FYUGP

ZOOLOGY HONOURS/ RESEARCH

FOR UNDER GRADUATE COURSES UNDER RANCHI UNIVERSITY

Implemented from
Academic Session 2022-2026

Members of Board of Studies for preparing Provisional Syllabus of the Four-Year Undergraduate Programme (FYUGP)

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Head of Department 16/08/2022

Contents

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.

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.

ACADEMIC CALENDAR

- 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:
  - a Certificate after completing 1 year (2 semesters) of study in the chosen fields of study,
  - a Diploma after 2 years (4 semesters) of study,
  - a Bachelor after a 3-year (6 semesters) programme of study,
  - a Bachelor (with Hons. / Research) after a 4-year (8 semesters) programme of study

VALIDITY OF REGISTRATION

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

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 AND SPAN PERIOD

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. However, it will be necessary to procure pass marks in each of the paper before completion of the course.
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 16 papers out of the total 22 papers.
v. Eligibility to get entry in Semester VII is to secure a minimum of 7.5 CGPA up to semester VI along with other criteria imposed by the Institution.

PUBLICATION OF RESULT

- The result if 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 = 176]

	Common Courses (29)									Introductory Courses (15)				Minor** (32)		Research Courses (18)				Total Credit
Semester	Language and Communication Skills (Modern Indian Language including TRL) (6)	Language and Communication Skills (English) (6)	Environmental Studies (3)	Understanding India (2)	Health & Wellness, Yoga Education, Sports & Fitness (2)	Digital Education (3)	Mathematical & Computational Thinking and Analysis (2)	Value-Based Course/ Global Citizenship Education (2)	Community Engagement/ NCC/ NSS/ (3)	Introductory Courses [Natural Sc./ Humanities/ Social Sc./Commerce] (9)	Introductory Course [Vocational Studies] (6)	**Internship/ Project (4)**	**Major* (54) + Adv. Major (24)**	Natural Sc./ Humanities/ Social Sc./ Commerce (18)	Vocational Studies (14)	Research Methodology Courses (6)	Research Proposal, Review of literature (4)	Research Internship/ Field Work (4)	Preparation of the Research Project Report (4)	**176**
1	2	3	4	5	6	7	8			9	10	11	14	15	16	17	18	19	20	21
I	6			2	2					3	3		6							**22**
II		6					2	2		3	3		6							**22**
Exit Point: Undergraduate Certificate																				
III			3			3			3	3		4	6							**22**
IV													6+6	6	4					**22**
Exit Point: Undergraduate Diploma																				
V													6+6	6	4					**22**
VI													6+6	6	4					**22**
Exit Point: Bachelor's Degree																				
VII													6+6 (Adv. Topics)			6	4			**22**
VIII													6+6 (Adv. Topics)		2			4	4	**22**
Exit Point: Bachelor's Degree with Hons. /Research																				

*There will be four disciplinary areas: A-Natural Science, B-Humanities, C-Social Science, and D-Commerce; each having basket of courses. A student will have to select a 'Major' from any of the four disciplinary areas (out of A, B, C & D). The selection for admission will be primarily based on availability of seats in Major and marks imposed by the institution.

**A student has to select three subjects for 'Introductory Regular Courses' from a pool of subjects associated with the Major offered by the institution. One of the three subjects will continue as 'Minor' from semester IV onwards, based on the academic interest and performance of the student..

Session 2022-26 onwards

COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME

Table 2: Course structure for Undergraduate Certificate Programme *[May Exit after Sem.-II]*

Semester	Common Courses			Introductory Courses		Major	Total Credits
Sem.-I	LCS (MIL/TRL) (6 Credits)	Understanding India (2 Credits)	Health & Wellness, Yoga Education, Sports & Fitness (2 Credits)	IRC-1 (3 Credits)	IVS-1A (3 Credits)	MJ-1 (6 Credits)	**(22)**
Sem.-II	LCS (English) (6 Credits)	Global Citizenship Education (2 Credits)	Mathematical & Computational Thinking (2 Credits)	IRC-2 (3 Credits)	IVS-1B (3 Credits)	MJ-2 (6 Credits)	**(22)**

Total = 44 Credits

(LCS: Language and Communication Skills; MIL: Modern Indian Languages; TRL: Tribal Regional Languages; IRC: Introductory Regular Courses; IVS: Introductory Vocational Studies, MJ: Major)

Table 3: Course structure for Undergraduate Diploma Programme *[May Exit after Sem.-IV]*

Semester	Common Courses			Introductory	Major Courses Credits	Minor	Internship/ Project	Vocational	Total
Sem.-III	Environmental Studies (3 Credits)	Community Engagement/ NCC/ NSS (3 Credits)	Digital Education (3 Credits)	IRC-3 (3 Credits)	MJ-3 (6 Credits)		Internship/ Project (4 Credits)		**(22)**
Sem.-IV					MJ-4, MJ-5 (6+6=12 Credits)	MN-1 (6 Credits)		VS-1 (4 Credits)	**(22)**

Total = 88 Credits

(MN: Minor; VS: Vocational Studies)

Table 4: Course structure for Bachelor's Degree Programme *[May Exit after Sem.-VI]*

Semester	Major Courses	Minor Courses	Vocational	Total Credits
Sem.-V	MJ-6, MJ-7 (6+6 = 12 Credits)	MN-2 (6 Credits)	VS-2 (4 Credits)	**(22)**
Sem.-VI	MJ-8, MJ-9 (6+6= 12 Credits)	MN-3 (6 Credits)	VS-3 (4 Credits)	**(22)**

Total = 132 Credits

Table 5: Course structure for Bachelor's Degree with Hons./Research Programme

Semester	Advance Courses	Research Courses		Vocational	Total Credit
Sem.-VII	AMJ-1, AMJ-2 (6+6=12 Credits)	Research Methodology (6 Credits)	Research Proposal (4 Credits)		**(22)**
Sem.-VIII	AMJ-3, AMJ-4 (6+6=12 Credits)	Research Int./Field Work (4 Credits)	Research Report (4 Credits)	VSR (2 Credits)	**(22)**

Total = 176 Credits

(AMJ: Advance Major; VSR: Vocational Studies associated with Research)

Table 6: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		
	Code	Papers	Credits
I	CC-1	Language and Communication Skills (Modern Indian language including TRL)	6
	CC-2	Understanding India	2
	CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2
	IRC-1	Introductory Regular Course-1	3
	IVS-1A	Introductory Vocational Studies-1	3
	MJ-1	Major paper 1 (Disciplinary/Interdisciplinary Major)	6
II	CC-4	Language and Communication Skills (English)	6
	CC-5	Mathematical & Computation Thinking Analysis	2
	CC-6	Global Citizenship Education & Education for Sustainable Development	2
	IRC-2	Introductory Regular Course-2	3
	IVS-1B	Introductory Vocational Studies-2	3
	MJ-2	Major paper 2 (Disciplinary/Interdisciplinary Major)	6
III	CC-7	Environmental Studies	3
	CC-8	Digital Education (Elementary Computer Applications)	3
	CC-9	Community Engagement & Service (NSS/ NCC/ Adult Education)	3
	IRC-3	Introductory Regular Course-3	3
	IAP	Internship/Apprenticeship/ Project	4
	MJ-3	Major paper 3 (Disciplinary/Interdisciplinary Major)	6
IV	MJ-4	Major paper 4 (Disciplinary/Interdisciplinary Major)	6
	MJ-5	Major paper 5 (Disciplinary/Interdisciplinary Major)	6
	MN-1	Minor Paper 1 (Disciplinary/Interdisciplinary Minor)	6
	VS-1	Vocational Studies-1 (Minor)	4

V	MJ-6	Major paper 6 (Disciplinary/Interdisciplinary Major)	6
	MJ-7	Major paper 7 (Disciplinary/Interdisciplinary Major)	6
	MN-2	Minor Paper 2 (Disciplinary/Interdisciplinary Minor)	6
	VS-2	Vocational Studies 2 (Minor)	4
VI	MJ-8	Major paper 8 (Disciplinary/Interdisciplinary Major)	6
	MJ-9	Major paper 9 (Disciplinary/Interdisciplinary Major)	6
	MN-3	Minor Paper 3 (Disciplinary/Interdisciplinary Minor)	6
	VS-3	Vocational Studies 3 (Minor)	4
VII	AMJ-1	Advance Major paper 1 (Disciplinary/Interdisciplinary Major)	6
	AMJ-2	Advance Major paper 2 (Disciplinary/Interdisciplinary Major)	6
	RC-1	Research Methodology	6
	RC-2	Research Proposal	4
VIII	AMJ-3	Advance Major paper 3 (Disciplinary/Interdisciplinary Major)	6
	AMJ-4	Advance Major paper 4 (Disciplinary/Interdisciplinary Major)	6
	RC-3	Research Internship/Field Work	4
	RC-4	Research Report	4
	VSR	Vocational Studies (Associated with Research)	2
		Total Credit	**176**

Abbreviations:

CC Common Courses
IRC Introductory Regular Courses
IVS Introductory Vocational Studies
IAP Internship/Apprenticeship/ Project
VS Vocational Studies
MJ Major Disciplinary/Interdisciplinary Courses
MN Minor Disciplinary/Interdisciplinary Courses
AMJ Advance Major Disciplinary/Interdisciplinary Courses
RC Research Courses
VSR Vocational Studies associated with Research

Table 7: Semester wise Examination Structure in Discipline Courses:

Semester	Common, Introductory, Major, Minor, Vocational & Internship 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	6	15	60	25
II	MJ-2	Ecology and Biochemistry	6	15	60	25
III	MJ-3	Cell Biology and Biostatistics	6	15	60	25
IV	MJ-4	Animal Physiology	6	15	60	25
	MJ-5	Comparative Anatomy	6	15	60	25
V	MJ-6	Molecular Biology	6	15	60	25
	MJ-7	Genetics & Ehtology	6	15	60	25
VI	MJ-8	Developmental Biology	6	15	60	25
	MJ-9	Evolution	6	15	60	25
VII	AMJ-1	A. Endocrinology B. Wildlife Conservation and Management	6	15	60	25
	AMJ-2	A. Immunology B. Mammalian Physiology	6	15	60	25
	RC-1	Research Methodology	6	25	75	---
	RC-2	Research Proposal	4	25	75	---
VIII	AMJ-3	Insecta	6	15	60	25
	AMJ-4	Fish & Fisheries	6	15	60	25
	RC-3	Research Internship/Field Work	4	---	---	100
	RC-4	Research Report	4	---	---	100
	VSR	Vocational Studies (Associated with Research)	2	---	---	100
		Total Credit	**98**			

Table 8: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure			
	Code	Papers	Credits	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I/ II/ III	IRC	Introductory Zoology	3	---	100	---
IV	MN-1	Animal Diversity	6	15	60	25
V	MN-2	Food Nutrition and Health	6	15	60	25
VI	MN-3	Environment & Public Health	6	15	60	25
		Total Credit	**21**			

AIMS OF BACHELOR'S DEGREE PROGRAMME IN ZOOLOGY

The aim of bachelor's degree programme in Zoology are as follows:

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 relation with the animals is, we need to understand their behaviour, population dynamics, physiology and the way 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 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 extent that a student at B.Sc. level can be a specialist in immunology, ornithology, animal behaviour or entomology. For such specializations, the curriculum needs to focus on special skills to maximise the students' employment probability; for example, few skills needed 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 programme learning outcomes relating to Honours/Research Degree in Zoology:

Knowledge and Understanding

Demonstrate:

(i) in-depth knowledge and understanding about 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 were able to find many differences within the same breed of an 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 with 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 for animal welfare.
- Understand fundamental aspects of animal science relating to 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 subject. In brief, the students graduated with this type of curriculum would be able to disseminate subject knowledge along with 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 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 I

I. MAJOR COURSE –MJ 1: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

NON –CHORDATES AND CHORDATES

Theory: 60 Lectures

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

UNIT I: Kingdom Protista (04 Lecture)

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

UNIT II: Phylum Porifera, Cnidaria, Ctenophora. (04 Lecture)

1. General characters and classification upto class
2. Canal system in Porifera
3. Coral and coral Reef formation.
4. Alteration of Generation in cnidarian.

5. Evolutionary significance of ctenophore

UNIT III: Helminthes **(04 Lecture)**

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

UNIT IV: Annelida **(04 Lecture)**

1. Segmentation in Annelids
2. Origin of coelom

UNIT V: Arthropoda **(04 Lecture)**

1. General characters, Classification upto class
2. vision in Arthropods, Appendages in Arthropods

UNIT VI: Mollusca **(05 Lecture)**

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

UNIT VII: Echinodermata **(05 Lecture)**

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

GROUP B

Chordates (Pisces to Mammals)

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

Introduction to chordates and its origin general characters and outline classification

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

1. General characters of Hemichordates Urochordates and Cephalochordates.

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

General characters and classification of cyclostomes.

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

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

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

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

UNIT VI: Reptilia **(04 Lecture)**

Poison apparatus and Biting mechanism in snakes.

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

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

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

General characters and classification up to classes, 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.
9. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

ZOOLOGY PRACTICAL- MJ 1 LAB

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

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: **60 Lectures**

GROUP A

1. Study of whole mount of Euglena, Amoeba and Paramecium; Binary fission and Conjugation in Paramecium. Sycon (including T.S. and L.S.), Obelia, Physalia Aurelia, Gorgonia, Metridium, Pennatula, Aphrodite, Nereis, Heteronereis, Pheretima, Hirudinaria, Sacculina, Cancer, Pila,Unio, Asterias, Antedon
2. Study of adult Fasciola hepatica, Taeniasolium and their life cycles (Slides/micro-photographs)
3. Study of adult Ascari slumbricoides and their life stages (Slides/micro-photographs)
4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta.

GROUP B

1. Study of Museum specimen: Petromyzon, Myxine, Scoliodon, Heteropneustes, Labeo, Exocoetus, Hippocampus, Tetrodon, Bufo, Hyla, Alytes, Salamandra, Uromastix, Draco, Vipera, Naja, Hydrophis, Columba, Bat
2. Types of beaks and claws

SEMESTER II

I. MAJOR COURSE- MJ 2: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

ECOLOGY AND BIOCHEMISTRY

Theory: 60 Lectures

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 Ecology: (06 Lecture)

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

UNIT III: Community Ecology: (06 Lecture)

1. Community Characters, Analytical and synthetic characters
2. Community Diversity Indices
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. Glycohysis, Kreb's cycle, ETS and ATP synthesis.
2. Glycogenesis, Gluconeosis. 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. 1.Raziuddin, M.., Mishra P.K. 2014, A Handbook of Environmental Studies, Akanaksha Publications,

Ranchi.
2. 2.Mukherjee, B. 2011: Fundamentals of Environmental Biology.Silverline Publications, Allahabad.
3. 3.Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
4. 4.Gadgil, M., &Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
5. 5.Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.
6. 6.Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
7. 7.Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
8. 8.Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36--37.
9. 9.McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29--64). Zed Books.
10. 10.McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
11. 11.Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.

Group B

1. 1.Cox, M.M and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
2. 2.Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
3. 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. 4.Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

ZOOLOGY PRACTICAL- MJ 2 LAB:

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

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: 60 Lectures

GROUP A

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided'
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. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

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.

SEMESTER III

1. MAJOR COURSE- MJ 3: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

CELL BIOLOGY AND BIOSTATISTICS

Theory: 60 Lectures

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

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

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

UNIT II: Endoplasmic reticulum, Nucleus. Ribosome, Lysosome **(05 Lecture)**

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

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

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

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

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

UNIT VII: Types of culture media: Sterlization methods **(08 Lecture)**

Somatic cell hybridization.

GROUP B:

Biostatistics **(10 Lecture)**

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, Regression Analysis.
3. Basics of statistics software – SPSS 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.

ZOOLOGY PRACTICAL- MJ 3 LAB:

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

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: 60 Lectures

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 Mercurobromophenol blue/Fast Green.

GROUP B

1. Calculation of mean, standard deviation and standard error.
2. Calculation of correlation coefficient values 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.
5. Suggested Readings:

SEMESTER IV

I. MAJOR COURSE- MJ 4: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

ANIMAL PHYSIOLOGY

Theory: 60 Lectures

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.
4. Develop an understanding of the related disciplines, such as cell biology, neurophysiology, pharmacology, biochemistry etc.
5. Get a flavor of research besides improving their writing skills and making them well versed with the current trends.
6. 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, Mechaninal 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

ZOOLOGY PRACTICAL- MJ 4 LAB:

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

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: 60 Lectures

1. Recording of simple muscle twitch with electrical stimulation (or virtual).
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells.
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
5. Microtome: Preparation of permanent slide of mammalian tissues.

II. MAJOR COURSE- MJ 5: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

COMPARATIVE ANATOMY

Theory: 60 Lectures

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: Integumentary System (06 Lecture)
Structure Function and Derivatives of integument

UNIT II: Skeletal System (07 Lecture)
An Overview of Axial and Appendicular Skeleton, Jaw suspensorium

UNIT III: Digestive System (07 Lecture)
Alimentary Canal and associated gland, Dentition

UNIT IV: Respiratory System (08 Lecture)
Skin, Gills, Lungs, Air Sacs and accessory respiratory organs

UNIT V: Circulatory System (08 Lecture)
Evolution of Heart and Aortic arches, General plan of Circulation

UNIT VI: Urinogenital System (08 Lecture)

Succession of Kidney, Evolution of Urinogenital duct

UNIT VII: Nervous system (08 Lecture)

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

UNIT VIII: Sense Organs (08 Lecture)

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.
5. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

ZOOLOGY PRACTICAL- MJ 5 LAB:

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

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: 60 Lectures

1. Study of placoid, cycloid and ctenoid scales through permanent slides/ photographs.
2. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit.
3. Carapace and plastron of turtle/ tortoise.
4. Mammalian skulls: One herbivorous and one carnivorous animal.
5. Dissection of rat to study arterial and urinogenital system (subject to permission digital mode)
6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video
7. Recording (may be included if dissection not permitted).
8. Project on skeletal modifications in vertebrates (may be included if dissection not permitted).

SEMESTER V

I. MAJOR COURSE- MJ 6: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

MOLECULAR BIOLOGY

Theory: 60 Lectures

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: DNA- Chemistry of nucleic acids (DNA & RNA): (08 Lecture)

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 E. coli: (08 Lecture)

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)

UNIT III: Transcription in E. coli: (08 Lecture)

Consensus sequences, Promoter (-35 & -10 elements), RNA polymerase, Phases- initiation, elongation and termination. RNA processing of mRNA.

UNIT IV: RNA: (08 Lecture)

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 Lecture)

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

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

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

UNIT VII: Gene recombination: (05 Lecture)

Homologous recombination.

UNIT VIII: Operon concept: (05 Lecture)

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

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

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

Reference Books:

1. Lenhinger 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. Molecular biology of cancer: Lecorino, Oxford University Press, UK.

ZOOLOGY PRACTICAL- MJ 6 LAB:

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

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: 60 Lectures

1. Study of polytene chromosomes from Chironomus / drosophila larvae.
2. Preparation of liquid culture medium (LB) and raise culture of E. coli.
3. Estimation of the growth kinetics of E. coli by turbidity method.
4. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking.
5. Demonstration of antibiotic sensitivity/resistance of E. coli to antibiotic pressure and interpretation of results.
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).
7. Quantitative estimation of RNA using Orcinol reaction.
8. Study and interpretation of electron micrographs/ photograph showing
    i. DNA replication
    ii. Transcription
    iii. Split genes

II. MAJOR COURSE- MJ 7: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

GENETICS & EHTOLOGY

Theory: 60 Lectures

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. • Develop skills, concepts and experience to understand all aspects of animal behaviour.
8. Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
9. 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. **(05 Lecture)**

UNIT II: Linkage:

Coupling & repulsion hypothesis, Morgan's view of linkage, kinds of linkage, Chromosomal theory of linkage, Human chromosomal maps. **(05 Lecture)**

UNIT III: Crossing over or Gene recombination:

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

UNIT IV: Eukaryotic Chromosomes:
Structure & chemical composition of chromosomes. Karyotype, Ideogram, Human karyotype, Lampbrush chromosome **(06 Lecture)**

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 Lecture)**

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

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). **(06 Lecture)**

UNIT VIII: Mutation:
Historical background, Mutagens, Chromosomal mutation & gene mutation, Chromosomal aberrations in humans, Euploidy& aneuploidy. **(06 Lecture)**

GROUP B: Ethology

UNIT I: General concepts of Ethology:
Motivation; Fixed Action Pattern, Imprinting **(02 Lecture)**

UNIT II: Behaviour and its types:
Individual and social interaction, Social organization, Innate and learned behavior, (**04 Lecture)**

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

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

Reference Books:

GROUP A

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

ZOOLOGY PRACTICAL- MJ 7 LAB:

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

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: 60 Lectures

GROUP A

1.To study the Mendelian laws and gene interactions.
2.Chi- square analyses using seeds/beads/Drosophila.
3.Linkage maps based on data from conjugation, transformation and transduction.
4.Linkage maps based on data from Drosophila crosses.
5.Study of human karyotype (normal and abnormal).
6.Pedigree analysis of some human inherited traits.

GROUP B

1. Nesting Behaviour, types of nest
2. Study of Migration Behavior(virtual)
3. Social Behaviour in Honey Bee/Termite

SEMESTER VI

I. MAJOR COURSE- MJ 8: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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.*

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

DEVELOPMENTAL BIOLOGY Theory: 60 Lectures

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 (20 Lecture)

1. Basic concept of Development- Potency, Commitment, Specification, Induction, Competence.
2. Phase of Development: Embryogenesis, Organogenesis, Blastogenesis in sea urchin & chick.
3. Period of Development: Embroynic period, Post embryonic period.
4. History of Embryology: Baer's law, theory of preformation, theory of epigenesist, mosaic theory.
5. Pattern & axes formation in amphibian.
6. Differential gene expression: cytoplasmic determinants and asymmetric cell division.

UNIT II: Early Embryonic Development (20 Lecture)

1. Gametes: sperm or male gametes: types of sperms, Eggs or Female gametes: types of eggs.

2. Gametogenesis: Spermatogenesis, Oogenesis.
3. Egg membranes.
4. Fertilization (External sea urchin and Internal Chick) & its mechanism.
5. Planes and patterns of cleavage.
6. Types of Blastula.
7. Fate Maps
8. Early development of frog and chick up to gastrulation.

UNIT III: Late Embryonic Development (05 Lecture)

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

UNIT IV: Post embryonic Development (10 Lecture)

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

UNIT V: Implications of Developmental Biology (05 Lecture)

1. Teratogensis: Teratogenic agents and their effect on embryonic development.
2. In vitro: fertilization (IVF)
3. Embryonic stem cells (Esc)
4. Amniocentesis.

Reference Books:

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

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ZOOLOGY PRACTICAL- MJ 8 LAB:

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

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: 60 Lectures

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of different types of placenta (photomicrograph/ slides)
4. Project report on chick embryo development.

II. MAJOR COURSE- MJ 9: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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.*

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

EVOLUTION Theory: 60 Lectures

Learning outcomes

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

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

Course Content:

UNIT I: Introduction to Evolutionary Theories (06 Lecture)

1. History of Evolution.
2. Historical review of evolutionary concept:
3. Lamarkism, Darwinism, Mordern synthetic theory

UNIT II: Evidence of Evolution (10 Lecture)

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

UNIT III: Process of Evolutionary change (06 Lecture)

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

UNIT IV: Principles of Population genetics (10 Lecture)

1. Population genetics.

2. Hardy – Weinberg law (statement and derivation of equation, application of law to human population)
3. Evolutionary forces upsetting H-W equilibrium
4. Natural selection
5. Genetic Drift

UNIT V: Species concept (10 Lecture)

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

UNIT VI: Extinctions (06 Lecture)

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

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

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

UNIT VIII: Phylogenetic trees (06 Lecture)

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. 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.

ZOOLOGY PRACTICAL- MJ 9 LAB:

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

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: 60 Lectures

1. Study of fossil evidences from plaster cast models and pictures.
2. Study of homology and analogy from suitable specimens/ pictures.
3. Study and verification of Hardy – Weinberg Law by chi – square analysis.
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies.
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic tree with the help of bioinformatics tools (Clustal X and Phylip) and its interpretation.

SEMESTER VII

I. ADVANCE MAJOR COURSE- AMJ 1A: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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*

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

ENDOCRINOLOGY

Theory: 60 Lectures

Learning outcomes

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

1. Understand neurohormones and neurosecretions.
2. Learn about hypothalamo and hypapophysial axis.
3. Understand about different endocrine glands and their disorders.
4. Understand the mechanism of hormone action.

Course Content:

UNIT I: Introduction to Endocrinology (05 Lecture)

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

UNIT II: Epiphysis, Hypothalamo- hypophysial Axis. (20 Lecture)

1. Structure of the pineal gland, secretions and their function in biological rhythms and reproduction.
2. Structure of hypothalamus, hypothalamic nuclei and their functions, Regulatoin of neuroendocrine glands.
3. Structure of pituitary gland, hormones of pituitary gland and their functions.
4. Hypothalamo- hypophysial portal system.
5. Hypothalamic control of adenohypophysis

UNIT III: Structure and functions of endocrine glands in Mammals. (20 Lecture)

1. Structure, hormones, functions and regulation of endocrine glands:

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

UNIT IV: Mechanism of Hormone Action (10 Lecture)

1. General mechanism of hormone action
2. Regulation of Hormone action: Hormone action at cellular level, Hormone receptors, Transduction and regulation of hormone action at molecular level, molecular mediators, genetic control of hormone action

UNIT V: Hormonal dysfunction and diseases (05 Lecture)

1. Dwarfism and acromegaly
2. Goiter
3. Addison's disease
4. Diabetes mellitus

ZOOLOGY PRACTICAL- AMJ 1A LAB:

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

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: 60 Lectures

1. Handling, sexing, numbering and maintenance of rat.
2. Dissection and demonstration of endocrine glands in laboratory bred rat.
3. Study of vaginal smear preparation of rat.
4. Demonstration of following surgical operations in laboratory bred rat:
   a. Orchidectomy b. Ovariectomy C. Tubectomy
5. Study of permanent histological slides of following endocrine glands in rat: Pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary.
6. Estimation of plasma level of any hormone using ELISA.
7. Compensatory ovarian hypertrophy in vivo bioassay in laboratory bred rat.
8. Group discussion and seminar presentation on related topics.

OR

ADVANCE MAJOR COURSE- AMJ 1B: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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*

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

WILDLIFE CONSERVATION AND MANAGEMENT

Theory: 60 Lectures

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. Develop an understanding of how animals interact with each other and their natural environment
2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues
3. Develop the ability to work collaboratively on team-based projects
4. Demonstrate proficiency in the writing, speaking, and critical thinking skills needed to become a wildlife technician
5. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management
6. Develop an ability to analyze, present and interpret wildlife conservation management information.

Course Content:

UNIT I: Value of wildlife and need for its conservation (20 Lecture)

Definition, value and importance of wildlife; Types of ecosystems. Causes of depletion of wildlife; Inventory and classification of wetland and animal inhabitants; Population vulnerability analysis and its components; Factors responsible for the extinction of animals; Types of protected areas and the concept of zoning within the protected areas; 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 (20 Lecture)

Wildlife conservation, ethics and importance of conservation; Impact of topography, geology, soil and water on wildlife; Impact of habitat destruction and fragmentation on wildlife; Biological parameters such as food, cover, forage and their impact on wild life; Population attributes; concepts of exponential and logistic growth rates of wildlife; 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, hair identification, pug marks and census methods. Predator-prey models and impact of predation.

UNIT III: Wildlife Conservation (20 Lecture)

Wildlife conservation objectives- strategies and issues; Captive breeding techniques and translocation and reintroduction; Inviolate area and critical habitats and their impact on wildlife; Different terrestrial habitats of wildlife in India; Restoration of degraded habitat; Damage caused by wildlife in India and its mitigation; Sick animal refuges in protected areas.

UNIT IV: Rehabilitation and management (20 Lecture)

Type of wildlife management-manipulative, custodial; Management of over abundant wild animal populations causing damages to nearby inhabitants and their crops and animals; Tools and techniques to control the menace of wild animals; man wildlife conflict resolution and mitigation; Management of 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.

ZOOLOGY PRACTICAL- AMJ 1B LAB:

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

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: 60 Lectures

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. Familiarization and study of animal evidences in the field; 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. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences). Group discussion or Seminar presentation on one or two related topics from the list

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II. ADVANCE MAJOR COURSE- AMJ 2A: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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*

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

IMMUNOLOGY

Theory: 60 Lectures

Learning outcomes

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

1. 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.
2. Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
3. Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities.
4. Know how resistance development and resistance transfer occur.
5. Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
6. Understand how are immune responses by T cells and B cells initiated and regulated.
7. Understand how does the immune system distinguish self from non-self.

Course Content:

UNIT I: Overview of Immune System (08 Lecture)

1. Introduction-Concept of Health & Disease.
2. Cells & Organs of the Immune System

UNIT II: Innate and Adaptive Immunity (08 Lecture)

1. Anatomical Barriers
2. Inflammation
3. Cells & Molecules involved in Innate Immunity
4. Adavtive Immununity (Cell mediated + humoral)

UNIT III: Antigens (08 Lecture)

1. Antigencity & Immunogenicity
2. Immunogens, Adjuvants and Haptens
3. Factors offending Immunogenicity
4. B and T cell Epritopes.

UNIT IV: Immunoglobulls. (08 Lecture)

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

UNIT V: Major Histocompatibility Complex (MHL) (08 Lecture)

1. Structure & function of MHC molecules.
2. Structure of T-cell receptor and its signaling.
3. T Cell development and selections

UNIT VI: Cytokines (05 Lecture)

Types, Properties and functions of Cytokines.

UNIT VII: Complement system (05 Lecture)

Components and path ways of complement activation.

UNIT VIII: Hypersensitivity (05 Lecture)

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

UNIT IX: Vaccines (05 Lecture)

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.

ZOOLOGY PRACTICAL- AMJ 2A LAB:

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

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: 60 Lectures

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Demonstration of
    i. ELISA
    ii. Immunoelectrophoreisis.

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.

OR

ADVANCE MAJOR COURSE- AMJ 2B: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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*

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

MAMMALIAN PHYSIOLOGY Theory: 60 Lectures

Learning outcomes

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

1. Understand the physiology at cellular and system levels.
2. Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient.
3. Understand how mammalian body gets nutrition from different biomolecules.
4. Understand the process of digestion and excretion.
5. Understand the organization of nervous system and process of nerve conduction.
6. Understand the process of vision and hearing.
7. Understand the process of muscle contraction.
8. Learn the determination of hemoglobin content, blood groups and blood pressure.

Course Content:

UNIT I: An overview of respiration and circulation in mammals

Respiration: Mechanism and regulation of breathing; Transport of oxygen and carbon dioxide; Respiratory quotient. Circulation: Blood buffers, blood groups, blood cells, cardiac cycle, Haemopoiesis, homeostasis.

UNIT II: An overview of digestion and excretion in mammals

Nutrition and Digestion: Balanced diet; Digestion and absorption of carbohydrates, proteins and fats; Gastrointestinal hormones: role in digestion. Excretion: Nephron; urine formation; Regulation of urine formation: role of renin, ADH, aldosterone.

UNIT III: An overview of nervous system and coordination in mammals

Nervous System: Organization, neuron and glial cells- types and structure; Synapses- types and transmission, resting membrane potential: genesis; Action potential: initiation and conduction. Vision: Structure of eye, retinal components, and photoreceptors: ionic basis of potential generation. Hearing: Structure of ear, mechanoreceptor: ionic basis of potential generation.

UNIT IV: An overview of Muscular system and muscle contraction in mammals Muscles: Types, Ultra structure of skeletal, smooth and cardiac muscles, muscle proteins; Neuromuscular junction; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch, tetanus and fatigue, isotonic and isometric contractions.

Reference Books:

1. Barret, K.; Brooks, H.; Boitano, S. and Barman, S. (2010) Review of Medical Physiology (23rd edition) Lange Medical.
2. Guyton, A.C. and Hall, J.E. (2006) A text book of Medical Physiology (11th edition) Saunders.
3. Keele, C.A. & Neil, E. (1989) Samson Oxford.

ZOOLOGY PRACTICAL- AMJ 2B LAB:

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

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: 60 Lectures

1. Preparation of temporary mounts: Blood film, Squamous epithelium, Striated muscle fibres and nerve cells.
2. Counting of white blood corpuscles and red blood corpuscles
3. Preparation of haemin crystals.
4. Estimation of haemoglobin content
5. Determination of blood groups
6. Measurement of blood pressure using sphygmomanometer
7. Determination of oxygen consumption (cockroach) of casein from milk
8. Recording of simple muscle twitch with electrical stimulation (or Virtual)
9. Demonstration of reflex action
10. Study of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney and brain cells Group discussion or Seminar presentation on one or two related topics from the list

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SEMESTER VIII

I. ADVANCE MAJOR COURSE- AMJ 3: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):

*There will be **two** groups 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. 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 Examination (ESE 60 marks):

*There will be **two** groups 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*

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

INSECTA

Theory: 60 Lectures

Learning outcomes

After completing this course, the students will be able to

1. Identify the types of insects.
2. Know the general physiology of insects.
3. Understand the importance of insects in environment.
4. Understand the interaction of insects with animal and plant kingdom.

Course Content:

UNIT I: Introduction (04 Lecture)

1. General features of insects
2. Distribution and success of Insect on earth

UNIT II: Insect Taxonomy (08 Lecture)

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

UNIT III: General Morphology of Insects (08 Lecture)

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

UNIT IV: Physiology of Insects (10 Lecture)

1. Reproductive system
2. Endocrine system

3. Nervous system
4. Sensory receptors – vision and sound receptors

UNIT V: Insect Animal Interaction (10 Lecture)

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

UNIT VI: Insect Plant Interaction (10 Lecture)

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
4. (IPM)

UNIT VII: Developmental Biology of Insects (10 Lecture)

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

Reference Books:

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

ZOOLOGY PRACTICAL- AMJ 3 LAB:

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

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: 60 Lectures

1. Study of one specimen from each insect order
3. Study of different kinds of antennae, legs and mouth parts of insects
4. Study of head and sclerites of any one insect
5. Study of insect wings and their venation.
6. Study of insect spiracles
7. Methodology of collection, preservation and identification of insects.
8. Morphological studies of various castes of Apis, Camponotus and Odontotermes
9. Study of any three insect pests and their damages
10. Study of any three beneficial insects and their products

II. ADVANCE MAJOR COURSE- AMJ 4: (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

FISH & FISHERIES

Theory: 60 Lectures

Learning outcomes

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

1. Understand and apply relevant scientific principles in the area of aquatic biology
2. Understand the basic taxonomy and physiology of fishes
3. Critically analyse, interpret and evaluate information relevant to aquatic biology
4. Appreciate the multidisciplinary nature of the study of aquatic biology and engage positively with people and ideas beyond their own discipline.
5. Explore some of the unique environmental problems dealing with aquatic environments.
6. Develop employable skills in freshwater biological water quality analysis.

Course Content:

GROUP A: Fish

UNIT I: Taxonomy of Fin Fish (08 Lecture)

1. Major taxa of inland and Marine fishes upto order.
2. Commercially important fresh water and marine fishes of India and their morphological characteristics.

UNIT II: Biology of Fin fish (10 Lecture)

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

UNIT III: Physiology of Fin fish (10 Lecture)

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

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

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

GROUP B: Fisheries

UNIT I: Inland Fisheries (04 Lecture)

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

UNIT II: Marine fishery (04 Lecture)

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

UNIT III:I: Aquaculture (10 Lecture)

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

UNIT IV: Fish technology and research (10 Lecture)

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:

1. An Introduction to the Study of Fishes – Albert C.L.G. Gunther, Discovery Publishing House, New Delhi – 110 002
2. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
3. 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
4. C.B.L. Srivastava, Fish Biology, Narendra Publishing House
5. J.R. Norman, A history of Fishes, Hill and Wang Publishers
6. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
7. Modern Ichthyology, S.M. Shafi, Inter India Publications
8. 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

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ZOOLOGY PRACTICAL- AMJ 4 LAB:

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

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: 60 Lectures

1. Collection and Identification of commercially important inland and marine fishes.
2. Visit to fish landing centres to study commercially important fishes and catch composition, Identification and collection of Eggs, fry and fingerlings of fish.
3. Study of internal organs of fish.
4. Estimation of fecundity.
5. Analysis of gut content.
6. Estimation of Age and growth by direct and indirect methods.
7. Haematology of finfish, Histological techniques.
8. Study on effect of liming, manuring and fertilization on hydrobiology of ponds and growth of fish.
9. Demonstration of induced breeding in fish (Video).
10. Collection of Aquatic weed, weed fishes and larval forms of fishes.
11. Project report on visit to any fish farm / Zebra fish rearing lab / Biofloc fish culture technique.

COURSES OF STUDY FOR **INTRODUCTORY/ MINOR ELECTIVE** FYUGP IN **"ZOOLOGY"**

SEMESTER I/ II/ III INTRODUCTORY REGULAR COURSE 1 Paper

I. INTRODUCTORY REGULAR COURSE (IRC)

(Credits: Theory-02, Practicals-01)

- All Four Introductory & Minor Papers of Zoology to be studied by the Students of **Other than Zoology Honours.**

- Students of **Zoology Honours** must Refer Content from the **Syllabus of Opted Introductory & Minor Elective Subject**.

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

INTRODUCTORY ZOOLOGY **Theory: 30 Lectures**

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

UNIT II: 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: A general introduction to human physiology.

UNIT IV: Basic structure of DNA and RNA,

UNIT V: Mendel's law of Inheritance and variation.

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

UNIT VII: General concept of Ecology, Ecosystem and its various components.

ZOOLOGY PRACTICAL- IRC LAB:

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

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: **60 Lectures**

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 Robersies
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

SEMESTER IV **MINOR ELECTIVE-1** **1 Paper**

I. MINOR ELECTIVE (MN 1) (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

ANIMAL DIVERSITY

Theory: 60 Lectures

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 (04 Lecture)

General features and Classification up to orders; Parental care

UNIT XIV: Reptiles (04 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, New

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ZOOLOGY PRACTICAL- MN 1 LAB:

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

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: 60 Lectures

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

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SEMESTER V **MINOR ELECTIVE-2** **1 Paper**

I. MINOR ELECTIVE (MN 2)) (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

FOOD NUTRITION AND HEALTH

Theory: 60 Lectures

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 Publishing Co. Pvt Ltd.
6. Wardlaw, G.M. and Hampl, J.S. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
7. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.
8. Manay, M.S. and Shadakshara swamy, M. (1998). Food-Facts and Principles; New Age International (P) Ltd.
9. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

ZOOLOGY PRACTICAL- MN 2 LAB:

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

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: 60 Lectures

1. Datecting 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.

SEMESTER VI MINOR ELECTIVE-3 1 Paper

I. MINOR ELECTIVE (MN 3)) (Credits: Theory-04, Practicals-02)

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

Instruction to Question Setter for

Semester Internal Examination (SIE 10+5=15 marks):
*There will be **two** groups 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. 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 Examination (ESE 60 marks):
*There will be **two** groups 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.*

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

ENVIRONMENT & PUBLIC HEALTH

Theory: 60 Lectures

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 does the immune system distinguish 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, Minamata disease, typhoid

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. Press, New York, 2003.
5. Joshep F Louvar and B Diane Louver Health and Environmental Risk Ansalysis fundamentals with applications, Prentice Hall, New Jersey 1997.

ZOOLOGY PRACTICAL- MN 3 LAB:

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

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: 60 Lectures

To determine pH, CI, SO_4, NO_3 in soil and water samples from different locations

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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.