+4
	Exit Point: Bachelor's Degree with Hons. /Hons. with Research											**160**	**224**

Note: Honours students not undertaking research will do 3 courses for 12 credits in lieu of a Research project / Dissertation.

Upgraded & Implemented from 3rd Sem. of Session 2022-26 & 1st Sem. of Session 2023-27 Onwards

Table 2: Semester wise Course Code and Credit Points for Single Major:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		
	Code	**Papers**	**Credits**
I	AEC-1	Language and Communication Skills (MIL 1 - Hindi/ English)	2
	VAC-1	Value Added Course-1	4
	SEC-1	Skill Enhancement Course-1	3
	MDC-1	Multi-disciplinary Course-1	3
	MN-1A	Minor from Discipline-1	4
	MJ-1	Major paper 1 (Disciplinary/Interdisciplinary Major)	4
II	AEC-2	Language and Communication Skills (MIL 2 - English/ Hindi)	2
	SEC-2	Skill Enhancement Course-2	3
	MDC-2	Multi-disciplinary Course-2	3
	MN-2A	Minor from Vocational Studies/Discipline-2	4
	MJ-2	Major paper 2 (Disciplinary/Interdisciplinary Major)	4
	MJ-3	Major paper 3 (Disciplinary/Interdisciplinary Major)	4
III	AEC-3	Language and Communication Skills (Language Elective 1 - Modern Indian language including TRL)	2
	SEC-3	Skill Enhancement Course-3	3
	MDC-3	Multi-disciplinary Course-3	3
	MN-1B	Minor from Discipline-1	4
	MJ-4	Major paper 4 (Disciplinary/Interdisciplinary Major)	4
	MJ-5	Major paper 5 (Disciplinary/Interdisciplinary Major)	4
IV	AEC-3	Language and Communication Skills (Language Elective - Modern Indian language including TRL)	2
	VAC-2	Value Added Course-2	2

	MN-2B	Minor from Vocational Studies/Discipline-2	4
	MJ-6	Major paper 6 (Disciplinary/Interdisciplinary Major)	4
	MJ-7	Major paper 7 (Disciplinary/Interdisciplinary Major)	4
	MJ-8	Major paper 8 (Disciplinary/Interdisciplinary Major)	4
V	MN-1C	Minor from Discipline-1	4
	MJ-9	Major paper 9 (Disciplinary/Interdisciplinary Major)	4
	MJ-10	Major paper 10 (Disciplinary/Interdisciplinary Major)	4
	MJ-11	Major paper 11 (Disciplinary/Interdisciplinary Major)	4
	IAP	Internship/Apprenticeship/Field Work/Dissertation/Project	4
VI	MN-2C	Minor from Vocational Studies/Discipline-2	4
	MJ-12	Major paper 12 (Disciplinary/Interdisciplinary Major)	4
	MJ-13	Major paper 13 (Disciplinary/Interdisciplinary Major)	4
	MJ-14	Major paper 14 (Disciplinary/Interdisciplinary Major)	4
	MJ-15	Major paper 15 (Disciplinary/Interdisciplinary Major)	4
VII	MN-1D	Minor from Discipline-1	4
	MJ-16	Major paper 16 (Disciplinary/Interdisciplinary Major)	4
	MJ-17	Major paper 17 (Disciplinary/Interdisciplinary Major)	4
	MJ-18	Major paper 18 (Disciplinary/Interdisciplinary Major)	4
	MJ-19	Major paper 19 (Disciplinary/Interdisciplinary Major)	4
VIII	MN-2D	Minor from Vocational Studies/Discipline-2	4
	MJ-20	Major paper 20 (Disciplinary/Interdisciplinary Major)	4
	RC/ AMJ-1 AMJ-2 AMJ-3	Research Internship/Field Work/Dissertation OR Advanced Major paper-1 (Disciplinary/Interdisciplinary Major) Advanced Major paper-2 (Disciplinary/Interdisciplinary Major) Advanced Major paper-3 (Disciplinary/Interdisciplinary Major)	12/ 4 4 4
		Total Credit	**160**

NUMBER OF CREDITS BY TYPE OF COURSE

The hallmark of the new curriculum framework is the flexibility for the students to learn courses of their choice across various branches of undergraduate programmes. This requires that all departments prescribe a certain specified number of credits for each course and common instruction hours (slot time).

Table 3: Overall Course Credit Points for Single Major

Courses	Nature of Courses	3 yr UG Credits	4 yr UG Credits
Major	Core courses	60	80
Minor	i. Discipline/ Interdisciplinary courses and ii. Vocational Courses	24	32
Multidisciplinary	3 Courses	9	9
AEC	Language courses	8	8
SEC	**Courses to be developed by the University**	9	9
Value Added Courses	Understanding India, Environmental Studies, Digital Education, Health & wellness, Summer Internship/ Apprenticeship/ Community outreach activities, etc.	6	6
Internship (In any summer vacation for Exit points or in Semester-V)		4	4
Research/ Dissertation/ Advanced Major Courses	Research Institutions/ 3 Courses		12
	Total Credits =	**120**	**160**

Table 4: Overall Course Code and Additional Credit Points for Double Major

Courses	Nature of Courses	3 yr UG Credits	4 yr UG Credits
Major 1	Core courses	60	80
Major 2	Core courses	48	64
Minor	i. Discipline/ Interdisciplinary courses and ii. Vocational Courses	24	32
Multidisciplinary	3 Courses	9	9
AEC	Language courses	8	8
SEC	**Courses to be developed by the University**	9	9
Value Added Courses	Understanding India, Environmental Studies, Digital Education, Health & wellness, Summer Internship/ Apprenticeship/ Community outreach activities, etc.	6	6
Internship (In any summer vacation for Exit points or in Semester-V)		4	4
Research/ Dissertation/ Advanced Major Courses	Research Institutions/ 3 Courses		12
	Total Credits =	**168**	**224**

Table 5: Semester wise Course Code and Additional Credit Points for Double Major:

Semester	Double Major Courses		
	Code	Papers	Credits
I	DMJ-1	Double Major paper-1 (Disciplinary/Interdisciplinary Major)	4
	DMJ-2	Double Major paper-2 (Disciplinary/Interdisciplinary Major)	4
II	DMJ-3	Double Major paper-3 (Disciplinary/Interdisciplinary Major)	4
	DMJ-4	Double Major paper-4 (Disciplinary/Interdisciplinary Major)	4
III	DMJ-5	Double Major paper-5 (Disciplinary/Interdisciplinary Major)	4
	DMJ-6	Double Major paper-6 (Disciplinary/Interdisciplinary Major)	4
IV	DMJ-7	Double Major paper-7 (Disciplinary/Interdisciplinary Major)	4
	DMJ-8	Double Major paper-8 (Disciplinary/Interdisciplinary Major)	4
V	DMJ-9	Double Major paper-9 (Disciplinary/Interdisciplinary Major)	4
	DMJ-10	Double Major paper-10 (Disciplinary/Interdisciplinary Major)	4
VI	DMJ-11	Double Major paper-11 (Disciplinary/Interdisciplinary Major)	4
	DMJ-12	Double Major paper-12 (Disciplinary/Interdisciplinary Major)	4
VII	DMJ-13	Double Major paper-13 (Disciplinary/Interdisciplinary Major)	4
	DMJ-14	Double Major paper-14 (Disciplinary/Interdisciplinary Major)	4
VIII	DMJ-15	Double Major paper-15 (Disciplinary/Interdisciplinary Major)	4
	DMJ-16	Double Major paper-16 (Disciplinary/Interdisciplinary Major)	4
		Total Credit	**64**

Abbreviations:

AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses
IAP	Internship/Apprenticeship/ Project
MDC	Multidisciplinary Courses
MJ	Major Disciplinary/Interdisciplinary Courses
DMJ	Double Major Disciplinary/Interdisciplinary Courses
MN	Minor Disciplinary/Interdisciplinary Courses
AMJ	Advanced Major Disciplinary/Interdisciplinary Courses
RC	Research Courses

AIMS OF BACHELOR'S DEGREE PROGRAMME IN ZOOLOGY

The broad aims of the bachelor's degree programme in Zoology are:

Zoology is the study of all animal life; from primitive microscopic malaria-causing protozoa to large advanced mammals, across all environmental spheres from red deer in mountain forests to dolphins in deep oceans, and from underground burrowing voles to golden eagles in the skies. Some of these animals are useful to us and we nurture them as pets or livestock; some are serious pests or disease-causing; and some are simply splendid and awe-inspiring. No matter what our relationship with the animals is, we need to understand their behaviour, population dynamics, physiology and how they interact with other species and their environments. It provides students with the knowledge and skill base that would enable them to undertake further studies in Zoology and related areas or in multidisciplinary areas that involve advanced or modern biology and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

The modern era requires a classical zoologist with a modern approach to master many subjects of Zoology. There is a need for the students to compete with the globe, therefore, the main focus of this curriculum is to enable the student to be professionally competent and successful in a career. Having Zoology as the backbone of the curriculum, this course, with the department-centric electives will enhance the skills required to perform research in laboratory and experimental research. The students can choose to focus on a "whole animal" or a "bits of animals" approach. The "whole animal" pathway makes the students proficient in the identification and study of animals while the latter approach provides the skills required to pursue laboratory and experimental work such as disease research, DNA technologies, wildlife forensics etc. The curriculum can be modified to such an extent that a student at the B.Sc. level can be a specialist in Immunology, Ichthyology, Animal behaviour or Entomology. For such specializations, the curriculum needs to focus on special skills to maximise the students' employment probability; for example, a few skills required by industry may include the species-specific monitoring for key species, handling of dangerous/ poisonous/ wild animals and the use of Geographic Information Systems (GIS) for data collection.

PROGRAM LEARNING OUTCOMES

The broad aim of the bachelor's degree programme in Zoology is to acquire Knowledge and Understanding as follows:

(i) In-depth knowledge and understanding of the fundamental concepts, principles, and processes underlying the academic field of Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture)

(ii) Procedural knowledge that creates different types of professionals in the field of Zoology and related fields such as, apiculture, aquarium fish keeping, medical diagnostics, and sericulture, etc.

(iii) Skills related to specialization areas within Zoology as well as within subfields of Zoology, including broader interdisciplinary subfields (Chemistry, Physics, and Mathematics).

- Over the years, Zoologists have been able to find many differences within the same breed of animal species. As a Zoology professional one can study extinct animals by specializing in Paleozoology, on the different types of birds in Ornithology opt for studying Herpetology and Arachnology, the branches dealing with the study of snakes and spiders, respectively or
- Appreciate the complexity of life processes, their molecular, cellular, and physiological processes, their genetics, evolution and behaviour and their interrelationships with the environment.
- Study concepts, principles, and theories related to animal behaviour and welfare.
- Understand and interpret data to reach a conclusion
- Design and conduct experiments to test a hypothesis.
- Understand scientific principles underlying animal health, management, and welfare.
- Accept the legal restrictions & ethical considerations placed on animal welfare.
- Understand fundamental aspects of animal science relating to the management of animals.

The core courses would fortify the students with in-depth subject knowledge concurrently; the discipline-specific electives will add additional knowledge about applied aspects of the program as well as its applicability in both academia and industry. Generic electives will introduce integration among various interdisciplinary courses. The skill enhancement courses would further add additional skills related to the subject as well as other than the subject. In brief, the students who graduated with this type of curriculum would be able to disseminate subject knowledge along with the necessary skills to suffice their capabilities for academia, entrepreneurship and Industry. For each syllabus, the course content has been divided into four units with a breakup of the topics to be covered to provide the students a better understanding of the main theme represented in the title of each unit. Such type of design is to indicate the breadth of content to be taught thus ensuring more or less uniform coverage of information on a certain theme. The teacher has to take up the contents in such a manner by asking questions and answering them that the whole process appears to be an interesting narrative with topics falling in line rather than appearing as unrelated complex terms. Learning will be more enjoyable and imbibing if appropriate examples are cited from our daily lives.

SEMESTER WISE COURSES IN ZOOLOGY MAJOR-1 FOR FYUGP **2022 onwards**

Table 7: Semester wise Examination Structure in Discipline Courses:

Semester	Courses		Examination Structure			
	Code	Papers	Credits	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	MJ-1	Non –Chordates and Chordates	4	25	75	---
II	MJ-2	Ecology and Biochemistry	4	25	75	---
	MJ-3	**Practical-I**	4	---	---	100
III	MJ-4	Cell Biology and Biostatistics	4	25	75	---
	MJ-5	**Practical-II**	4	---	---	100
IV	MJ-6	Comparative Anatomy	4	25	75	---
	MJ-7	Animal Physiology	4	25	75	---
	MJ-8	**Practical-III**	4	---	---	100
V	MJ-9	Molecular Biology	4	25	75	---
	MJ-10	Genetics & Ethology	4	25	75	---
	MJ-11	**Practical-IV**	4	---	---	100
VI	MJ-12	Developmental Biology	4	25	75	---
	MJ-13	Evolution	4	25	75	---
	MJ-14	Endocrinology & Immunology	4	25	75	---
	MJ-15	**Practical-V**	4	---	---	100
VII	MJ-16	A. Insecta OR B. Fish & Fisheries OR C. Ecology	4	25	75	---
	MJ-17	Toxicology	4	25	75	---
	MJ-18	Global Climate Change	4	25	75	---
	MJ-19	**Practical-VI A/ B/ C**	4	---	---	100
VIII	MJ-20	Biotechniques	4	25	75	---
	AMJ-1	Advanced Immunology & Developmental Biology	4	25	75	---
	AMJ-2	Applied Cytogenetics	4	25	75	---
	AMJ-3	**Practical-VII**	4	---	---	100
	or RC-1	Research Methodology	4	25	75	---
	RC-2	Project Dissertation/ Research Internship/ Field Work	8	---	---	200
		Total Credit	**92**			

Table 8: Semester wise Course Code and Credit Points for Skill Enhancement Courses:

Semester	Skill Enhancement Courses		Examination Structure			
	Code	Papers	Credits	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	SEC-1	Wildlife Conservation and Management	3	---	75	---
II	SEC-2	Sericulture & Apiculture	3	---	75	---
III	SEC-3	Elementary Computer Application Softwares	3	---	75	---
		Total Credit	**9**			

Table 9: Semester wise Course Code and Credit Points for Minor Courses:

Semester	Minor Courses		Examination Structure			
	Code	Papers	Credits	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	MN-1A	Introductory Zoology	4	15	60	25
III	MN-1B	Animal Diversity	4	15	60	25
V	MN-1C	Food Nutrition and Health	4	15	60	25
VII	MN-1D	Environment & Public Health	4	15	60	25
		Total Credit	**16**			

INSTRUCTION TO QUESTION SETTER

SEMESTER INTERNAL EXAMINATION (SIE):

There will be Only One Semester Internal Examination in Major, Minor and Research Courses, which will be organized at college/institution level. However, Only One End semester evaluation in other courses will be done either at College/ Institution or University level depending upon the nature of course in the curriculum.

A. (SIE 10+5=15 marks):

There will be two group of questions. **Question No.1 will be very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.

The Semester Internal Examination shall have two components. (a) One Semester Internal Assessment Test (SIA) of 10 Marks, (b) Class Attendance Score (CAS) of 5 marks.

B. (SIE 20+5=25 marks):

There will be two group of questions. **Group A is compulsory** which will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** two questions of ten marks each, out of which any one to answer.

The Semester Internal Examination shall have two components. (a) One Semester Internal Assessment Test (SIA) of 20 Marks, (b) Class Attendance Score (CAS) of 5 marks.

Conversion of Attendance into score may be as follows:

Attendance Upto 45%, 1mark; 45<Attd.<55, 2 marks; 55<Attd.<65, 3 marks; 65<Attd.<75, 4 marks; 75<Attd, 5 marks.

END SEMESTER UNIVERSITY EXAMINATION (ESE):

A. (ESE 60 marks):

There will be two group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer.

B. (ESE 75 marks):

There will be two group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

C. (ESE 100 marks):

There will be two group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks. Group B will contain descriptive type six questions of twenty marks each, out of which any four are to answer.

FORMAT OF QUESTION PAPER FOR SEMESTER INTERNAL EXAMINATION

Question format for **10 Marks**:

Subject/ Code

F.M. =10 **Time**=1Hr. Exam Year

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 1 out of 2** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....

Group B

2. ..... [5]
3. ..... [5]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **20 Marks**:

Subject/ Code

F.M. =20 **Time**=1Hr. Exam Year

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 1 out of 2** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]

Group B

3. ..... [10]
4. ..... [10]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEMESTER UNIVERSITY EXAMINATION

Question format for **50 Marks**:

Subject/ Code

F.M. =50 **Time**=3Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....

Group B

2. ..... [15]
3. ..... [15]
4. ..... [15]
5. ..... [15]
6. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **60 Marks**:

Subject/ Code

F.M. =60 **Time**=3Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **75 Marks**:

Subject/ Code

F.M. = 75 **Time**=3Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]
9. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **100 Marks**:

Subject/ Code

F.M. = 100 **Time**=3Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [10x1=10]
   i. ..... vi. .....
   ii. ..... vii. .....
   iii. ..... viii. .....
   iv. ..... ix. .....
   v. ..... x .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [20]
5. ..... [20]
6. ..... [20]
7. ..... [20]
8. ..... [20]
9. ..... [20]

Note: There may be subdivisions in each question asked in Theory Examination.

SEMESTER I

I. MAJOR COURSE –MJ 1:
NON –CHORDATES AND CHORDATES

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to protists, non-chordates and chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
5. Understand how morphological change due to change in environment helps drive evolution over a long period of time.
6. The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills.

Course Content:

GROUP A: NON CHORDATES

UNIT I: Living World **(04 Lecturess)**

1. Concept of origin of life.
2. Tree of life
3. Different sects of protists (*Noctiluca*, *Dianoflagellates*, *Diatoms*, Sporozoans & Others)
4. Symmetry, Coelom, Origin of segmentation
5. Distinction between taxonomy & systematics
6. Conceptual phylogenetic, phenetics, and cladistic systematics

UNIT II: Kingdom Protista **(04 Lectures)**

1. General introduction and classification upto class
2. Locomotion in Protista
3. Reproduction and Nutrition in Protista

UNIT III: Phylum Porifera, Cnidaria, Ctenophora. **(04 Lectures)**

1. General characters and classification up to class
2. Canal system in Porifera
3. Coral and coral Reef formation.
4. Alteration of Generation in cnidarian.
5. Evolutionary significance of ctenophore

UNIT IV: Helminthes **(04 Lectures)**

1. General characters and classification of Platyhelminthes, and Aschelminthes. upto class
2. Life cycle of *Fasciola hepatica, Ascaris lumbricoides*

UNIT V: Annelida **(04 Lectures)**

1. General characters, Classification up to class
2. Segmentation in Annelids

UNIT VI: Arthropoda **(04 Lectures)**

1. General characters, Classification up to class

2. vision in Arthropods, Appendages in Arthropods

UNIT VII: Mollusca **(03 Lectures)**

1. General characteristic of Mollusca. Classification up to class
2. Torsion and Detorsion in Mollusca

UNIT VII: Echinodermata **(03 Lectures)**

1. General characters, classification up to class
2. Water vascular system in Echinodermata

GROUP- B: CHORDATES (Pisces to Mammals)

UNIT I: Chordata **(04 Lectures)**

Introduction to chordates and its origin general characters and outline classification

UNIT II: Protochordates **(04 Lectures)**

1. General characters of Hemichordates Urochordates and Cephalochordates.

UNIT III: Agnatha **(03 Lectures)**

General characters and classification of cyclostomes.

UNIT IV: Pisces **(03 Lectures)**

1. General classification of chondricthyes and Osteicthyes
2. Parental care in fishes
3. Migration of fish

UNIT V: Amphibia **(04 Lectures)**

1. General Classes and classification of Amphibia
2. Parental care in Amphibians.

UNIT VI: Reptilia

1. General Classes and classification of Reptilia **(04 Lectures)**
2. Poison apparatus and Biting mechanism in snakes.

UNIT VII: Aves **(04 Lectures)**

1. General characters of Aves
2. Flight adaptations in birds
3. Flightless Birds, a brief idea.
4. Migration in birds

UNIT VIII: Mammalia **(04 Lectures)**

Different groups of mammals, Dentition in mammals.

Reference Books:

1. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
5. Singh, S. Keshari S. and Abhishek, K.S. (2016). Medical Zoology and Parasitology, Jharkhand Jharokha, Classical Publishing Company.
6. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
7. Pough H. Vertebrate life, VIII Edition, Pearson International.
8. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
1. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

II. SKILL ENHANCEMENT COURSE- SEC 1:
WILDLIFE CONSERVATION AND MANAGEMENT

Marks: 75 (ESE: 3Hrs) = 75	Pass Marks: Th (ESE) = 30

(Credits: Theory-03) **45 Hours**

About the course

1. The course is an introduction to wildlife management and gives an account of the tools used by wildlife managers.
2. Topics covered are to equip students with adequate knowledge of various biodiversity monitoring methodologies, conservation and management issues of vertebrate pests, wildlife conflict and over abundant species, wildlife health and diseases.

Learning outcomes

After successfully completing this course, the students will be able to:

1. To know about wildlife and preparation of an inventory of the wildlife of own area.
2. To study the causes of its depletion.
3. To know the distinction between wildlife sanctuary, National park and the Biosphere Reserve.
4. Concept of homes range –territory of big cats. Concept of pug-mark, difference of pug-marks between male and female big cats, remote sensing and geographic information system.
5. To know the reasons of entry of wild animals (elephant and leopard) in human dwellings.
6. Strategies of conservation of wildlife fauna and flora.

Course Content:

UNIT I: Value of wildlife and need for its conservation (12 Lecture)

Definition, value and importance of wildlife; Causes of depletion of wildlife; Inventory and classification of wetland and animal in habitants; Wildlife Sanctuaries and National Parks in India: general strategies and issues; Theories of population dispersal; Animal movement, concept of home range and territory; Tracking movement by remote sensing and GIS.

UNIT II: Population and prey-predator dynamics (12 Lecture)

Wildlife conservation, ethics and importance of conservation; Impact of habitat destruction and fragmentation on wildlife; Biological parameters such as food, cover, forage and their impact on wild life; Density dependent and independent population regulation; Impact of introduced species on preexisting flora and fauna of wildlife; Identification and estimation of wild animals by fecal sample analysis, pug marks and census methods. Predator-prey models and impact of predation.

UNIT III: Wildlife Conservation (12 Lecture)

Wildlife conservation objectives- strategies and issues; Captive breeding techniques and translocation and reintroduction; Restoration of degraded habitat; Damage caused by wildlife in India andits mitigation; Sick animal refuges in protected areas.

UNIT IV: Rehabilitation and management (9 Lecture)

Type of wildlife management-manipulative, custodial; Management of over abundant wild animal populations causing damages to nearby inhabitants and their crops and animals; man wildlife conflict resolution and mitigation; Management exotic and invasive wetland species in India. Habitat manipulation control and regulation of grazing. Weed eradication; Major diseases of domestic and wild animals and their control and impact of wild life tourism.

Practicals:

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
3. Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna.
5. Group discussion or Seminar presentation on one or two related topics from the list.

SEMESTER II

I. MAJOR COURSE- MJ 2:
ECOLOGY AND BIOCHEMISTRY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to:

1. Know the evolutionary and functional basis of animal ecology.
2. Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
3. Solve the environmental problems involving interaction of humans and natural systems at local or global level.
4. Understand about the importance and scope of biochemistry.
5. Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
6. Understand the structure and function of immunoglobulins.
7. Understand the concept of enzyme, its mechanism of action and regulation.
8. Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.
9. Learn measurement of enzyme activity and its kinetics.

Course Content:

GROUP A: ECOLOGY

UNIT I: An Overview of Ecology (06 Lecture)

1. Structure and function of an ecosystem
2. Energy flow in an ecosystem: Lindeman"s trophic dynamic concept
3. Laws of limiting factor: Shelfords law of tolerance
4. Food chain and Food web
5. Productivity and its management
6. Biome: An introduction and its type.

UNIT II: Population Dynamics: (06 Lectures)

1. Population its attributes, Survivorship curve.
2. Exponential and logistic growth.
3. Population Regulation –Density and density-independent factors

UNIT III: Community Ecology: (06 Lectures)

1. Community Characters, Analytical and synthetic characters
2. Community Diversity Indices, Simpson's matching coefficient, Jacard's Similarity index, Shannon diversity index
3. Community Interactions –positive and Negative interactions
4. Niche concept: Niche overlap. Gause's principle with laboratory and field examples.
5. Community Dynamics-Succession and climax concept

UNIT IV: Environment Management: (06 Lecture)

1. Natural resources-types
2. Biogeochemical cycles –Water, Carbon, Nitrogen
3. Biodiversity-Alpha, Beta, Gamma. Hotspots
4. Environmental Degradation causes and its management including air, Water, Soil. and Noise

UNIT V: Environmental movements: (06 Lecture)

1. Chipko movement
2. Silent valley
3. Sardar Sarovar Mega Dam project.
4. Role of Gender and cultures in environmental conservation

GROUP B: BIOCHEMISTRY

UNIT I: Biomolecules: A brief account of Carbohydrates, protein and lipids. (06 Lecture)

UNIT II: Carbohydrates: (06 Lecture)

1. Structure and classification. Metabolism of carbohydrates. Glycolysis, Krebs cycle, ETS and ATP synthesis.
2. Glycogenesis, Gluconeogenesis. Glycogenesis HMP shunt.

UNIT III: Lipids (06 Lecture)

Structure and classification. Steroids ketogenesis and synthesis of Palmitic Acid.

UNIT IV: Proteins (06 Lecture)

1. Composition, structure and biological significance.
2. Amino acids: structure and classification.
3. Catabolism of Amino acid: Transamination & Deamination.

UNIT V: Enzymes (06 Lecture)

1. Nomenclature and classification.
2. Enzyme kinetics. Regulation of Enzyme action Coenzymes and Isoenzymes.
3. Enzyme inhibition and Km equation Organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Reference Books:

Group A

1. Raziuddin, M.., Mishra P.K. 2014, A Handbook of Environmental Studies, Akanaksha Publications, Ranchi.
2. Mukherjee, B. 2011: Fundamentals of Environmental Biology.Silverline Publications, Allahabad.
3. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
4. Gadgil, M., &Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
5. Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.
6. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
7. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
8. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29--64). Zed Books.
9. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
10. Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.
11. Krebs Ecology

Group B

1. Cox, M.M and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Ed, W.H. Freeman and Co., New York.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009,). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
4. Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

II. MAJOR COURSE- MJ 3:
PRACTICALS-I:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 60 marks
Practical record notebook = 15 marks
Viva-voce = 25 marks

Practical:

GROUP A

1. Study of life tables and plotting of survivorship curves - different types –through provided data.
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: phytoplankton and zooplankton; Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Biological Oxygen Demand, Chemical Oxygen Demand and free CO2.
4. Collection of animals and preparation of report over it.

GROUP B

1. Quantitative test of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE.

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Zoology,* Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. *Practical Organic Zoology,5th Ed.,* Pearson (2012)
3. Principles and Techniques of Biochemistry and Molecular Biology: Wilson and Walker, edited by Hofman
4. Experimental procedures in life sciences: S. Rajan

III. SKILL ENHANCEMENT COURSE- SEC 2: SERICULTURE & APICULTURE

Marks: 75 (ESE: 3Hrs) = 75	Pass Marks: Th (ESE) = 30

(Credits: Theory-03) **45 Hours**

Course Objectives:

1. To identify and know about the silkworm species.
2. To be aware of the different stages in the life cycle of Bombyx mori.
3. To know about the silk work rearing technology
4. To be aware of the types of bacterial, fungal and protozoan pests of silk worm and their control.
5. To visit the sericulture centres available locally.
6. To know about the social organization of honey bee and its rearing equipment, modern methods of creating artificial hives and cross pollination.
7. To know how to extract honey.
8. To be aware of the enemies of bees.
9. To procure the information about bees wax, propolis etc. and their uses for developing
10. Entrepreneurship in Api- industry.

Course Contents:

GROUP- A: SERICULTURE

Unit1: Introduction (3 Lectures)

Sericulture: Definition, history and present status; Silk route. Types of silk worms, Distribution and Races. Exotic and indigenous races. Mulberry and non-mulberry Sericulture

Unit2: Biology of Silk worm (3 Lectures)

Life cycle of Bombyxmori

Structure of silk gland and secretion of silk

Unit3: Rearing of Silk worms (13 Lectures)

Selection of mulberry variety and establishment of mulberry garden. Rearing house and rearing appliances. Disinfectants: Formalin, bleaching powder, RKO. Silk worm rearing technology: Early age and Late age rearing. Types of mountages Spinning, harvesting and storage of cocoons

Unit4: Pests and Diseases (4 Lectures)

Pests of silk worm: Uzifly, dermestid beetles and vertebrates Pathogenesis of silk worm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases

Unit5: Entrepreneurship in Sericulture (2 Lectures)

Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various Sericulture centres.

Suggested Readings:

1. Handbook of Practical Sericulture: S.R. Ullaland M.N. Narasimhanna CSB, Bangalore
2. Appropriate Sericultural Techniques; Ed. M.S. Jolly, Director, CSR & TI, Mysore.
3. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub.Co. Ltd., Tokyo, Japan 1972.
4. Manual of Silkworm Egg Production; M.N. Narasimhanna, CSB, Bangalore 1988.
5. Silkworm Rearing; Wupang —Chunand Chen Da-Chung, Pub. By FAO, Rome 1988.
6. A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
7. Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986

GROUP- B: APICULTURE

Unit1: Biology of Bees **(3 Lectures)**

History, Classification and Biology of Honey Bees
Social Organization of Bee Colony

Unit2: Rearing of Bees **(10 Lectures)**

Artificial Bee rearing (Apiary), Beehives–Newton and Langstroth
Bee Pasturage
Selection of Bee Species for Apiculture Bee
Keeping Equipment
Methods of Extraction of Honey (Indigenous and Modern)

Unit3: Diseases and Enemies **(2 Lectures)**

Bee Diseases and Enemies, Control and Preventive measures

Unit4: Bee Economy **(2 Lectures)**

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit5: Entrepreneurship in Apiculture **(3 Lectures)**

Bee Keeping Industry– Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

Suggested Readings:

1. Prost, P.J.(1962). *Apiculture*. Oxford and IBH, New Delhi.
2. Bisht D.S., *Apiculture*, ICAR Publication.
3. Singh S., *Bee keeping in India*, Indian council of Agricultural Research, New Delhi.

SEMESTER III

I. MAJOR COURSE- MJ 4:
CELL BIOLOGY AND BIOSTATISTICS

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to

1. Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
2. Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
3. Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
4. Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.
5. Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.
6. Know basic concepts of probability and statistics
7. Understand data mining tool and its practical application in a case study
8. Apply the knowledge in future course of their career development in higher education and research

Course Content:

GROUP- A: CELL BIOLOGY

UNIT I: A general concept of prokaryotic and eukaryotic cells **(03 Lectures)**

Cell theory, General structure of different cell organelles including Mitochondria, Golgi complex.

UNIT II: Endoplasmic Reticulum, Nucleus, Chromosome, Ribosome, Golgi apparatus, and Lysosome **(05 Lectures)**

UNIT III: Cytoskeleton-Composition and function. Microtubules and microfilaments GERL system **(04 Lectures)**

UNIT IV: Cell membrane structure: Chemical composition of Plasma membrane of Erythrocyte, Active and Passive transport, (Diffusion and osmosis) ATPase Pump and Exchange. **(10 Lectures)**

UNIT V: Cell Adhesion molecules and ECM **(05 Lectures)**

UNIT VI: Cell cycle, cell signaling, and cell culture: **(15 Lectures)**

1. A brief introduction to cell cycle, its various phases
2. Mitosis and Meiosis, Cell division, Checkpoints, and its regulation.
3. Apoptosis and Cancer
4. Cell signaling, Regulation of signaling pathways. (GPCR and RTK)
5. Cell-Cell communication

UNIT VII: Types of culture media: Sterilization methods **(08 Lectures)**

Somatic cell hybridization.

GROUP B: BIOSTATISTICS **(10 Lectures)**

1. Types of data: Primary and secondary data
2. Mean, Median, Mode, Standard Deviation, Standard error, Chi square test, t-test, f-test, ANOVA, Correlation, and Regression Analysis.
3. Basics of statistics software – MS-EXCEL, PAST, and R

Reference Books:

GROUP-A

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition.
2. John Wiley and Sons. Inc.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition.
5. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the
7. Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
8. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London

GROUP B

1. W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences (10th edition) John Wiley.
2. Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and Health
3. Sciences (2nd edition) McGraw Hill.
4. Zar, J.H. (2013) Biostatistical Analysis (5th edition) Pearson.

II. MAJOR COURSE- MJ 5:
PRACTICALS-II:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 60 marks
Practical record notebook = 15 marks
Viva-voce = 25 marks

Practicals:

GROUP A

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study various stages of meiosis from permanent slides.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
    a. DNA by Feulgen reaction
    b. DNA and RNA by MGP
    c. Mucopolysaccharides by PAS reaction
    d. Proteins by Mercury bromophenol blue/Fast Green.

GROUP B

1. Calculation of mean, standard deviation and standard error.
2. Calculation of correlation coefficient values, Regression analysis and finding out the probability
3. Student's t – test dependent and independent, hand calculation and calculation using MS-Excel.
4. ANOVA - hand calculation and calculation using MS-Excel.

Reference Books:

1. Principles and Techniques of Biochemistry and Molecular Biology: Wilson and Walker, edited by Hofmann.
2. Experimental procedures in Life sciences: S. Rajan
3. Basic techniques in Biochemistry, Microbiology and Molecular Biology: Akancha Jain
4. Mahajan's methods in Biostatistics for Medical students and Research workers.

III. SKILL ENHANCEMENT COURSE- SEC 3:
ELEMENTARY COMPUTER APPLICATION SOFTWARES

Marks: 75 (ESE: 3Hrs) = 75	Pass Marks: Th (ESE) = 30

A Common Syllabus for FYUGP (Credits: Theory-03) **45 Hours**

Instruction to Question Setter for
End Semester Examination (ESE):
*There will be **objective type test** consisting of **Seventy-five questions of 1 mark each**. Students are required to mark their answer on **OMR Sheet** provided by the University.*

Course Objectives:

The objective of the course is to generate qualified manpower in the area of Information Technology (IT) and Graphic designing which will enable such person to work seamlessly at any Offices, whether Govt. or Private or for future entrepreneurs in the field of IT.

A. INTRODUCTION TO COMPUTER SYSTEM

1. Basic Concept of Computer: What is Computer, Applications of Computer, Types of computer, Components of Computer System, Central Processing Unit (CPU) **(3 Lecture)**

2. Concepts of Hardware: Input Devices, Output Devices, Computer Memory, Types of Memory, processing Concept of Computer **(4 Lecture)**

3. Operating system: What is an Operating System, Operating System Examples, Functions of Operating System(Basic), Introduction to Windows 11, Working on Windows 11 environment, Installation of Application Software, My Computer, Control Panel, searching techniques in windows environment, Basic of setting **(6 Hours)**

4. Concept of Software: What is Software, Types of Software, Computer Software- Relationship between Hardware and Software, System Software, Application Software, some high level languages **(4 Hours)**

5. Internet & its uses: Basic of Computer networks; LAN, WAN, MAN, Concept of Internet, Applications of Internet; connecting to internet, what is ISP, World Wide Web, Web Browsing software's, Search Engines, URL, Domain name, IP Address, using e-governance website, Basics of electronic mail, getting an email account, Sending and receiving emails. **(6 Hours)**

B. MICROSOFT OFFICE 2016 AND LATEST VERSIONS

6. Microsoft Word: Word processing concepts, Creation of Documents, Formatting of Documents, Formatting of Text, Different tabs of word 2016 environment, Formatting Page, Navigation of Page, Table handling, Header and footer, Page Numbering, Page Setup, Find and Replace, Printing the documents **(7 Hours)**

7. Microsoft Excel (Spreadsheet): Spreadsheet Concepts, Creating, Saving and Editing a Workbook, Inserting, Deleting Work Sheets, Formatting worksheet, Excel Formula, Concept of charts and Applications, Pivot table, goal seek, Data filter, data sorting and scenario manager, printing the spreadsheet **(6 Hours)**

8. Microsoft Power Point (Presentation Package): Concept and Uses of presentation package, Creating, Opening and Saving Presentations, working in different views in Power point, Animation, slide show, Master Slides, Creating photo album, Rehearse timing and record narration **(5 Hours)**

9. Digital Education: What is digital education, Advantages of digital Education, Concept of e-learning, Technologies used in e learning **(4 Hours)**

Reference Books

1. Nishit Mathur, Fundamentals of Computer, APH publishing corporation (2010)
2. Neeraj Singh, Computer Fundamentals (Basic Computer), T Balaji, (2021)
3. Joan Preppernau, Microsoft Power Point 2016 step by step, Microsoft press (2015)
4. Douglas E Corner, The Internet Book 4th Edition, prentice –Hall (2009)
5. Steven Welkler, Office 2016 for beginners, Create Space Independent Publishing Platform (2016)
6. Wallace Wang, Microsoft Office 2019, Wiley (January 2018)
7. Noble Powell, Windows 11 User Guide For Beginners and Seniors, ASIN, (October 2021)

SEMESTER IV

I. MAJOR COURSE- MJ 6:
COMPARATIVE ANATOMY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to:

1. Develop an understanding of the evolution of vertebrates thus integrating structure, function and development.
2. Have an overview of the evolutionary concepts including homology and homoplasy, and detailed discussions of major organ systems.
3. Understand how cells, tissues, and organisms function at different levels. The course content also provides the basis of understanding their abnormal function in animal and human diseases and new methods for treating those diseases.
4. Get a flavor of research besides improving their writing skills and making them well versed with the current trends. It will further enable the students to think and interpret individually due to different aspects chosen.

Course Content:

UNIT I: Tissues **(06 Lectures)**

Types of tissues – epithelial, connective, Muscular, and Nervous

UNIT II: Integumentary System **(06 Lectures)**

Structure, Function, and Derivatives of integument

UNIT III: Skeletal System **(07 Lectures)**

An Overview of Axial and Appendicular Skeleton, Jaw suspensorium

UNIT IV: Digestive System **(07 Lectures)**

Alimentary Canal and associated gland

UNIT V: Respiratory System **(08 Lectures)**

Skin, Gills, Air Sacs, accessory respiratory organs, and Lungs

UNIT VI: Circulatory System **(08 Lectures)**

Evolution of Heart and Aortic arches, General plan of Circulation (single and double circuit)

UNIT VII: Urinogenital System **(08 Lectures)**

Succession of Kidney (Pronephric, Mesonephric and Metanephric),
Evolution of Urinogenital duct

UNIT VIII: Nervous system **(08 Lectures)**

Comparative account of brain, Autonomic Nervous System, Spinal Cord, Cranial & Spinal Nerves in Mammals

UNIT IX: Sense Organs **(08 Lectures)**

Brief account of Visual and Auditory receptors

Reference Books:

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills
4. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
1. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

II. MAJOR COURSE- MJ 7:
ANIMAL PHYSIOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to:

1. Develop an understanding of the evolution of various organ systems which work in coordination.
2. Have a detailed discussions of major organ systems.
3. Understand how cells, tissues, and organs function at different levels. Develop an understanding of the related disciplines, such as cell biology, neurophysiology, pharmacology, biochemistry etc.
4. Get a flavor of research besides improving their writing skills and making them well versed with the current trends. Undertake research in any aspect of animal physiology in future.

Course Content:

UNIT I: Tissue **(06 Lecture)**

Structure and classification, Bone and Cartilage

UNIT II: Digestive System **(06 Lecture)**

Gastrointestinal tract and its associated glands, Mechanical and Chemical digestion of food, Absorption of Carbohydrate, Protein and Lipid

UNIT III: Respiratory System **(06 Lecture)**

Histology of trachea and Lungs, Respiratory volumes, Respiratory Pigments, Diffusion of respiratory gases and Transport of O_2 and CO_2

UNIT IV: Circulatory System **(06 Lecture)**

Structure and Working of Mammalian Heart

Blood groups, Rh factor Blood and its components, Blood clotting Mechanism Cardiac cycle

UNIT V: Skeletal system **(06 Lecture)**

Ultra-structure of Skeletal Muscle, chemical basis of muscle contraction.

UNIT VI: Excretory System **(06 Lecture)**

Kidney: structure and function, Mechanism of urine formation, Counter- Current theory, Ornithine-Arginine cycle

UNIT VII: Reproductive System **(08 Lecture)**

Histology of male and female reproductive organs.

physiology of reproduction in male and female, Accessory Reproductive organs, Methods of Contraception, Reproductive Hormone.

UNIT VIII: Endocrine system: **(08 Lecture)**

Basics of Endocrine glands (Pituitary, Pineal, Thyroid, Pancreas Adrenal, Thymus, and Gonads). Classification of hormone. Mode of hormone action. (TSH/Adrenaline)

UNIT IX: Nervous System **(08 Lecture)**

Ultrastructure of Neuron, Physiology of nerve conduction, Reflex Action,

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
4. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
5. DeFiore Atlas of Human histology. Physiology Vandor
6. Ganong's Physiology

III. MAJOR COURSE- MJ 8:
PRACTICALS-III:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 60 marks
Practical record notebook = 15 marks
Viva-voce = 25 marks

Practicals:

1. Comparative general anatomy of digestive, respiratory, muscular, cardio vascular and reproductive system of (Virtual demonstration).
2. Observation of simple muscle twitch in Frog with electrical stimulation (virtual).
3. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
4. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells.
5. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
6. Preparation of permanent slide of mammalian tissues.
7. Hematology: Blood group determination, hemoglobin estimation, bleeding and clotting time, Morphology of different blood cells and their count.

Reference Books:

1. Animal physiology: Omkar, S.C. Nigam
2. Human Microscopic Anatomy: R.V. Krstic, Springer - Verlay

SEMESTER V

I. MAJOR COURSE- MJ 9:
MOLECULAR BIOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to:

1. Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.
2. Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.
3. Apply their knowledge in problem solving and future course of their career development in higher education and research.
4. Get new avenues of joining research in related areas

Course Content:

UNIT I: Chemistry of nucleic acids (DNA & RNA): (08 Lectures)

N-bases, Pentose sugar, Nucleosides & Nucleotides, Watson-Crick model of DNA, Types of DNA (A, B & Z), Base pairing, Major & minor grooves of DNA, uninterrupted genes.

UNIT II: DNA synthesis in Prokaryotes & Eukaryotes: (11 Lectures)

Semi-conservative DNA replication, Replication fork, DNA polymerases, Phases- initiation, elongation and termination. Errors in DNA and their repair (base excision repair & nucleotide excision repair), Homologous recombination.

UNIT III: Transcription in Prokaryotes & Eukaryotes: (10 Lectures)

Consensus sequences, Promoter (-35 & -10 elements), RNA polymerases, Phases- initiation, elongation and termination. RNA processing of mRNA. Regulation genes.
Introduction of peripheral dogma.

UNIT IV: RNA: (08 Lectures)

RNA hypothesis, Chemistry of RNA, types of RNA (mRNA, rRNA, tRNA, snoRNA), Structure of mRNA &tRNA (clover-leaf model), Basics of RNA edit, RNAi.

UNIT V: Genetic codes: (08 Lectures)

History of genetic codes, Features of genetic codes, Wobble hypothesis. Central dogma.

UNIT VI: Translation in E. coli: (05 Lectures)

Translation factors, charging of tRNAs, Phases- initiation, elongation and termination.

UNIT VIII: Operon concept: (05 Lectures)

Operon and its types, Lac operon – inducible, constitutive & non-inducible.

UNIT IX: Basics of the genetics of cancer: (05 Lectures)

Proto-oncogenes, Gene regulation of the cell cycle. Gene therapy, Stem cell therapy, BLAST.

Reference Books:

1. Lininger Principles of biochemistry: Cox & Nelson, MacMillan & Freeman, USA
2. Molecular biology of Gene: Watson et al., Pearson Publication, USA
3. Strickberger's Genetics, Prinitis Hall of India (PHI), Delhi
4. Principles of Genetics: Snustad& Simmons, John Wiley & Sons, USA
5. Modern Genetics Analysis: Integrating Genes and Genomes, Griffith et al., W. H. Freeman & Company, USA
6. Genetics: Russell & Benjamin, Cummings Publishing Company, USA.
7. Genetics: PK Gupta, Rastogi Publication, New Delhi.
8. Gene regulation: Latchmann, Taylor & Francis, USA
9. Lodish – Cell and molecular biology
10. Lewing- Gene (latest edition)
11. Molecular biology of cancer: Lecorino, Oxford University Press, UK.

II. MAJOR COURSE- MJ 10:
GENETICS & ETHOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing this course, the students will be able to:

1. Understand how DNA encodes genetic information and the function of mRNA and tRNA
2. Apply the principles of Mendelian inheritance.
3. Understand the cause and effect of alterations in chromosome number and structure.
4. Relate the conventional and molecular methods for gene manipulation in other biological systems.
5. Discuss and analyse the epigenetic modifications and imprinting and its role in diseases.
6. Get new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, genotoxicity, etc
7. Learn a wide range of theoretical and practical techniques used to study animal behaviour.
8. Develop skills, concepts and experience to understand all aspects of animal behaviour.
9. Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
10. Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild.

Course Content:

GROUP A: GENETICS

UNIT I: Pre-Mendelian genetics, Mendel's life, Symbols, and terminologies, Laws of dominance, segregation & independent assortment, Back cross & test cross, Multiple alleles, and Incomplete Dominance. Allelic and Non-allelic gene interactions. **(06 Lectures)**

UNIT II: Linkage:

Coupling & repulsion hypothesis, Morgan's view of linkage, kinds of linkage, Chromosomal theory of linkage, Human chromosomal maps. **(06 Lectures)**

UNIT III: Crossing over or Gene recombination:

Somatic & germinal crossing over, kinds of crossing over, Theories of the mechanism of crossing over. **(06 Lectures)**

UNIT IV: Eukaryotic Chromosomes:

Structure & chemical composition of chromosomes. Karyotype, Ideogram, Human karyotype, Lampbrush chromosome **(06 Lectures)**

UNIT V: Sex determination:

Genic balance theory, Chromosomal theory &, Types of sex determination, Environmental sex determination, Role of SRY gene in sex determination, and developing gonads. **(06 Lectures)**

UNIT VI: Sex-linked inheritance:

Sex chromosomes, X-linked genes (colour blindness & haemophilia in humans), Y-linked inheritance, Sex-limited & Sex influenced traits. **(04 Lectures)**

UNIT VII: Pedigree analysis:

Penetrance & expressivity, Symbols, Pedigree analysis of dominance inheritance (polydactyly in man), Recessive inheritance (cystic fibrosis), and sex-linked inheritance (colour blindness). **(05 Lectures)**

UNIT VIII: Mutation:

Historical background, Mutagens, Chromosomal mutation & gene mutation, Chromosomal aberrations in humans, Euploidy & aneuploidy. **(08 Lectures)**

GROUP B: ETHOLOGY

UNIT I: General concepts of Ethology:

Basics of Motivation, Fixed Action Pattern, Imprinting **(04 Lectures)**

UNIT II: Behaviour and its types:

Individual and social interaction, Social organization, Innate and learned behavior, Genetic basis of behaviour (**05 Lectures)**

UNIT III: Orientation in animals - its nature and types (02 Lectures)

Taxis and Kinesis

UNIT IV: Biological rhythms – occurrence and significance: (02 Lectures)

Reference Books:

GROUP A

1. 1.Strickberger's Genetics, Prinitis Hall of India (PHI), Delhi
2. Principles of Genetics: Snustad & Simmons, John Wiley & Sons, USA
3. Modern Genetics Analysis: Integrating Genes and Genomes, Griffith et al.,
4. W. H. Freeman & Company, USA
5. Genetics: Russell & Benjamin, Cummings Publishing Company, USA.
6. Principles of Genetics: Tamerin, Tata McGraw Hills, Delhi
7. Genetics: PK Gupta, Rastogi Publication, New Delhi.

GROUP B

1. Manning A. & Dawkins M.S. – An Introduction to Animal Behaviour. Cambridge 1995
2. Prasad S. – Animal Behaviour. CBS 2004
3. Mathur R. – Animal Behaviour. Rastogi 2002
4. Sadguru Prasad- Animal Behaviour

III. MAJOR COURSE- MJ 11:
PRACTICALS-IV:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 60 marks
Practical record notebook = 15 marks
Viva-voce = 25 marks

Practicals:

GROUP A

1. Histochemical tests of nucleic acids (DNA & RNA).
2. Isolation of DNA through gel electrophoresis.
3. Study of PCR of given sample.
4. Study of Spectrophotometer for a given sample.

GROUP B

1. Pedigree analysis of baldness, Thalassemia, Ear hypertrichosis, PTC taste, Eye Color.
2. Chi- square analyses using seeds/beads/Drosophila.
3. Study of human karyotype (normal and abnormal).
4. Nesting Behaviour, types of nests
5. Study of Migration Behavior(virtual)
6. Social Behaviour in Honey Bee/Termite

Reference Books:

1. Introduction to spectroscopy : Pavia, Lapman
2. Birding Basics : Tips, tools and Techniques for Great Bird watching
3. Lab Manual for Introductory Cytogenetics PLNT3140.
4. Experimental Animal Science – Birds and Insects : Dr. Manoj Kumar Arya and Pawan Kr. Bharti
5. Karyotyping and Data interpretation : Link. Springer

SEMESTER VI

I. MAJOR COURSE- MJ 12: DEVELOPMENTAL BIOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing the course, the students will be able to

1. Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
2. Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
3. Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks
4. Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
5. Understand the relevance of developmental biology in medicine or its role in development of diseases.

Course Content:

UNIT I: Basic concept of Development (10 Lectures)

1. Basics of induction and specification
2. Phases of Development: Blastogenesis , Organogenesis, in sea urchin & chick.
3. Period of Development: Embryonic period, postembryonic period.
4. History of Embryology: Baer's law, theory of preformation, theory of epigenesis, mosaic theory.

UNIT II: Early Embryonic Development (15 Lectures)

1. Gametogenesis: Spermatogenesis, Oogenesis, sperm: types of sperms, and Egg membranes.
2. Eggs: types of eggs, Hormonal regulation of gametogenesis.
3. Fertilization (External Sea urchin and Internal Chick) & its mechanism.
4. Cleavage. Types of Blastulas, and Fate Maps
5. Early development of frog and chick up to gastrulation.

UNIT III: Late Embryonic Development (15 Lectures)

1. Menstrual and Estrus cycles
2. Extra embryonic membranes in birds.
3. Implantation of embryo in humans.
4. Placenta: Structure, types and functions of placenta.

UNIT IV: Post embryonic Development (10 Lectures)

1. Metamorphosis: Types of Metamorphosis, Metamorphosis in amphibians
   Hormonal control of metamorphosis in amphibians
2. Regeneration: Types of Regeneration, Epimorphosis, Morphallaxis, and Compensatory regeneration
3. Ageing- Concepts and Theories.

UNIT V: Implications of Developmental Biology (10 Lectures)

1. Teratogenesis: Teratogenic agents and their effect on embryonic development.
2. In vitro: fertilization (IVF), Ectopic Pregnancy, Embryonic stem cells (Esc), Amniocentesis.

Reference Books:

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky B.I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
3. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
4. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

II. MAJOR COURSE- MJ 13:
EVOLUTION

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

After successfully completing the course, the students will be able to

6. Develop a holistic appreciation on the phylogeny and adaptations in animals.
7. Enable the students to understand the evolution of universe and life.
8. Understanding on the process and theories in evolutionary biology.
9. Examine the evolutionary history of the taxa based on developmental affinities.
10. Understand the process of evolution
11. Evolution of life forms in through geological time scale
12. To trace the phylogeny of species.

Course Content:

UNIT I: Introduction to Evolutionary Theories (06 Lectures)

1. Historical review and Concept of Evolution.
2. Theories of Evolution - Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, and Modern synthetic theory

UNIT II: Evidence of Evolution (10 Lectures)

1. Evidence of Evolution: Geological time scale
2. Fossil record (types of fossils, transitional forms,)
3. Adaptive Radiation, Homology and analogy
4. Evolution of horse.

UNIT III: Process of Evolutionary change (06 Lectures)

1. Sources of Variations: Heritable variations and their role in evolution.
2. Concept of co-evolution, parallel evolution.

UNIT IV: Principles of Population genetics (10 Lectures)

1. Population genetics, Gene pool, Gene Frequency (mathematical approach)
2. Hardy – Weinberg law (statement and derivation of equation, application of law to human population), Numerical approaches of H_W law.
3. Natural selection
4. Genetic Drift

UNIT V: Species concept (10 Lectures)

1. Product of Evolution: Micro evolutionary changes (Inter population variations, clines, races)
2. Species concept
3. Isolating mechanism
4. Modes of speciation- allopatric, sympatric.
5. Macro evolution (Adaptive Radiation)

UNIT VI: Extinctions (06 Lectures)

1. Back ground and Mass extinctions (causes and effects)
2. Detailed example of K-T extinctions

UNIT VII: Origin and Evolution of Man (06 Lectures)

1. Unique hominin characteristics contrasted with primate characteristics.
2. Primate phylogeny from Dryopithecus leading to Homo sapiens.

UNIT VIII: Phylogenetic trees (06 Lectures)

1. Multiple sequence alignment
2. Construction of Phylogenetic trees.
3. Interpretation of phylogenetic trees.

Reference Books:

1. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
4. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition.
5. Wiley- Blackwell. 5.Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
6. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
7. Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley.

III. MAJOR COURSE- MJ 14:
ENDOCRINOLOGY & IMMUNOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

1. After successfully completing the course, the students will be able to
2. Understand neurohormones and neurosecretions. Learn about hypothalamo and hypapophysial axis.
3. Understand about different endocrine glands and their disorders. Know the mechanism of hormone action.
4. Carry out common procedures for culturing, purifying and diagnostics of micro-organisms understand the disease-causing potential of bacteria and viruses, and the responses of the immune system.
5. Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
6. Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities. Know how resistance development and resistance transfer occur.
7. Identify the major cellular and tissue components which comprise the innate and adaptive immune system. Understand how are immune responses by T cells and B cells initiated and regulated.
8. Understand how does the immune system distinguish self from non-self.

Course Content:

GROUP- A: ENDOCRINOLOGY

UNIT I: Introduction to Endocrinology (03 Lectures)

1. Definition and Classification of hormones.
2. Endocrine, paracrine and merocrine modes of hormone delivery

UNIT II: Structure and functions of endocrine glands in Mammals. (19Lectures)

Structure, hormones, functions and regulation of endocrine glands:

1. Pituitary
2. Pineal
3. Thyroid
4. Parathyroid
5. Adrenal
6. Pancreas
7. Testis
8. Ovary
9. Local endocrine gland
10. Neuro Secretions.

UNIT III : Mechanism of Hormone Action (05 Lectures)

1. General mechanism of hormone action
2. Regulation of Hormone action (Adrenaline, Thyroxine and Insulin): Hormone action at cellular and molecular level, Hormone receptors, molecular mediators, genetic control of hormone action

UNIT IV: Hormonal dysfunction and diseases (03 Lectures)

1. Dwarfism, acromegaly and Acromicria
2. Goiter, Grave's Disease
3. Addison's disease, Cushing syndrome
4. Diabetes mellitus, Insipidus

GROUP-B: IMMUNOLOGY

UNIT I: Overview of Immune System (02 Lectures)

1. Introduction to Immunity and types.
2. Cells & Organs of the Immune System

UNIT II: Innate and Adaptive Immunity (04 Lectures)

1. Anatomical Barriers
2. Inflammation

3. Cells & Molecules involved in Innate Immunity
4. Adaptive Immunity (Cell-mediated & humoral)

UNIT III: Antigens (04 Lectures)

1. Antigenicity & Immunogenicity
2. Immunogens, Adjuvants, and Haptens
3. B and T cell Epitopes.

UNIT IV: Immunoglobulins. (05 Lectures)

1. Structure and function of different types of Ig
2. Antigen – antibody Interactions
3. Immuno assays (ELISA and RIA)
4. MAB

UNIT V: Major Histocompatibility Complex (MHC) (04 Lectures)

1. Structure & function of MHC molecules.
2. Structure of T-cell receptor and it's signaling.
3. T Cell development and selections

UNIT VI: Cytokines (03 Lectures)

1. Types, Properties and functions of Cytokines.

UNIT VII: Complement system (03 Lectures)

1. Components and path ways of complement activation.

UNIT VIII: Hypersensitivity (03 Lectures)

1. Gell and coombs classification and brief description of various types of hypersensitivity.

UNIT IX: Vaccines (02 Lectures)

1. Introduction to vaccine
2. Various types of vaccines.

Reference Books:

1. Kindit, T.J., Golds by R.A., Osborne, B.A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R.B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003) Cellular and Molecular Immunology. V edition. Saunders Publication.
1. Kuby - Immunology

IV. MAJOR COURSE- MJ 15:
PRACTICALS-V:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 60 marks
Practical record notebook = 15 marks
Viva-voce = 25 marks

Practicals:

Group A

1. Study of permanent slides of different developmental stages of frog and Rabbit
2. Study of vaginal smear preparation of rat.
3. Preparation of permanent slides of different incubation stages of Chick embryo.

Group B

1. Study of permanent histological slides of following endocrine glands in rat: Pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary.
2. Estimation of plasma level of any hormone using ELISA.
3. Study of homology in Bat and Bird
4. Analogy in fish and Dolphin
5. Serial homology in Prawn
6. Adaptive Radiation in mammals
7. Study of permanent slides of all endocrine glands

Group C

1. Malarial Strip test.
2. RT-PCR Test
3. Blood Group (Rh) Determination
4. Blood agglutination for antigen – antibody reaction.

Reference Books:

1. An advanced Laboratory manual of Zoology: T. Poddar
2. Manual for the Laboratory diagnosis of Malaria: Abnet Abebe (PDF available on net)
3. PCR Primer – A Laboratory manual: Carl. W. Dieffen bach
4. Real-time PCR handbook (http://www.gene-quantification.de)

SEMESTER VII

I. MAJOR COURSE- MJ 16 A:
INSECTA

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Learning outcomes

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

1. About the taxonomic characteristics of insects.
2. The morphological variations.
3. About the physiological details.
4. About the interaction between plant – insects.

Course Content:

GROUP A: INSECTA

UNIT I: Introduction **(04 Lectures)**

1. General features of insects. 2. Distribution and success of Insects on

UNIT II: Insect Taxonomy **(08 Lectures)**

1. Basics of insects classification:
2. Classification of insects up to orders (Orthoptera, Coleoptera, Dictyoptera, Lepidoptera)

UNIT III: General Morphology of Insects **(08 Lectures)**

1. External features of a typical insect. Structure & Type of antennae.
2. Structure & Types of Mouthparts w.r.t feeding habits.
3. Type of legs adapted to diverse habitat

UNIT IV: Physiology of Insects **(10 Lectures)**

1. Reproductive system. 2. Endocrine system 3. Nervous system
2. Sensory receptors – vision and sound receptors

UNIT V: Insect Animal Interaction **(10 Lectures)**

1. Social economic insects (honey bees and termites) – Social organization & Social behaviour.
2. Insects as a vector – Mechanical and biological vectors
3. (*Musca domestica, Anopheles & Culex*)

UNIT VI: Insect Plant Interaction **(10 Lectures)**

1. Role of allochemicals & pheromones in host plant mediation.
2. Host plant selection by phytophagous insects
3. Insect as plant pests & concept integrated pest management (IPM)

UNIT VII: Developmental Biology of Insects **(10 Lectures)**

1. Developmental biology of Insects – oogenesis &
2. spermatogenesis. Structure of egg and sperm
1. Fertilization, Growth, types of Metamorphosis and its hormonal regulation

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Reference Books: Please Refer page no.46

OR MJ 16 B:

FISH & FISHERIES

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Learning Outcomes:

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

1. The major taxonomical groups of fish.
2. Their physiological details.
3. Fish pathology, adaptations and related features.
4. Aquaculture practices.

UNIT I: Taxonomy of Fin Fish (08 Lectures)

1. Major taxa of inland and Marine fishes up to order.
2. Commercially important freshwater and marine fishes of India. Morphological characteristics.

UNIT II: Biology of Fin fish (10 Lectures)

1. A brief idea of the Circulatory, respiratory, Nervous, Urinogenital system, endocrine system, skeletal system and sensory system of fin fishes.

UNIT III: Physiology of Fin fish (10 Lectures)

2. Effects of environmental factors on physiology of Fin fish.
3. Study of Osmoregulation, excretion and stress related changes, bioluminescence, electric organs
4. ARO (accessory respiratory organs)
5. Lateral line organ system

UNIT IV: Fish pathology and Health management (04 Lectures)

1. A brief idea of Fish parasites, diseases, and their treatment

UNIT V: Fish and Adaptation (04 Lectures)

1. Hill stream fishes
2. Cold-water fisheries of India.
3. Fishing crafts and gears.

UNIT VI: Marine fishery (04 Lectures)

1. Marine fishery resources in India
2. Estuarine fishes.

UNIT VII: Aquaculture (10 Lectures)

1. Principles of Aquaculture: Definition and scope
2. Systems of Aquaculture – Pond culture, Pen culture, Cage culture, Biofloc culture, RAS
3. Extensive and intensive fish culture
4. Monoculture, Polyculture, Composite and integrated culture system, fish culture system of India.

UNIT VIII: Fish technology and research (10 Lectures)

1. Preservation and processing of harvested fish, fishery by-products, transgenic fish, Zebra fish as a model of research.
2. Introductory Ornamental fish culture and aquarium maintenance.

Reference Books: Please Refer page no.46

OR MJ 16 C:

ECOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Learning Outcomes:

On successful completion of this course the student should know:

1. After completing this course the student will be able to be aware about components of Ecosystems and its limiting factors.
2. To know about Tundra, desert, Tropical rain forest Ecosystems.
3. To be aware about the Energy flow, Food chain and webs
4. To know population attributes, community interactions, natural resources, services, cause of their degradation and management.
5. To know mineralization and recycling of nutrients.

1. **UNIT I: An overview of Ecology, Ecosystems and Biomes** **15 Lectures**

Introduction and scope of Ecology. Multidisciplinary relevance in current perspective. Structure and function of ecosystem; Abiotic factors affecting survival and sustenance of organisms e.g., water, temperature, light, pH and salinity. Role of limiting factors in survival of biotic components. Major ecosystems of the world: Ecological features, limiting factors, zonation and classification of organisms of fresh water and marine ecosystems. Introduction to Biome: Ecological features of Tundra, Desert, Savannah and Tropical Rain forest Biomes. Energy flow in ecosystem, food chain and food web. Productivity. Mineralization and recycling of nutrients: C, N, P & S.

2. **UNIT II: Population ecology; Human population growth** **15 Lectures**

Ecology of populations: Unitary and Modular populations. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves. Unique and group attributes of population: mortality, age ratio, sex ratio, dispersal. Factors regulating population dispersal and growth: Exponential and logistic growth. Population regulation: density-dependent and independent factors; r and K strategies. Metapopulations, demes and interdemic extinction. Life history strategies: reproductive effort, offspring size and cost-benefit ratio. Ecological efficiencies. Human population growth: Impacts on environment, carrying capacity, human health and welfare.

3. **UNIT III: Biotic community, characteristics and attributes** **15 Lectures**

Community characteristics: stratification; Dominance, diversity, species richness, abundance, Evenness, Similarity. Diversity and food-web indices. Ecotone and edge effect; Types of interaction: Positive interactions: commensalism, proto-cooperation, and mutualism. Negative interactions: parasitism and allelopathy; predation and predator-prey dynamics; herbivory. Interspecific competition and coexistence, Inter and intra-specific; abundance. Ecological succession: Definition, Process, types, theories of succession.

4. **UNIT IV: Environmental degradation; Environmental movement etc.** **15 Lectures**

Environmental ethics; Pollution: Air, water and noise pollution and their control; Natural resources: Mineral, water and forest, their significance and conservation; Types of biodiversity, Hotspots, benefit and threat of conservation strategies; Biodiversity: status, monitoring and documentation; major drivers of biodiversity change; Biodiversity mapping using GPS, GIS and remote sensing. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Application of ecology in management and Conservation programmes. Role of gender and cultures in environmental conservation. Environmental movements: Bishnois. Chipko, Silent valley, Big dam movements. Environmental education and public awareness

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Reference Books: Please Refer page no.46

Reference Books for MJ 16 A: INSECTA

1. Insect pathology: Shadanand Upadhyay
2. Handbook of Nature study in colour – Insects: Anna Comstock
3. Modern Entomology – D.B. Tembhare
4. A general textbook of entomology. Imms. A. D. Chapman & Hall, UK
5. The insects: Structure and functions. Chapman. R.F. Cambridge University Press, UK
6. Principles of insect morphology. Snodgrass. R.F. Cornell University Press, USA.
7. Introduction to the study of insects. Norro. D.J. Triplehorn. C.A. and Johanson. N.F. Saunders. College Publication, USA.
8. Developmental Biology. Gilbert. Sinauer Associates, Inc., Publishers. Sunderland, Massachusetts U.S.A.
9. The insect Societies. Wilson. Howard University Press. UK
10. Host selection by Phytophagous insects. Bernays and Chapman. Chapman and Hall. NY, USA.
11. Advances in Insect Physiology. Russell Jurenka. Academic Press, London, UK
12. Insect Physiology and Biochemistry. James L. Nation. CRC Press, London, UK

Reference Books for MJ 16 B: FISH & FISHERIES

1. The Laboratory Fish (A Hand book of Experimental Animals) : Gary Ostrander
2. Fish feeding Experiments: T. Lovell
3. Laboratory Fish in Biomedical Research – Springer. Link
4. Laboratory Zebra Fish: Claudia Harper.
5. Eco-immunotoxic studies on a fish during Experimental plumbism (Pb) clarias batrachus: Dr. P.C. Rout
6. Fish of U.P. and Bihar: C.B.L. Srivastav
7. An Introduction to the Study of Fishes – Albert C.L.G. Gunther, Discovery Publishing House, New Delhi – 110 002
8. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
9. D.H. Evans and J.d. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
10. C.B.L. Srivastava, Fish Biology, Narendra Publishing House
11. J.R. Norman, A history of Fishes, Hill and Wang Publishers
12. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
13. Modern Ichthyology, S.M. Shafi, Inter India Publications
14. Feeding and Digestive Functions of Fishes, J.E.P. Cyrino, D.P. Bureau, B.G. Kapoor, CRC Press, Taylor & Francis Group, Boca Raton, London, New York

Reference Books for MJ 16 C: ECOLOGY

1. The experimental analysis of distribution and abundance: C.J. Krebs
2. Ecological experiments : Nelson. G. Cambridge University Press
3. Colinvaux, P. A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.
4. Krebs, C. J. (2001) Ecology (6th edition) Benjamin Cummings.
5. Odum, E.P., (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole.
6. Ricklefs, R.E. (2000) Ecology (5th edition) Chiron Press.
7. Southwood, T.R.E. and Henderson, P.A. (2000) Ecologial Methods (3rd edition) Blackwell Sci.
8. Kendeigh, F C. (1984) Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
9. Stiling, P. D. (2012) Ecology Companion Site: Global Insights and Investigations. McGraw Hill Education.

II. MAJOR COURSE- MJ 17:
TOXICOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Objectives:

1. This course is focused on theoretical and applied knowledge on the effects of chemical substances on human health. The students will also get introduced to the toxicological analysis and the signs and symptoms of important toxic syndromes.
2. The students will also study the basic toxicokinetic principles and metabolic systems to elucidate mechanisms of toxicity induced by xenobiotic compounds.

Course Learning Outcomes:

After completing this course the students will be able to:

1. learn basic principles of signaling pathways and mechanisms of cell death
2. understand gene-environment interactions
3. examine the application how xenobiotics disrupt normal cellular processes of genomics, proteomics, and metabolomics data
4. understand mechanisms of systemic and organ toxicity induced by xenobiotics; and
5. learn how to analyze and interpret complex data sets in toxicological research and deliver a scientific presentation.
6. use clinical and laboratory findings in the treatment of acute toxic exposures

Course Content:

Unit I: Basic Concept of Toxicology **12 Lectures**

Introduction of toxicology, history of toxicology, definition of toxicology, definition of poison, definition of toxicity and classification of toxicants. Mode of action of toxic agents.

Unit II: Xenobiotics **14 Lectures**

Introduction, Important of xenobiotics concerned to Human health, absorption of xenobiotics, distribution of xenobiotics, accumulation of xenobiotics, elimination, biotransformation and excretion. Adverse effects of xenobiotics through Biological Magnification and Biotransformation, mechanism of Xenobiotic Translocation, Membrane permeability and mechanism of chemical transfer,

Unit III: Pesticides and Heavy Metal Toxicity **14** Lectures

Pesticides and their toxicological effects. Classification of Pesticides, Insecticides, Mode of action of Insecticide. Heavy Metal Toxicity: Introduction, dispersion, general principal of metal toxicity, sources, toxic metals and their toxicity. Arsenic, Alumunium, Cadmium (ItaiItai disaster), Chromium Lead, Mercury, Manganese, Zinc and Nickel

Unit IV: Evaluation of toxicity. **12 Lectures**

Acute, sub-acute and chronic assays LD50, LC50, NOEL. Maintenance and general handling of animals for toxicological laboratory. Ecotoxicology, clinical toxicology, occupational and nanotoxicology.

Recommended readings

1. Clinical and Experimental Toxicology of organophosphates and carmabates: Bryan Ballantyne and C. Marrs.
2. Williams, P.L.; James, R. C. Roberts, S.M. (2003) Principles of Toxicology: Environmental and Industrial Applications, John Wiley & Sons, Inc.
3. Klaassen, C. the basic science of poisons Mcraw-Hill.
4. Duffs, J. and Worth, H. (2006) Fundamental Toxicology, RSC Publication

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III. MAJOR COURSE- MJ 18:
GLOBAL CLIMATE CHANGE

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Objectives:

Upon completion of this course, the students will be able to understand

1. Climate system, the various forcing and give a brief introduction to the atmosphere and ocean circulation..

Course Learning Outcomes:

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

1. Develop understanding on the concept and issues of global environmental change.
2. Analyse the causes and effects of depletion of stratospheric ozone layer.
3. Examine the climate change and its effect on living beings.
4. Understand the physical basis of natural green gashouse effect on man and materials.
5. Evaluate human influenced driver of our climate system and its applications.

Course Content:

Unit I: An overview of earth system 13 lectures

Global Environmental change issues. Paleoclimate ± what can we learn from the past? Concept of earth system, climate forcing, responses, feedback loops, equilibrium states, Daisy world Stratospheric ozone layer: Evolution of ozone layer; Planetary Energy balance, seasonal variability. Radiative transfer, an improved estimate of climate sensitivity.

Unit II: Causes and consequences of Ozone layer depletion 12 lectures

Greenhouse gases and their sources; Greenhouse effects; Causes of depletion of ozone layer and consequences; Climate change: Effects of enhanced UV-B on plants, microbes, animals, human health and materials; global energy infrastructure and GHG emissions.

Unit III: Other adverse impacts on climate 14 lectures

Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Acid rain and its effects on plants, animals, microbes and ecosystems. Eutrophication, Consequences on climate, oceans, agriculture, natural vegetation and humans; Clouds, Storms and Climate -Cloud Formation and Climate, El Niño and the Southern Oscillation -El Niño and its Effects.

Unit IV: International summits and agreements 13 lectures

International efforts on climate change issues. Global efforts for mitigating ozone layer depletion. Climate modeling and climate change feedbacks. International Agreements: the United Nations Framework Convention on Climate Change, Kyoto Protocol, Paris Agreement. Integrated Assessment, Decisions under uncertainty: Abate now, or delay? Emissions budgets.

Recommended readings

1. Climate change – A very short introduction by Mark Maslin.
2. Design and Analysis of Experiments D.C. Montgomery.
3. Adger, N.; Brown, K. and Conway, D. (2012). Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.
4. Turekian, K.K. (1996). Global Environmental Change-Past, Present, and Future. Prentice Hall.
5. Matthew, R.A.; Barnett, J. and McDonald, B. (2009). Global Environmental Change and Human Security. MIT Press., USA.
6. Hester, R.E. and Harrison, R.M. (2002). Global Environmental Change. Royal Society of Chemistry

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IV. MAJOR COURSE- MJ 19 A/ B/ C:
PRACTICALS-VI:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Lectures duration. Evaluation of Practical Examination may be as per the following guidelines:

Use of bioinformatics date (provided) in BLAST = 10 marks
Separation of amino acids or DNA by Gel electrophoresis = 20 marks
Use of PCR = 10 marks
Dissertation = 35 marks
Viva-voce = 25 marks

List of Practical

MJ 19 A: INSECTA

1. Study of museum specimen of local fauna of different orders.
2. Morphology of different types of month parts, antenna, legs and wings of insect of different orders.
3. Dissection of alimentary canal to show malphigian tubules, salivary glands and nerve cords.
4. Culture of the life cycle of social insects.
5. Molecular characterization of gut bacteria of *Drosophila*.
6. Study of permanent slides of T.S. of ovary, endocrine glands and L.S. of malphigian tubules.

Reference Book:

1. Insect pathology: Shadanand Upadhyay
2. Handbook of Nature study in colour – Insects: Anna Comstock
3. Modern Entomology – D.B. Tembhare

OR

MJ 19 B: FISH & FISHRIES

1. Temporary slide preparation of planktons
2. Bioassay of gut micro biota
3. Study of scales of Major and minor carps.
4. Orohypophyseal dissection of pituitary gland.
5. Dissection of Air breathing fish to expose accessory respiratory organs.
6. Study of fused, pre caudal and caudal vertebrae of fish
7. Morphometric study of some fresh water fish.
8. Study of ornamental fish.
9. Study of permanent slides of T.S. endocrine glands of fish (ovary, testis, pituitary)

Reference Book:

1. The Laboratory Fish (A Hand book of Experimental Animals) : Gary Ostrander
2. Fish feeding Experiments: T. Lovell
3. Laboratory Fish in Biomedical Research – Springer. Link
4. Laboratory Zebra Fish: Claudia Harper.
5. Eco-immunotoxic studies on a fish during Experimental plumbism (Pb) clarias batrachus : Dr. P.C. Rout
6. Fish of U.P. and Bihar: C.B.L. Srivastav
7. The Laboratory Fish in Biomedical Research: Livia D'Angelo, Elsevier Science, 2021

OR

MJ 19 C: ECOLOGY

1. To measure microclimatic variables *viz*., temperature, humidity and light conditions in a microhabitat. 2. Making an ecosystem in a wide-mouthed bottle.
2. Constructing a food web by observing and collecting organisms from a given area.
3. Studying the impact of herbivore on plant species (planted in pots under specific conditions)
4. Constructing distribution map of species of a genus through GPS by estimating the coordinates.
5. Investigation of volatile inhibitory substances produced through decomposition of plant debris and root exudates.
6. Estimation of the ratio of the producers and consumers.

Reference Book:

1. The experimental analysis of distribution and abundance: C.J. Krebs
2. Ecological experiments: Nelson. G. Cambridge University Press
1. Animal in Biomedical Research: Tyagi Gaurav
2. Hand book of Nature study in color-Insects: Anna Comstock
3. Ecological experiments: Nelson.
4. The experimental analysis of distribution and abundance: C.J Krebs
5. Climate change, A very short Introduction: Mark Maslin, Oxford India
6. Design and Analysis of Experiments: D.C Montgomery

SEMESTER VIII

I. MAJOR COURSE- MJ 20: BIOTECHNIQUES

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Objectives:
Upon completion of this course, the students will be able to understand
1. To understand the basic ethics and values of a laboratory.
2. To understand the basic instruments in a laboratory.
3. To understand the recent advances in biotechniques.

Course Learning Outcomes:
1. Upon successful completion of this course, the students should know:
2. The different types of analytical, and scanning instruments and techniques.

Course Content:

UNIT I: Introduction (6 Lectures)

Importance of biotechniques in the field of zoological sciences. Significance of different types of instruments in zoology. Best practices in a laboratory. Basic ethics of laboratory. Biosafety levels in laboratories.

UNIT II: Analytical Instruments: (10 Lectures)
Spectrophotometry and its principles. Immuno–cytochemistry (ELISA).
Spectroscopy - Atomic Absorption, ESR, and NMR spectroscopy, Incubators and Deep Freezers

UNIT III: Scanning Instruments: (8 Lectures)
Microscopy - Scanning and Transmission electron microscopes, Fluorescence microscopy and Compound microscope

UNIT IV: Application of Biotechniques in Zoological Science (12 Lectures)
GC-Mass Spectrometry (GC-MS), Circular Dichroism (to know the secondary structure, folding and binding properties of proteins), Electrophoresis (Agarose and SDS PAGE), Centrifugation: Basic principles, differential, and density gradient centrifugation, Thermal shakers, and Rotors.
Amino acid sequencing techniques, Gene sequencing techniques, Introduction of Genetic Analysers

UNIT V: Cryotechniques (8 Lectures)
Cryopreservation of cells, tissues, and organisms, Cryotechniques for microscopy.

UNIT VI: Microbial Techniques (8 Lectures)
Autoclaves and Laminar flow hoods (tools of sterilization). General-purpose media in the microbial lab - Nutrient agar and broth preparation, streak preparation (Microbial culture)

UNIT VII: Chromatographic Techniques (8 Lectures)
Basic principles of different types of chromatography (paper, TLC, GLC, Ion-exchange, and HPLC)

Reference Books:
1. Principles and Techniques of Biochemistry and Molecular Biology – Wilson and Walker – Cambridge University Press.
2. Delves P.J., Martin S.J., Burton D.R. & Roitt I.M. – Roitt's Essential Immunology. 11th edn. Oxford 2006
3. Basic Biotechniques – Cheena Chawla, NBT, New Delhi
4. Biotechniques : Theory & Practice – SVS Rana, Rastogi Publications

II. ADVANCED MAJOR COURSE- AMJ 1:
ADVANCED IMMUNOLOGY & DEVELOPMENTAL BIOLOGY

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Learning Outcomes:

1. The advanced immunology course is intended to provide to the basic scientist with an enhance understanding immunological concepts that are relevant to wide range of biological fields.

Course Content:

UNIT I: Advanced Immunology **20 lectures**

The students familiarity with the immunological literature and self-learning are enhanced on the following topics:

1. Antibodies treatments of Cancer (Oncotherapy).
2. Use of antibodies and fluorescent dyes in cytochemistry.
3. The advancements in the field of receptors- ligand concepts.
4. Immunoglycomics, Immunoproteomics & Immunogenomics

UNIT II: Fundamentals of the Developmental Biology **20 Lectures**

Role of morphogens – cytoplasmic determinants of cell differentiation in *Drosophila* (morphogenetic instructions and their modulations)

The basic approach to watch development – Dye marking, Genetic labelling, Transgenic DNA chimeras.

The advanced knowledge of the aspects of specialization.

UNIT III: Morphogenesis and Organogenesis in Animals **20 Lectures**

Mechanism of segmentation in Drosophila.

Axes and pattern formation in – Drosophila, Amphibia and Chick.

Vulva formation in *Caenorhabditis elegans*.

Sex determination.

Limb development in tetrapods

Reference Books:

1. Lodish H., Berk A., Matsudaira P. Kaiser C.A., Krieger M., Scott M.P., Zipurky S.L., & Darnell J. –
2. Molecular Cell Biology. 5th edn. W.H. Freeman 2004
3. Sadava D.E. – Cell Biolgy. Organelle, Structure and Function. Jones and Bartlett 1997
4. Cooper G.M. – The Cell: A molecular approach. ASM Press 1997
5. Freifelder D. & Malacinski G.M. – Essentials of Molecular Biology 2nd edn. Panima 1993
6. Becker W.M., Reece J.B. & Poenic M.F. – The World of the Cell. 3rd edn. Benjamin 1996
7. Twyman R.M. – Advanced Molecular Biology. Viva 2003
8. De Robertis E.D.P. & De Robertis Jr. E.M.E. – Cell and Molecular Biology. 8th edn. Lippincott
9. Williams and Wilkins 2001
10. Alberts B., Johnson A., Lewis J., Raff M., Roberts K. – Molecular Biology of the Cell. 7th edn. Garland Science 2020
11. Gilbert – Developmental Biology, 13th Eds.
12. Berril N. J. – Developmental Biology. Tata McGraw-Hill 2018

III. ADVANCED MAJOR COURSE- AMJ 2: APPLIED CYTOGENETICS

Marks: 25 (5 Attd. + 20 SIE: 1Hr) + 75 (ESE: 3Hrs) = 100	Pass Marks: Th (SIE + ESE) = 40

(Credits: Theory-04) **60 Hours**

Course Objectives:

Upon completion of this course, the students will be able to understand

1. Insight into cell biology. Understanding advanced molecular biology
2. Industry-oriented professional skills in molecular biology and biotechnology.

Course Learning Outcomes:

Upon successful completion of this course, the students should know:

1. To know the regulations of the cell physiology.
2. To understand the regulations of molecular basis of cell.
3. To understand the future scope of tools and technological applications of advanced molecular biology and DNA technologies.

Course Content:

1. Applying cytogenetics in phylogenetic studies. **(2 Lectures)**
2. Applied cytogenetics – past, present and future. **(2 Lectures)**
3. Cytogenetics- Karyotyping and FISH **(3 Lectures)**
4. Cytogenetic and molecular genetic techniques in hematological and solid tumours. **(3 Lectures)**
5. Examination of chromosomes to diagnose aneuploidy and structural abnormalities in fetus to fix any disorder. **(3 Lectures)**
6. Examination of nuclear morphology in cancer cell – Breast and Oral cancers **(3 Lectures)**
7. Cytogenetics chromosomal analysis of blood cell or bone marrow to look for specific gene mutation in certain leukemias **(4 Lectures)**
8. Southern Blot Analysis (to decipher autoimmune disease), Immunoprecipitation **(4 Lectures)**
9. Advanced recombinant DNA methods. Isolation and purification of RNA, DNA (genomic and plasmid), and proteins **(6 Lectures)**
10. Analysis of RNA, DNA, and proteins by one and two-dimensional gel electrophoresis, isoelectric focusing gels **(8 Lectures)**
11. Isolation of specific nucleic acid sequences and Protein sequencing methods **(4 Lectures)**
12. Gene knockout in bacterial and eukaryotic organisms **(4 Lectures)**
13. Detection of post-translation modification of proteins (ER and Golgi glycosylation of proteins) **(4 Lectures)**
14. Applied cytogenetics in human genome research (DNA sequencing methods & strategies of human genome); large-scale expression analysis, such as microarray-based techniques **(5 Lectures)**
15. Isolation, separation, and analysis of carbohydrate and lipid molecules; RFLP, RAPD, and AFLP techniques **(5 Lectures)**

Reference Books:

1. Primrose S.B. – Molecular Biotechnology. 2nd edn. Panima 2001
2. Glick B.R. & Pasternak J.J. – Molecular Biotechnology. 3rd edn. ASM Press 2003
3. Golemis E. (edt) – Protein-Protein Interactions. Cold Spring Harbor Laboratory Press 2002
4. Brown T.A. – Gene Cloning. 4th edn. Blackwell 2005
5. Nicholl O.S.T. – An Introduction to Genetic Engineering. Cambridge Univ. Press 1994
6. Mitra S. – Genetic Engineering; Principle and Practice. Mac Millan 2002
7. Smith J.E. – Biotechnology. 3rd edn. Cambridge Univ. Press 1986
8. Balsubramanian D., Bryce C.F.A., Dharmalingam K., Green J. & Jayaraman. – Concepts in Biotechnology. Universities Press 2002
9. Bains W. - Biotechnology: From A to Z. 2nd edn. Oxford 1998
10. Kumar H.D. – A Textbook on Biotechnology. Affiliated East West 1991

IV. ADVANCED MAJOR COURSE- AMJ 3: PRACTICALS-VII:

Marks: Pr (ESE: 3Hrs) =100	Pass Marks: Pr (ESE) = 40

(Credits: Practicals-04) **120 Hours**

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Preparation of buffers and determination of pH	*= 10 marks*
Preparation of permanent slides of metaphase chromosome of tip of onion– 1)	*= 10 marks*
Extraction/Isolation of genomic DNA or RNA	*= 15 marks*
Separation of RNA or DNA by Gel electrophoresis	*= 15 marks*
Demonstration of PCR	*= 10 marks*
Practical Records	*= 15 marks*
Viva – voce	*= 25 marks*

List of Practical

1. Karyotyping of a given sample.
2. Study of tumor cell nuclei.
3. Extraction/Isolation of genomic DNA and RNA from mammalian blood cell
4. Conduction of PCR.
    a. Agarose Gel Electrophoretic analysis of DNA, or RNA.
5. Sub-cellular fractionation of functional mitochondria
    a. Isolation of mitochondria from mouse liver by differential centrifugation. (virtual mode)
    b. Identification of mitochondrial fraction by assay of marker enzyme. (virtual mode)
6. Preparation of buffers and determination of pH.
7. Quantitative estimation of carbohydrate, total protein, lipid, cholesterol, DNA, and RNA.
8. Chemical analysis of urine for the presence of urea, sugar, proteins, and ketone bodies.
9. Determination of protein by PAGE.
10. Analysis of enzyme activities of LDH, alkaline phosphatase, α-amylase.
11. Preparation of permanent slides of chick embryo of different incubation periods.

Reference Books:

1. Basic Human Genetics: Mange and Mange, Sinauer Assoc
2. The Principles of Clinical Cytogenetics: Gersen & Keagle , Humana
3. Human Molecular Genetics 4th Ed.: Strachan and Read, Wiley
4. An Introduction to Molecular Human Genetics: Pasternak, Fritzgerald
5. Molecular Biology in Medicine: Cox and Sinclair, Blackwell
6. Genes in Medicine: Rasko and Downes, Kluwer
7. Principles & Practice of Medical Genetics: Rimoin et al, Churchill
8. Clinical Genetics Handbook: Robinson and Linden, Blackwell
9. Molecular Biotechnology: Primrose, Panima
10. Molecular Cloning: Sambrook et al, CSHL
11. Gene Cloning and DNA Analysis - An Introduction: T.A. Brown, Blackwell
12. Biochemistry with clinical correlation- Thomas Devlin, 2nd ed, John Wiley and sons
13. Practical Biochemistry, Principles, and Techniques (1995). Ed. Keith Wilson and John Walker
14. Molecular biology of the Cell –Bruce Albert Pub. By Garland Pub. Inc. New York & London.
15. Molecular Cell biology – Lodish Berk, Matsudaira, Kaiser, Krleger (2004) pub. By W, H. Freeman & Company, New York.
16. Molecular cell biology – Gerald carp (2005) pu. By John Wiley &Sons
17. Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell, Taylor & Francis Group, New York, USA.

COURSES OF STUDY FOR FYUGP IN **"ZOOLOGY" MINOR**

MINOR COURSE-1A (SEM-I)

I. MINOR COURSE- MN 1A: INTRODUCTORY ZOOLOGY

Marks: 15 (5 Attd. + 10 SIE: 1Hr) + 60 (ESE: 3Hrs) = 75	Pass Marks: Th (SIE + ESE) = 30

(Credits: Theory-03) **45 Hours**

Course Learning Outcomes:

1. A general concept of the animal world
2. Awareness of students regarding biological mechanism of various processes, functions as well evolutionary significance could be learnt
3. Students will acquire knowledge about the cell in detail along with the different organelles
4. Will understand their own body processes
5. Will get an idea about origin of life and evolution.

Course Content:

UNIT I: (07 Lectures)

General Introduction to Animal World, Need of Classification, General idea of Classification and Taxonomy, Cell theory.

UNIT II: (13 Lectures)

Cell- Structure, Cell theory. Difference between Prokaryotic and Eukaryotic cells
An overview of various cell organelles, including detailed structure of Mitochondria, Golgi body, Endoplasmic Reticulum, Nucleus, Ribosome, and their significant feature. (Any three)

UNIT III: (05 Lectures)

A general introduction to human physiology.

UNIT IV: (05 Lectures)

Basic structure of DNA and RNA,

UNIT V: (05 Lectures)

Mendel's law of Inheritance and variation.

UNIT VI: (03 Lectures)

Evolution: Lamarck's Inheritance theory, Darwin's natural selection theory mutation theory.

UNIT VII: (07 Lectures)

General concept of Ecology, Ecosystem and its various components.

Reference book:

1. Modern text book of Zoology, Invertebrate: R.L Kotpal
2. Modern text book of Zoology: R.L Kotpal
3. Cell Biology: H.C Nigam, Vishal publication
4. Animal physiology: H.C Nigam
5. Evolution and Environmental Biology: H.C Nigam
6. Zoology for degree students: V.K Aggrawal, S. Chand

II. MINOR COURSE- MN 1A PR:
MINOR PRACTICALS-1A PR

Marks: Pr (ESE: 3Hrs) = 25	Pass Marks: Pr (ESE) = 10

(Credits: Practicals-01) **30 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 15 marks
Practical record notebook = 05 marks
Viva-voce = 05 marks

Practicals:

1. Study of Permanent slides.
2. *Amoeba, Paramecium, Sycon, Ascaris*, Starfish, wall lizard, frog, Columba Bat, Kidney (T.S Mammal) liver, Pancreas, Ovary, Testis.
3. Homologous and Analogous organs.
4. Project on Food chain

Suggested Books.

1. Animal Diversity (Biology of Invertebrates) -Pechnik
2. Cell Biology: De Roberties
3. Cell Biology: Ambrose
4. Cell Biology: C.B. Powar
5. Physiology: Gyton
6. Evolution: V.B. Rastogi
7. Ecology: M.C. Dash, P.D. Sharma

MINOR COURSE-1B (SEM-III)

III. MINOR COURSE- MN 1B:
ANIMAL DIVERSITY

Marks: 15 (5 Attd. + 10 SIE: 1Hr) + 60 (ESE: 3Hrs) = 75	Pass Marks: Th (SIE + ESE) = 30

(Credits: Theory-03) **45 Hours**

Course Learning Outcomes:

1. Develop understanding on the diversity of life with regard to protista, non-chordates and chordates
2. Grouping of animals on the basis of their morphological characters.
3. will be able to examine evolutionary history of a taxon

Course Content:

UNIT I: Kingdom Protista (03 Lecture)

General characters and classification up to classes; Locomotary Organelles and locomotion in Protozoa

UNIT II: Phylum Porifera (03 Lecture)

General characters and classification up to classes; Canal System in Sycon 3

UNIT III: Phylum Cnidaria (03 Lecture)

General characters and classification up to classes; Polymorphism in Hydrozoa

UNIT IV: Phylum Platyhelminthes (03 Lecture)

General characters and classification up to classes; Life history of Taeniasolium

UNIT V: Phylum Nemathelminthes (03 Lecture)

General characters and classification up to classes; Life history of Ascarislumbricoides and its parasitic adaptations

UNIT VI: Phylum Annelida (03 Lecture)

General characters and classification up to classes; Metamerism in Annelida

UNIT VII: Phylum Arthropoda (03 Lecture)

General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

UNIT VIII: Phylum Mollusca (02 Lecture)

General characters and classification up to classes; Torsion in gastropods

UNIT IX: Phylum Echinodermata (03 Lecture)

General characters and classification up to classes; Water-vascular system in Asteroidea

UNIT X: Protochordates (04 Lecture)

General features and Phylogeny of Protochordata

UNIT XI: Agnatha (04 Lecture)

General features of Agnatha and classification of cyclostomes up to classes

UNIT XII: Pisces (04 Lecture)

General features and Classification up to orders; Osmoregulation in Fishes

UNIT XIII: Amphibia **(06 Lecture)**

General features and Classification up to orders; Parental care

UNIT XIV: Reptiles **(06 Lecture)**

General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

UNIT XV: Aves **(05 Lecture)**

General features and Classification up to orders; Flight adaptations in birds

UNIT XVI: Mammals **(05 Lecture)**

Classification up to orders; Origin of mammals

Reference Books:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The
2. Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
4. Pough H. Vertebrate life, VIII Edition, Pearson International.
5. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
6. Pechnek, J.A.2000. Biology of Invertebrates. Tata McGraw-Hill Publishing Company.

IV. MINOR COURSE- MN 1B PR: MINOR PRACTICALS-1B PR

Marks: Pr (ESE: 3Hrs) = 25	Pass Marks: Pr (ESE) = 10

(Credits: Practicals-01) **30 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 15 marks
Practical record notebook = 05 marks
Viva-voce = 05 marks

Practicals:

Study of the following specimens:

1. Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taeniasolium, Male and female Ascarislumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis.
2. Any six common birds from different orders, Sorex, Bat, Funambulus, Loris

Study of the following permanent slides:

1. T.S. and L.S. of Sycon
2. Study of life history stages of Taenia
3. T.S. of Male and female Ascaris
4. Key for Identification of poisonous and non-poisonous snakes

Reference Books:

1. Invertebrate Practical: S. Lal
2. Vertebrate Practical: S. Lal
3. A manual of practical Zoology Invertebrate: Dr. P.S. Verma
4. An advanced laboratory manual of Zoology – T. Poddar, S. Mukhopadhyay, S.K. Das

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MINOR COURSE-1C (SEM-V)

V. MINOR COURSE- MN 1C:
FOOD NUTRITION AND HEALTH

Marks: 15 (5 Attd. + 10 SIE: 1Hr) + 60 (ESE: 3Hrs) = 75	Pass Marks: Th (SIE + ESE) = 30

(Credits: Theory-03) **45 Hours**

Course Learning Outcomes:

1. Will understand the role of food and nutrition in health and diseases
2. Implement strategies for food acess, procurement, preaparation and Strategy.

Course Content:

UNIT I: Nutrition and dietary nutrients (10 Lecture)

Basic concept of Food: Components and nutrients. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.

UNIT II: Macro nutrients and micronutrients (10 Lecture)

Nutritional Biochemistry: Macronutrients. Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role. Micronutrients. Vitamins- Water-soluble andFat- soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.

UNIT III: Malnutrition and nutrient deficiency diseases (20 Lecture)

Definition and concept of health: Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives, if any. Life style dependent diseases- hypertension, diabetes mellitus, and obesity-their causes and prevention. Social health problems- smoking, alcoholism, narcotics. Acquired Immuno Deficiency Syndrome (AIDS): causes, treatment and prevention. Other ailments viz., cold, cough, and fever, their causes and treatment.

UNIT IV: Diseases caused by microorganisms (20 Lecture)

Food hygiene: Potable water- sources and methods of purification at domestic level. Foodand Water-borne infections: Bacterial diseases: cholera, dysentery; typhoid fever, viral diseases: Hepatitis, Poliomyelitis etc., Protozoan diseases: amoebiasis, giardiasis; Parasitic diseases: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention. Causes of food spoilage and its prevention.

Reference Books:

1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed;; New Age International Publishers
2. Srilakshmi, B. (2002). Nutrition Science; New Age International (P) Ltd.
3. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
4. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
5. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH
6. Publishing Co. Pvt Ltd.
7. Wardlaw, G.M. and Hampl, J.S. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
8. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.
9. Manay, M.S. and Shadakshara swamy, M. (1998). Food-Facts and Principles; New Age International (P) Ltd.
1. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

VI. MINOR COURSE- MN 1C PR: MINOR PRACTICALS-1C PR

Marks: Pr (ESE: 3Hrs) = 25	Pass Marks: Pr (ESE) = 10

(Credits: Practicals-01) **30 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 15 marks
Practical record notebook = 05 marks
Viva-voce = 05 marks

Practicals:

1. Detecting adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric.
2. Estimation of Lactose in milk.
3. Study of the stored grain pests from slides/ photograph (*Sitophilusoryzae*, *Trogoderma granarium, Callosobruchuschinensis* and *Triboliumcastaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.
4. Project- Computer aided diet analysis and nutrition counselling for different age groups.

Reference Books:

1. Experimental Biology – A Laboratory Manual: Abhijit Dutta
2. Experiment on the practical control of stored Grain Insects with a Revolving Drum – Type – Heater: Andre Andant
3. Stored grain pests and their management: B.P. Khare.
4. Pests of stored grains and their management: M.C. Bhargava
5. Pest management in stored grain: S. Mohan
6. Text Book of Nutrition and Dietetics: Kumud Khanna
7. Public Health, Nutrition in developing countries: Sheila Chandar Vir

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MINOR COURSE-1D (SEM-VII)

VII. MINOR COURSE- MN 1D:
ENVIRONMENT & PUBLIC HEALTH

Marks: 15 (5 Attd. + 10 SIE: 1Hr) + 60 (ESE: 3Hrs) = 75	Pass Marks: Th (SIE + ESE) = 30

(Credits: Theory-03) **45 Hours**

Course Learning Outcomes:

After successfully completing this course, the students will be able to:

1. Understand the fundamental issues of environment.
2. Analyze different sources of environmental problems and methods of measurement of pollution.
3. Examine economic growth and quality of life.
4. Examine the microbiology of waste water treatment and its various schemes.
5. Summarise and orally present current microbiological problem areas.
6. Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
7. Know how resistance development and resistance transfer occur.
8. Understand how the immune system distinguishes self from non-self.

Course Content:

UNIT I: Introduction (10 Lecture)

Sources of Environmental hazards, hazards identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

UNIT II: Climate Change (10 Lecture)

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

UNIT III: Pollution (10 Lecture)

Air, Water, Noise pollution sources and effects, Pollution control

UNIT IV: Waste Management Technologies (15 Lecture)

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and three-mile island accident and their aftermath.

UNIT V: Diseases (15 Lecture)

Causes, Symptoms and control of Tuberculosis, Asthma, Cholera, Dengue disease, typhoid, COVID, Celiac disease, Silicosis

Reference Books:

1. Cutter, S.L., Environmental Risk and Hazards, Prentice- Hall of India Pvt. Ltd. New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental Management", Jhon Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N. Univ.
5. Press, New York, 2003.
1. Joshep F Louvar and B Diane Louver Health and Environmental Risk Ansalysis fundamentals with applications, Prentice Hall, New Jersey 1997.

VIII. MINOR COURSE- MN 1D PR: MINOR PRACTICALS-1D PR

Marks: Pr (ESE: 3Hrs) = 25	Pass Marks: Pr (ESE) = 10

(Credits: Practicals-01) **30 Hours**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 15 marks
Practical record notebook = 05 marks
Viva-voce = 05 marks

Practicals:

1. Air quality index of your city/town/village.
2. Water quality index.
3. City solid waste management survey.
4. City garbage management survey.
5. E-Disposal survey.
6. Energy survey of a house having minimum four individuals.

Reference Books:

1. Practical methods for water and Air pollution monitoring: S.K. Bhargav
2. Environmental Engineering – Water quality Test: Dr. Subhas Thanappan
3. Water Analysis: W. Fresenius
4. Integrated Solid Waste Management: George Tchobanoglous
