

Syllabus of Zoology

(Theory and Practical)

**(Semester-wise course structure for Post-Graduation in Zoology in CSJM University,
Kanpur in accordance with guidelines of NEP-2020)**



**As approved by
Board of Studies for Zoology
C.S.J.M. University, Kanpur**

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CSJM University
M.Sc. Zoology Syllabus

Practical

1. Practical work will be based on the paper (Core or Elective) in the given semester.
2. Each practical work will be of 4 credits (or 100 marks)

Research Project in Postgraduation

- A student has to do a detailed research project in 4th and 5th year of higher education (first and second year of post-graduation)
- This research project will be based on the main subject.
- This research project can be interdisciplinary/multidisciplinary. It can also be based on industrial training/internship/survey work.
- This research project will be done under a supervisor from the institutional teaching faculty. A Co-supervisor from any industry/company/technical institute/Research Institute can also be chosen.
- A postgraduate student has to do a research project of 4 credits (4 hours per week) per semester.
- The final project report/dissertation of both semesters will be submitted at the end of the year by the student.
- The final report will be evaluated by the supervisor and an external examiner appointed by the University for 100 marks. It will have 8 credits.
- Evaluation of the project work will be done considering the project report, presentation and viva-voce.
- Students can be credited 25 extra marks if they get research papers based on projects published in UGC-CARE listed Journals during their postgraduation course. Nevertheless, the maximum marks will not exceed 100.
- Grades will be mentioned on the basis of marks obtained in the research project and they will be included in the CGPA calculations.

Minor Elective paper from other faculty

- In the first year, a PG student will have to opt for one minor elective paper from any other faculty of 4 credits.



Dr. Atul Kumar Mishra

Associate Professor

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Minutes of virtual meeting of Board of Studies, Zoology on 10.05.2022 at 6:30 PM to 07:50PM

Link provided by the Dean, Academics, CSJM, University, Kanpur

The following members were present in the meeting.

Convener:

1. **Dr. Atul Kumar Mishra**, Associate Professor, Department of Zoology, D.A-V. College, Kanpur (U.P.)

External Members:

2. **Prof. Vinoy Kumar Srivastava**, Head & Dean, Department of Zoology, Barkatullah University, Bhopal (M.P.)
3. **Prof. Ashwani Kumar Dubey**, Prof. and Head, Department of Zoology, Sri Krishna University, Chhatarpur (M.P.)
4. **Dr. A. K. Verma**, Head, Department of Zoology, Govt. P.G. College, Saidabad, Prayagraj (U.P.)

Internal Members:

5. **Dr. Sangeeta Awasthi**, Head, Department of Zoology, A.N.D. N.N.M. Mahavidyalaya, Kanpur (U.P.)
6. **Dr. Sandeep Shukla**, Associate Professor, Department of Zoology, D.B.S. College, Kanpur
7. **Dr. Yogesh Babu Dixit**, Head, Department of Zoology, Janta Mahavidyalaya P.G. College, Ajitmal, Auraiya (U.P.)
8. **Dr. Sunita Arya**, Associate Professor, Department of Zoology, D.G.P.G. College, Kanpur (U.P.)

Special Invitee Member:

9. **Dr. Deepak Kumar Dwivedi**, Assistant Professor, Department of Zoology, D.A-V. College, Kanpur (U.P.)

First of all, Dr. Atul Kumar Mishra, Convener, BOS welcomed all the members and apprised all the members about the guidelines about the NEP at PG level received so far from the University.

Dr. Sunita Arya said that research projects should be research oriented, so that along with the student, the teacher can also get its benefit. She recommended that quantitative biology and Tools and techniques should be kept in I semester because it will be useful for students in their further study.

Dr. A.K. Verma said that the curriculum should not be made by looking at the lab facility, but the lab should be upgraded on the basis of the syllabus. He also said that the level of the curriculum should not be kept very tough but it should be career oriented.

Dr. Sangeeta Awasthi said that the curriculum should be designed keeping in mind the mental capability of the student as well as Facilities in Practical Labs. She strongly recommended that Chronobiology should be treated as elective paper and suggested to add more elective papers in II, III and IV semesters.

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Dr. Atul Kumar Mishra
Convener
Board of Studies of Zoology
Department of Zoology
D.A.V. College, Kanpur

[Handwritten signatures of the members of the Board of Studies]

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Dr. Sandeep Shukla also recommended that number of elective papers should be increased for more options available to the student's interest in the respective subject.

Dr. Yogesh Dixit also said that the Lab facility has to be kept in mind while making the curriculum.

Prof. Vinoy Kumar Srivastava recommended that combination of chordates and physiology should be given in the curriculum. This would be much beneficial for the students.

Prof. Ashwani Kumar Dubey said that we have to develop our lab in whatever resources we have and motivate the student towards practical so that research projects become the base platform for research. He also recommended that the Forensic science is a modern and advanced science so for student's welfare, this branch must be treated as a elective paper.

Dr. Deepak Kumar Dwivedi said that the paper of specialization or elective should be given in 3rd and 4th semester and in 1st and 2nd semester only core subjects should be emphasized and also added that more focus should be given on practical.

In the end, Dr. Atul Kumar Mishra, Convener, BOS thanked all the members for joining this virtual meeting and giving their important suggestions. At last, He gave their sincere thanks to all the members of BOS (Zoology) committee for their great efforts for designing framework of NEP PG curriculum of Zoology. He appreciated their hard team work.

Convener:

1. Dr. Atul Kumar Mishra

Signature

External Members:

2. Prof. Vinoy Kumar Srivastava

3. Prof. Ashwani Kumar Dubey

4. Dr. A. K. Verma

Internal Members:

5. Dr. Sangeeta Awasthi

6. Dr. Sandeep Shukla

7. Dr. Yogesh Babu Dixit

8. Dr. Sunita Arya

Special Invitee Member:

9. Dr. Deepak Kumar Dwivedi

11/5/2022

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Dr. Atul Kumar Mishra
Convener
Board of Studies of Zoology
Department of Zoology
D.A.V. College, Kanpur



CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR

STRUCTURE OF SYLLABUS FOR THE

PROGRAM: M.Sc., SUBJECT: ZOOLOGY

Syllabus Developed by		
Name of BoS Convenor / BoS Member	Designation	College/University
DR. ATUL KUMAR MISHRA	Convenor	D.A.V. COLLEGE, CIVIL LINES, KANPUR

SEMESTER / YEAR	COURSE CODE	TYPE	COURSE TITLE	CREDITS	CIA	ESE	MAX. MARKS
I ST YEAR / I ST SEM	B050701T	CORE	NON CHORDATA	4	25	75	100
	B050702T	CORE	BIOSYSTEMATICS AND EVOLUTIONARY BIOLOGY	4	25	75	100
	B050703T	CORE	CELL BIOLOGY AND GENETICS	4	25	75	100
	B050704T	CORE	QUANTITATIVE BIOLOGY, RESEARCH METHODOLOGY AND BIOINSTRUMENTATION	4	25	75	100
	B050705P	PRACTICAL	PRACTICAL	4	25	75	100
I ST YEAR / II ND SEM	B050801T	CORE	CHORDATA	4	25	75	100
	B050802T	CORE	ANIMAL PHYSIOLOGY AND BIOCHEMISTRY	4	25	75	100
	B050803T	CORE	REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY	4	25	75	100
	B050804T	ELECTIVE	APICULTURE	4	25	75	100
	B050805T		SERICULTURE				
	B050806T		LAC- CULTURE				
	B050807T		AQUACULTURE				
	B050808P	PRACTICAL	PRACTICAL	4	25	75	100
	B050809R	PROJECT	RESEARCH PROJECT	8	25	75	100
	MINOR ELECTIVE	FROM OTHER FACULTY (IN 1 ST YEAR)	4/5/6	25	75	100	
II ND YEAR / III RD SEM	B050901T	CORE	ETHOLOGY, BIODIVERSITY AND WILDLIFE CONSERVATION	4	25	75	100
	B050902T	CORE	MOLECULAR BIOLOGY, IMMUNOLOGY AND BIOINFORMATICS	4	25	75	100
	B050903T	ELECTIVE	WASTE MANAGEMENT AND SUSTAINABLE DEVELOPMENT	4	25	75	100
	B050904T		AGROCHEMICALS AND PEST MANAGEMENT				
	B050905T	ELECTIVE	ENTOMOLOGY	4	25	75	100
	B050906T		PARASITOLOGY				
	B050907T		ICHTHYOLOGY				
	B050908T		ENDOCRINOLOGY				
	B050909T		ENVIRONMENTAL BIOLOGY				
	B050910T	ANIMAL CYTOGENETICS					
B050911P	PRACTICAL	PRACTICAL	4	25	75	100	



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STRUCTURE OF SYLLABUS FOR THE

PROGRAM: M.Sc., SUBJECT: ZOOLOGY

II ND YEAR / IV TH SEM	B051001T	CORE	ECOLOGY AND TOXICOLOGY	4	25	75	100
	B051002T	ELECTIVE	PUBLIC HEALTH AND HYGIENE	4	25	75	100
	B051003T		HUMAN NUTRITION AND THERAPEUTICS				
	B051004T	ELECTIVE	MICROBIOLOGY	4	25	75	100
	B051005T		BIOTECHNOLOGY				
	B051006T	ELECTIVE	APPLIED ENTOMOLOGY	4	25	75	100
	B051007T		CLINICAL PARASITOLOGY				
	B051008T		APPLIED ICHTHYOLOGY				
	B051009T		MOLECULAR ENDOCRINOLOGY				
	B051010T		APPLIED ENVIRONMENTAL BIOLOGY				
	B051011T		CLINICAL CYTOGENETICS				
	B051012P	PRACTICAL	PRACTICAL	4	25	75	100
	B051013R	PROJECT	RESEARCH PROJECT	8	25	75	100

[Handwritten signatures and names of faculty members]

Syllabus

       

Semester - I

       

Non Chordata

Paper Code: B050701T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Concepts of Protista Classification of an organism (Whittaker) Body Covering and skeleton of Protozoa, Ultrastructure Nucleus and reproduction in Protozoa, Locomotion and Osmoregulation in Protozoa, Nutrition in Protozoa	15
II	Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan Filter feeding in Protozoans, Polychaeta, Molluscs and Echinoderms Cell type, Canal System, Skeleton and Reproduction in Porifera Nematocysts, Polymorphism, Metagenesis, Corals and Coral reefs, Origin of Metazoan General Organization of Trematoda & Cestoda, Parasitic Adaptations in Helminthes	15
III	Economic importance of Nematodes in Plants and Animals Invertebrate Larvae: Larval forms of free-living invertebrates, Larval forms of Cestodes and Trematodes Evolutionary Significance of Trochophore Larva, Adaptive radiation in Polychaetes Organization and affinities of Onychophora, Larval forms and Parasitism of Crustacea, Respiratory organs in Arthropods	15
IV	Modifications of Foot in Mollusca, Shell types in Mollusca Torsion in Gastropoda, Detortion, Respiration in Mollusca, Nervous System in Mollusca Origin of Deuterostomia, Water Vascular System in Echinodermata Salient features and affinities of Rotifera, Ctenophora and Phoronida	15

Suggested books:

1. Hyman, L.H. The Invertebrate Vol.-I & II
2. Barrington, EJU: Invertebrate structure and function
3. Ruppert, Edward E., Fox, Richard S. & Barnes, Robert D. Invertebrate Zoology: A Functional Evolutionary Approach
4. Pechenik, Jan A. Biology of the Invertebrates
5. Non Chordata – Meglitsch Paul A
6. Parker T.J. and Haswell, W.A. Text book of Zoology Vol. – I
7. Jargenstein, G. Evolution of Metazoan Life
8. Moore: An Introduction to the Invertebrates

Biosystematics and Evolutionary Biology

Paper Code: B050702T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Basic Concept of Animal Taxonomy, A Historical review, taxonomic terms, Classification and Nomenclature; Phenon; taxon and category, α , β and γ Taxonomy Recent trends in Taxonomy: Chemotaxonomy, Cytotaxonomy, Serotaxonomy, Molecular Taxonomy Microtaxonomy: Species concepts, nominalistic species concepts, biological species concept and evolutionary species concept	15
II	Macrotaxonomy: Phenetics, Cladistics and Phylogenetic Variations in Systematics, Taxonomic Procedures, Keys Importance of application of systematics in Biology International Code of Zoological nomenclature (ICZN), Type concept, Law of priority, The present Scenario and the global taxonomic initiatives	15
III	Various Evolutionary theories, Natural Selection and its types, molecular signatures of natural selection. Adaption: its evolutionary analysis, Speciation: allopatric, sympatric, parapatric, peripatric. Elemental Forces of evolution: Mutation, genetic drift, Isolation	15
IV	Hardy-Weinberg law and its application, Conditions for the maintenance of genetic equilibrium, genetic death, probability and Goodness of fit Polygenic inheritance, Chromosome phylogeny in Drosophila Molecular phylogenies, Molecular clock, Molecular tools in phylogeny	15

Suggested books:

1. Principles of Systematic Zoology by Ernst Mayr
2. Principles of Animal Taxonomy by G.G. Simpson
3. Schuh, R.T., and A.V.Z. Brower. Biological Systematics: Principles and Applications
4. Wiley, E. O. and B. S. Lieberman. Phylogenetics: Theory and Practice of Phylogenetic Systematics
5. Animal Taxonomy by H. E. Goto
6. Evolution: An Introduction by S.C. Stearns and R.F. Hoekstra
7. Evolution by N. H. Barton et. al.
8. Ridley, M: Evolution
9. Schuh, R.T., and A.V.Z. Brower. Biological Systematics: Principles and Applications
10. Futuyma: Evolutionary Biology
11. Lull, R.S. Organic Evolution
12. Hartl and Clarke: Principles of Population Genetics

Cell Biology and Genetics

Paper Code: B050703T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Cellular membrane and cytoskeleton: An overview of membrane functions, Chemical composition of cell membrane. Structure and functions of membrane proteins: Integral protein, peripheral membrane proteins and lipid-anchored membrane proteins. Membrane models. Movement of substances across cell membranes: Diffusion, active transport, uniport, symport and antiport Microtubules, Intermediate filaments and Microfilaments: Structure, Functions and assembly, Endomembrane system (ER-GC), Ribosome, Targeting and sorting of proteins: Processing through endomembrane system, Targeting of cytosolic proteins</p>	15
II	<p>Mitochondria: Structure, Assemblies of respiratory chain & Fo-F1 ATPase, Oxidative phosphorylation, ATP and other high energy phosphate compounds Nucleolus: Structure and biogenesis of ribosomes, Cell Signalling: Cell-cell interaction, Chemical mediators, Cell surface and intracellular receptors, Regulation of signalling pathways, JAK-STAT pathway, MAP Kinase pathway, Apoptosis Cell division: Mitosis, Role of maturation promoting factor, regulation of cell cycle, chromosomal movement, Exit from mitosis, Cytokinesis Meiosis: Overview, Chromosome pairing and recombination</p>	15
III	<p>Genetics-I: Mendel's laws and their chromosomal basis, Extensions of Mendelism: Dominance relationships, Epistasis, Pleiotropy, Expressivity and penetrance. Methods of gene mapping: 3-point test cross in Drosophila, Gene mapping in human by linkage analysis in pedigrees, Tetrad analysis in Neurospora Gene Mutation: Types of gene mutations, Methods for detection of induced mutations, P-element insertional mutagenesis in Drosophila, DNA damage and repair, mechanism of Homologous recombination</p>	15
IV	<p>Genetics II: Nature of the gene and its functions: Evolution of the concept of gene, Fine structure of gene, Regulation of gene activity in lac and trp operons of E. coli, organization of a typical eukaryotic gene, Mobile DNA, enhancers and silencers; non-coding genes, Organization and function of mitochondrial DNA Recombinant DNA technology: Restriction enzymes, Plasmid and phage vectors for cloning, Genomic and cDNA libraries; detection of genes and their products</p>	15

Suggested books:

1. Becker et. al.: The World of the Cell
2. The Cell: A Molecular Approach by Cooper and Hausman
3. Cell and Molecular Biology by Karp
4. Molecular Biology of the Cell by Alberts et al.
5. Molecular Cell Biology by Lodish et al
6. Genetics by Benjamin A. Pierce
7. Concepts of Genetics by William S. Klug, M. R. Cummings
8. Lewin: Gene XII
9. Genome 3 by T. A. Brown
10. Principles of gene manipulation and genomics by R.M. Twyman and S.B. Primrose
11. Genetics by Peter J. Russell
12. Watson: Molecular Biology of the Gene
13. Cells by Wong
14. Cell Biology by Pollard et al
15. Genetics a molecular approach by T.A. Brown
16. Cell and molecular biology by Sheeler and Bianchi

Quantitative Biology, Research Methodology and Bioinstrumentation

Paper Code: B050704T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Measures of central tendency: Mean, Median and Mode Measures of Dispersion: Range, Mean Deviation, Standard Deviation, Coefficient of Variations, Correlation and Regression Testing of Hypothesis: Null Hypothesis & Alternative Hypothesis, Type I and Type II Error, Level of Significance Test of Significance: Parametric tests (Paired and unpaired t-test, Z-test, F-test) & non-Parametric tests (Chi-square test and Mann-Whitney U-test) Probability: Probability theory: Binomial distribution, Poisson distributions Analysis of Variance (ANOVA): One way and two-way	15
II	Research Design, Data Collection, Data Presentation: Classification and Tabulation of Data. Diagrammatic and Graphical Presentation of Data: Bar Diagram, Histogram, Frequency Polygon, Pie-diagram, Analysis of Data Literature survey: sources, print and digital Types of Research: Descriptive vs Analytical; Applied vs Basic; Qualitative vs Quantitative; Conceptual vs Empirical; Survey vs Experimental Interpretation, report writing and Publication, Ethical aspects of biological research	15
III	Microscopy: Light, Phase contrast, Transmission & electron microscopy, Fluorescence microscopy, freeze fracture electron microscopy, different fixation and staining techniques for EM Principal of spectrophotometry (UV & Visible), PH meter and GM Counter Electron Spine Resonance & Nuclear Magnetic Resonance spectroscopy Centrifugation: Isolation of DNA, RNA and Proteins Chromatography: Paper Chromatography, TLC, HPLC Electrophoresis: one dimensional & two-dimensional Polymerase change reaction (PCR), DNA sequences, Microtome, Laminar flow	15
IV	Histochemical and Immunotechniques: Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques (FISH and GISH) Electrophysiological methods: Patch-clamp recording, ECG, CAT, fMRI, PET, MRI	15

Suggested books:

1-Boyer: Modern Experimental Biochemistry and Molecular biology 2. Switzer and Garrity: Experimental Biochemistry 3. Wilson and Walker: Practical Biochemistry 4. Plumer: An Introduction to Practical Biochemistry Holme and Peck: Analytical Biochemistry 5. Antonisamy, B., Christopher S. and Samuel, P. P. Biostatistics: Principles and Practice 6. Pagana, M. and Gavreau, K. Principles of Biostatistics 7. Zar, Jerrold H. Biostatistical Analysis 8. Walliman, N. Research Methods-The Basics 8. Kothari, C. R. Research Methodologies-Methods and Techniques 9. Dawson, C. Practical Research Methods 10. Booth, W.C., Colomb, G.G. and Williams, J.M. (2003). The Craft of Research 11. Physical Biochemistry by David M. Freifelder

Practical Syllabus

Semester I

       

The duration of the practical examination will be 04 hours. The distribution of marks in End Semester Examination (ESE) will be as follows-

1. Exercises based on Non Chordata (B050701T)	20
2. Exercises based on Biosystematics and Evolutionary biology (B050702T)	05
3. Exercises based on Cell biology and Genetics (B050703T)	05
4. Exercises based on Quantitative biology, research methodology & Bioinstrumentation (B050704T)	10
5. Identify and comment upon spot 1-10 (10 spots)	15
6. Viva-voce	10
7. Practical record	10
Grand Total =	75

Distribution of marks of Continuous Internal Assessment (CIA):

1. Examination	15
2. Seminar/Presentation/Assignment/Quizzes.....	10
Grand Total =	25



M.Sc. Semester-I

Zoology Practical Examination (ESE) - 20....

Date:

Batch:

Duration: 4 hrs

Max. Marks: 75

Question Paper

- Q.No.1.** Dissect the animal provided (.....) so as to expose its nervous system as clearly as possible. Display your dissection suitably. **10**
(*Aplysia/ Mytilus/Sepia/Squilla*)
- Q. No. 2.** Make a suitable permanent stained preparation offrom the material / animal..... provided. **10**
- Q. No. 3.** Identify and comment upon spots. (1-10) **15**
- Q. No. 4.** Any one exercise based on Biosystematics and Evolutionary biology **05**
(One invertebrate +one vertebrate)
- Q. No. 5.** Any one exercise from Cell biology and Genetics **05**
- Q. No. 6.** Any one exercise from Quantitative biology and Bioinstrumentation **10**
- Q. No. 7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **10**

Spots: (Museum specimens:4 and Slides:6)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.



Detailed Syllabus of Semester -I

B050701T Non Chordata:

1. Major Dissections-

Aplysia- Nervous system

Mytilus-Nervous system

Sepia – Nervous system

Squilla- Nervous system

2. Minor Dissections-

Palaemon – Nervous system

Pila – Nervous system

Lamellidens- Nervous system

3. Take out and Mount- (Permanent Preparation):

Pheretima – Nerve ring, Septal nephridia, ovary

Palaemon – Appendages, Statocyst, Hastate plate

Pila- Osphradium, Radula

Cockroach- Salivary glands, testes, ovary, Gizzard

Lamellidens- Gill lamella

4. Mounting materials to be provided:

Porifera: Gemmule of *Spongilla*, Spongin fibres, Spicules

Coelenterata: *Obelia* colony, *Hydra*, *Sertularia*, *Companularia*

Arthropoda: *Daphnia*, Zoea larva, Mysis larva, *Pediculus*, *Cimex*

5. Study of Museum Specimens and Prepared slides

B050702T Biosystematics and Evolutionary biology:

1. Adaptive modifications in feet of birds and mouth parts of insects (from slides)
2. Embryological evidence of evolution (through charts)
3. Serial homology in appendages of *Palaemon*
4. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit)
5. Evolution of Horse – through models
6. Study of adaptation and its significance in following animals-
 - (i) *Physalia*
 - (ii) *Taenia*
 - (iii) *Ascaris*
 - (iv) *Fasciola*
 - (v) *Hirudinaria*
 - (vi) *Limulus*



- (vii) *Peripatus*
- (viii) *Antedon*
- (ix) *Petromyzon*
- (x) *Pristis*
- (xi) *Chimaera*
- (xii) *Exocoetus*
- (xiii) *Anabas*
- (xiv) *Neoceratodus*
- (xv) *Rhacophorus*
- (xvi) *Chamaeleon*
- (xvii) *Draco*
- (xviii) *Struthio*
- (xix) *Tachyglossus*
- (xx) *Macropus*

Biosystematics:

Specimen collection, preservation and identification (Any one animal from any phyla of animal kingdom)

B050703T Cell biology and Genetics:

1. Study of different stages of Mitosis and Meiosis (Prepared slides)
2. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
3. Temporary/permanent squash preparation of giant chromosome
4. Analysis of Pedigree charts
5. Genetical exercises based on Test cross, Dihybrid cross, Sex linked inheritance
6. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome)

B050704T Quantitative biology, Research methodology and Bioinstrumentation:

- I. **Microtomy:** Preparation of Blocks, section cutting, and stretching by wax methods and staining of vertebrate tissues by double staining methods
- II. **Microscope and its practical uses-** Simple microscope, Compound microscope, Binocular microscope, Phase contrast microscope, Electron microscope
- III. **Common biological instruments in laboratory:** Practical use Chromatography, Electrophoresis, pH meter, Colorimeter
- IV. General method of microscopic preparation, single and double staining methods
- V. Method of preparation of fixatives, stains and useful reagents used in a laboratory

Quantitative biology:

1. Measures of central tendencies (Arithmetic means, Median, Mode, Standard deviation and Numerical based on them)
2. Mean deviation, test of significance (t-test and Chi-square test) numerical problems based on them
3. Corelation coefficient
4. Analysis of variance

Semester-II

       

Chordata

Paper Code: B050801T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Origin and general characters of Chordata: Classification of class Amphibia, Reptilia, Aves and Mammalia General organization and affinities of Protochordata: Hemichordata, Urochordata, Cephalochordata , Retrogressive metamorphosis in ascidian larva General organization and affinities of Ostracoderms, Cyclostomes and Dipnoi General organization of Fishes, Swim Bladder and their functional significance, Parental care, Migration	16
II	Amphibia: Origin of tetrapods, General organization of Anura, Neoteny, Peculiarities of Urodela, Peculiarities and affinities of Apoda, Adaptive Radiation Reptilia: Skull in Reptiles, Origin and evolution, Adaptive radiation, General organization and affinities of Chelonia, Crocodilia, Squamata, Rhynchocephalia,	16
III	Aves Origin and evolution, Flightless birds, Palate in birds and their importance, Modification of beaks, feet in birds, Migration in Birds, Adaptations for flight, Parental care, Adaptive radiation	14
IV	Mammalia: Origin of mammals, Adaptive radiation of Mammalia, Structural peculiarities and phylogenetic relations of Prototheria and Metatheria, Uterus modifications, Aquatic mammals, Stomach in ruminants	14

Suggested books:

1. The life of vertebrates by Young
2. Vertebrates; their structure and life by W. B. YAPP
3. Vertebrate biology by RT ORR
4. Vertebrate Biology by D. Linzey
5. The Biology of Hemichordata and protochordata by Barrington
6. Textbook of Zoology Vertebrates by Parkar and Haswell
7. An Introduction to The Vertebrates by L A Adams
8. Studies on the structure and development of vertebrates by EDWIN S. GOODRICH
9. Harvey et al: The Vertebrate Life
10. Hildebrand: Analysis of Vertebrate Structure
11. Colbert's Evolution of the Vertebrates
12. McFarland et al: Vertebrate Life
13. Romer and Parsons: The Vertebrate Body
14. Vertebrates: Comparative Anatomy, Function, Evolution by Kenneth V. Kardong

Animal Physiology and Biochemistry

Paper Code: B050802T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Physiology of Digestion: Digestion and absorption of proteins, Digestion and absorption of carbohydrates Digestion and absorption of lipids, Regulation of digestion and absorption</p> <p>Physiology of Circulation: Composition of blood, Haemopoiesis, Blood Coagulation, Heart, Origin and conduction of cardiac impulse, Cardiac cycle and its regulation</p> <p>Physiology of Respiration: Respiratory organs and Respiratory pigments, lung air volumes, transport and exchange of gases, Respiratory centers: organization and function</p> <p>Physiology of Muscles: contraction and relaxation of skeletal muscle and Smooth muscle</p>	15
II	<p>Physiology of Excretion: Three basic modes of excretion, Urine formation, Counter current mechanism, Regulation of body fluid and electrolyte, Hormonal regulation</p> <p>Neurophysiology: Neurons, Axonal transmission, Synaptic transmission, action potential, neural control of muscle tone and posture, neurotransmitters</p> <p>Physiology of Endocrine System: Overview of endocrine glands, Mechanism of action of hormones</p> <p>Physiology of Thermoregulation: comfort zone, body temperature – physical, chemical, neural regulation, acclimatization</p> <p>Physiology of Vision and Hearing</p>	15
III	<p>Chemical bonds, biomolecules, pH, Acids and Bases, Buffers, Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, biological energy transducers</p> <p>Carbohydrates: Classification, nomenclature and functions, Synthesis and breakdown of glycogen and glucose</p> <p>Lipids: Structures and types of saturated and unsaturated fatty acids. Lipid metabolism: Biosynthesis of fatty acids, oxidation of fatty acids (β- oxidation) and carnitine shuttle Ketogenesis: biosynthesis and utilization of ketone bodies. Regulation of ketogenesis</p>	15
IV	<p>Enzymes: Nomenclature, classification, action, Enzyme kinetics, Mechanism of enzyme action, Coenzymes, Ribozymes, Isoenzymes, DNA enzymes and half-life of enzymes, Enzyme Inhibition: competitive and non-competitive inhibition</p> <p>Proteins: Structures, classification and properties of amino acids, Primary, secondary, tertiary and quaternary structure of proteins, Biosynthesis of proteins</p> <p>Secondary Metabolites: Alkaloids, Terpenoids</p>	15

Suggested books:

Principles of Animal Physiology by Moyes and Schulje 2. Animal physiology by SCHMIDT 3. Eckert animal physiology mechanisms and adaptations 4. Ganong's Review of Medical Physiology 5. Guyton and Hall: Textbook of Medical Physiology 6. Principles of Anatomy & Physiology by Tortora, G.J. & Grabowski, S. 7. Animal physiology by Hill, Richard W., et al. 8. Human Physiology Volume 1 & 2. By Chatterjee C C 9. Lehninger's Principles of Biochemistry 10. Biochemistry Vols 1 & 2 by Voet & Voet

Reproductive and Developmental Biology

Paper Code: B050803T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Human Reproductive system: Structure and function of male reproductive organs; Formation of sperm and fertility of individual. Structure and function of female reproductive organs; Sexual differentiation, Formation of sperm; Formation of ova. Physiology of ovulation, menstrual cycle; Nutrition and stress influences on the ovulatory cycle, Amniocentesis</p> <p>Puberty: control of the onset; stages; delayed and precocious puberty Process of fertilization; Implantation and formation of the foetus and placenta; Pregnancy, Labour and birth, lactation and neonatal life; Reproductive Ageing; Menopause</p>	15
II	<p>Evolution of reproductive mechanism and regulation: Evolution of human reproductive strategy; Evolutionary impact on behaviour; Sexuality hormonal effects on maternal-infant bonding</p> <p>Reproductive Health: Sexual dysfunctions, sexually transmitted diseases; Cancers of the reproductive system; Adenomyosis: gland-like growth into myometrium; Birth Control; Assisted Reproduction Technologies; Intrauterine devices (IUD), endometriosis, fibroids, Endometritis: chronic infection of uterus, congenital uterine anomalies; Ovarian cysts, pelvic varicosities</p>	15
III	<p>Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants, Organization of HOX gene in vertebrates, Fertilization, Cleavage, Morula, Blastula and Gastrula, Standard techniques and methods of experimental embryology: vital dying, extirpation, isolation, transplantation and grafting</p>	15
IV	<p>Morphogenesis and organogenesis: Organizers: characteristics and physiology, axes and pattern formation in <i>Drosophila</i>, amphibia and chick; vulva formation in <i>Caenorhabditis elegans</i>, eye lens induction, limb development in vertebrates Metamorphosis: Hormonal control of metamorphosis, metamorphosis and genetics Malignancy: teratogens, carcinogens, oncogenes, neoplasia</p>	15

Suggested books:

1.Langman's Medical Embryology by Thomas W.S. 2. Larsen's Human Embryology by Gary C.S.; et al. 3. Developmental Biology by Gilbert, S.F. 3. Encyclopaedia of Reproduction by Ernst Knobil and Jimmy D. Neill 4. The biology of reproduction by Giuseppe Fusco and Alessandro Minelli 5. Biology of reproduction by Peter J. Hogarth 6. Essential Developmental Biology by Jonathan M. W. Slack 7. Developmental biology by Werner A. Müller 8. Principle of development by Wolpert 9. Developmental biology by N. J. BERRILL 10. Developmental biology by John W. Saunders 11. Principles of developmental biology by Wilt & Hake 12. Essential developmental biology by J M W Slack

Apiculture

Paper Code: B050804T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Introduction to Apiculture: History of Apiculture, Systematics, Honey Bee species, Honey Bee morpho-anatomy, Colony organization, Polymorphism, Caste system, Division of labour, Honey Bee flora – importance, propagation - congenial conditions for starting up of apiculture. Migratory Bee Keeping - designing floral Calendar, Improved Agricultural practices - crop pollination - Pesticides impact on Honey bees Foraging and Honey flow periods, social behaviour of Honey Bees, Bee as pollinators: Crop improvement: Quality and yield through honeybee pollination</p>	15
II	<p>Apiculture as an occupation: Extent of Apiculture in Uttar Pradesh and India, Limitations on the development of Apiculture, Advantages of extensive Apiculture, Bee keeping equipment - introduction to types of bee boxes - BIS standard Tools used in apiculture. Bee breeding multiplication of colonies - Queen reaching technique. Honey: Production, Properties and application: Production of Honey by honeybee within its stomach using plant nectar, application in various fields - other valuable by products of honey bees Honey - its medicinal properties - application in various fields - other valuable by products of honey bees</p>	15
III	<p>Steps in Apiculture: Purchase of a colony, the Apiary site, how to manage a colony, the manipulation of a colony, Honey extraction & handling - Quality control standards - Honey testing kit Processing of honey, Other Bee products: Bees wax, Pollens, Royal Jelly, Propolis and Bee venom Control of Honeybee Diseases: Bee enemies and diseases: Introduction, Enemies of honeybees – Wax Moth, Ants, Wasps, Microbes, Pests; Diagnosis and identification. Bacterial, viral, fungal and protozoan diseases; Mites attacking honeybees. Establishment of a colony. planned pollination services</p>	15
IV	<p>Apiculture techniques and Apiary management: Routine management, Seasonal management, Migratory beekeeping, Harvesting and marketing of Honey bee products. Important Institutions pertinent to Apiculture: National Bee Board, Honey Bee research and Training Institute, Apiaries. Economics in small scale and large-scale bee keeping. Economic Value of Commercial Beekeeping. Preparing bankable bee keeping project: Steps involved in starting a beekeeping project, Funding sources for beekeeping projects.</p>	15

Suggested books:

1. Abrol, D. P. Bees and Beekeeping
2. Withhead, S. B. Honey bees and their management
3. Dharam singh and Singh, D. P. A. Handbook of Beekeeping
4. Mishra R.C. Honey bees and their management in India
5. Singh, S. Beekeeping in India
6. Gupta, J.K., Sharma, H K and Thakur, R K. Practical Manual on Beekeeping
7. Bisht D.S., Apiculture
8. David Cramp. The complete step by step book of Beekeeping
9. Pradip, V. Jabde. Text book of Applied Zoology

Sericulture

Paper Code: B050805T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	An Introduction to Sericulture History of sericulture, systematic, Exotic and indigenous races of silkworm, Mulberry silk worm, feeding habit of silk worm, life history of various species of silk worm, Tassar silk worm, Eri silk worm, Life cycle of mulberry silk worm (Bombyx-mori)	15
II	Historical Review of Sericulture Extent of sericulture in the global part in the world Silk Industry in various part of India, World silk production World map and silk road, spread of Sericulture to Europe, South Korea, Japan, India and other countries. Sericultural practices in tropical and temperate climate, Silk production in East Area, Silk production in China & Japan, Silk production in India and Malaysia Various Silk research institute and Regional Silk stations	15
III	Advances of extensive Sericulture Basic requirement of tools for starting Silk Industries. Getting started in Silk Industry planning before start of sericulture Industry. Tools used for sericulture. Climatic conditions, soil conditions for plantation, Manuring, fertilizers at the time of Silk Production, Rearing of Silk Worm, Polyhedrosis of Silk worm	15
IV	Sericulture techniques and Sericulture management Marketing of various Silk products, National Sericulture Board (NSB) Sericulture Institute and training institute in India, Economic Importance of Silk, Status of Sericulture Industry in India, Distribution of Silk Industry in India, Sericulture Industry and Human welfare, Function of Central Silk Board and their Co-ordination in various parts of India	15

Suggested books:

1. Manual on sericulture: Rome: Food and Agriculture Organization of the United Nations
2. Ullal, S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture
3. Jolly, M. S. Appropriate Sericultural Techniques
4. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1
5. Narasimhanna, M. N. Manual of Silkworm Egg Production
6. Sengupta, K. (1989) A Guide for Bivoltine Sericulture

Lac culture

Paper Code: B050806T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	An Introduction to Lac Culture: Historical review of Lac culture Various products of lac and their commercial value Extent of Lac culture in the world. Lac Producing places in India Distribution of Lac in the global area	15
II	Biology of silkworm: Systematic position of lac insect in animal kingdom Morphology and Anatomy of lac insect. Difference between male and female lac insects Life history various species of lac insect i.e., Tachardia-lacca (Laccifer)	15
III	Various Host Plants of lac insects, Common host plants of India and other countries, names of various Host plants of lac insects, Cultivation of lac, Inoculation period Type of inoculation, Swarming of lac insects	15
IV	Harvesting of lac, Harvesting period and types of harvesting Lac cultivation and Recent plant of lac cultivation. Lac Industry and processing of lac industry Properties of Lac. Physical and chemical composition of Lac, Enemies of lac cultivation, Lac Industry of India, Economic Importance	15

Suggested books:

1. Text Book of Applied Zoology by Jabde, P.V.
2. Insects by Mani, M.S.
3. Lac-Culture in India by N Ghorai
4. Lac Cultivation in India by Patrick Moore Glover



Aquaculture

Paper Code: B050807T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Major cultivable species for aquaculture. A knowledge of inland water bodies suitable for culture in India Culture of Indian Major Carps. Exotic carps of freshwater, Hatcheries and their management. Culture technology – Fresh Water mullets, crabs, shrimps, mariculture muscles and oyster. Water quality requirements for Aquaculture. Role of temperature, PH, Salinity dissolved oxygen, Ammonia, nitrate Nitrite, Phosphate, BOD, COD. Aquaculture engineering, house hatchery, ponds, Recirculating system.	15
II	Bundh breeding and induced breeding of carb by hypohysation and use of synthetic hormones. Preparation and management of Indian Major carps, culture prods – nursery, rearing and production ponds. Fresh Seed technology, Natural collection and bundh breeding	15
III	Culture of Giant fresh water prawn <i>Macrobrachium</i> spp.-seed collection, formation source, hatchery management. Culture of tiger shrimp, <i>Penaeus monodon</i> and <i>Litopenaeus vannamei</i> Culture of brackish water fish – <i>Osteobrama belangeri</i> Culture of pearl oysters. Fresh water and marine aquaria Breeding of aquarium fishes.	15
IV	Role of genetics in aquaculture Gynogenesis, androgenesis, Sex reversal and breeding. Production of transgenic fish Fish health – infection and diseases in fish common fish pathogens Culture of sea weeds, major commercial importance seaweed species. Methods of crab culture. Culture of ornamental fishes, Culture of airbreathing fishes in India Culture of molluscs, Environmental impact of aquaculture	15

Suggested books:

1. Aquaculture Principles and Practices by Pillay.
2. Fish ponds in Farming systems: Zigpp, V.D., Veereth J.A.J. Tri, L.Q., Van Mensvoort, MEF. boswa, R.H. and Beveridge.
3. Aquaculture and Fisheries by Dunham
4. Hute, M. and Kahn, Textbook of fish culture
5. Introduction to Aquaculture by Matthew Landau
6. Aquaculture By: John E. Bardach
7. Textbook of Fish Culture by Marcel Heut



Practical Syllabus

Semester II

       

B050808P

Practical

Max. Marks 100 (25+75)

The duration of the practical examination will be 04 hours. The distribution of marks will be as follows-

1. Exercises based on Chordata (B050801T)	20
2. Exercises based on Animal physiology and biochemistry (B050802T)	05
3. Exercises based on Reproductive biology & developmental biology (B050803T)	05
4. Exercises based on B050804T/ B050805T/ B050806T/ B050807T	10
5. Identify and comment upon spot 1-10 (10 spots from B050801T)	15
6. Viva-voce	10
7. Practical record	10
Grand Total =	75

Distribution of marks of Continuous Internal Assessment (CIA):

1. Examination	15
2. Seminar/Presentation/Assignment/Quizzes.....	10
Grand Total =	25



M.Sc. Semester-II

Zoology Practical Examination (ESE) - 20....

Date:

Batch:

Duration: 4 hrs

Max. Marks: 75

Question Paper

- Q.No.1.** Dissect the animal provided (.....) so as to expose its nervous system/Neck nerves as clearly as possible. Display your dissection suitably. **10**
(*Scoliodon/ Wallago/Sting ray/Rat*)
- Q. No. 2.** Make a suitable permanent stained preparation of from the material / animal..... provided. **10**
- Q. No. 3.** Identify and comment upon spots. (1-10) **15**
- Q. No. 4.** Any one exercise based on Animal Physiology and biochemistry **05**
- Q. No. 5.** Any one exercise from Reproductive and Developmental biology **05**
- Q. No. 6.** Any one exercise from Apiculture/Sericulture/Lac culture/Aquaculture **10**
- Q. No. 7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **10**

Spots: (Museum specimens:4 and Slides:6)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.



Detailed Syllabus of Semester -II

B050801T Chordata:

1. Major Dissections-

Scoliodon -Cranial nerves

Wallago - Cranial nerves

Sting ray – Cranial nerves

Rat – Neck nerves

2. Minor Dissections-

Wallago- Weberian ossicles

Scoliodon – Afferent, Efferent, Internal ear, Scroll valve

Amphioxus – Oral hood, Velum, Pharyngeal wall

3. Mounting materials to be provided/take out and mount-

Protochordates- *Salpa*, *Oikopleura*, *Doliolum*

Scoliodon- Ampullae of Lorenzini, Placoid scales

Herdmania – Branchial wall, Neural gland complex, Section of test, Spicules

Cartilage – free-hand sections of frog's hyoid and suprascapula, stain with Haematoxylin

4. Osteology- Bony fish (*Labeo*), Amphibia (Frog), Reptilia (*Varanus*), Aves (Fowl), Mammalia (Rabbit/Rat), Jaw suspension in vertebrates

5. Histology of various organs-prepared slides

6. Study of Museum specimens and prepared slides of Chordates

B050802T Animal physiology and biochemistry:

Animal physiology-

1. To prepare haemin crystals from blood sample
2. To measure the human blood pressure
3. To estimate the amount of haemoglobin in human blood using Haemoglobinometer
4. To study the phenomenon of Knee-jerk reflex
5. To count the blood cells (RBCs & WBCs) by Haemocytometer
6. To determine the human blood groups
7. To determine the clotting time of human blood

Biochemistry-

1. Identification and/or separation of different amino acids in a mixture by ascending Paper chromatography
2. Test for amylase
3. Test of Carbohydrates
4. Test for protein
5. Test of lipids
6. Test of acetone



B050803T Reproductive and developmental biology:

1. Histological sections- Testis, Ovary, Epididymis, accessory glands, Uterus (Proliferative and secretory stages) -Prepared slides
2. Study of histology of endocrine glands (Pituitary, Thyroid, Adrenal, Islets of Langerhans)
3. Study of whole mounts and sections of developmental stages of frog through permanent
4. Slides/Models: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
5. 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

B050804T Apiculture:

1. Specimen study of different castes of honey bee species
2. Collection and identification of different honey bee species Viz. *Apis serana indica*, *A. dorsata*, *A. mellifera*, *A. Florae*
3. Life cycle study of honey bees
4. Study of leg modification in workers
5. Temporary mount preparation of mouth parts of honey bees
6. Temporary mount preparation of sting apparatus of honey bees
7. Demonstration of honey testing methods like blot method, burning method and alkali method etc.
8. Study of different bee hives and allied implements used in bee keeping
9. Identification of various enemies of Honey bees
10. Study of different tools used in apiculture
11. Visit to any Apiary for the study of different steps of Bee keeping

B050805T Sericulture:

1. Study of various species of Silkworm and their distribution through chart/specimen in a laboratory
2. Study of life cycle of silkworm in an open field/in a laboratory
3. Observation of feeding habit (Larva) on mulberry leaves in an ideal laboratory condition
4. Prepare a research project on various Silk research institutes and regional silk stations in India
5. Study of various tools and equipment used in Sericulture
6. Study of properties of different types silk produced by different species
7. Visit to any sericulture site for the study of Silk Industry, Silk production and to understand all the steps of sericulture

B050806T Lac culture:

1. Study of global distribution of Lac insects i.e.; *Tachardia lacca* through chart/models
2. Study of male and female Lac insects through museum specimen
3. Study of life history of Lac insect
4. Study of Indian host plants of Lac insects and their scientific names through charts
5. Study of the composition and properties of Lac
6. Study of enemies of lac cultivation or abiotic and biotic factors, precautions to be taken for better cultivation of Lac
7. Visit a place of Lac Industry to understand the cultivation of Lac insects, inoculation, swarming period and harvesting



B050807T Aquaculture:

1. Preparation and of an aquarium in a laboratory study of aquarium fishes with Zoological and common names
2. Visit a local pond and collect the edible fresh water fishes and culture in an aquarium
3. Study of types and management of fish culture i.e.; breeding, hatching, nursery, rearing and stocking ponds in nearby place/with the help of charts/models
4. Estimation of organic matter of bottom soil
5. Visit to local fish seed production centre and local fish farms
6. Collection of pond, river or ditches water for the study of physico-chemical analysis of water
7. Collect a fresh water sample from the local fresh water habitat for the study of microscopic organisms like protozoans, Daphnia, coelenterates etc. for identification in laboratory

A series of handwritten signatures in blue ink, including names like 'Sangita Anandhi', 'Smita', and 'Dedrindhi'.

Semester-III

       

Ethology, Biodiversity and Wildlife Conservation

Paper Code: B050901T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Introduction to Ethology: Patterns of behaviour: Kinds of behaviour: foraging behaviour, Territorial behaviour. Mate selection and courtship behaviour. Parental care, defensive behaviour. Allelomimetic and maladaptive (abnormal) behaviour. Stereotyped Behaviours (Taxes, kinesis and Reflexes) History of behavioural studies, Proximate and ultimate causes of behavioural evolution, Methods and recording of a behavior, Types of stimuli invoking response: internal and external cues. Biological rhythm Learning and memory: Conditioning, Habituation, Insight Learning, Associative and Non-associative Learning, Reasoning, Molecular basis of learning and memory Perception of the environment – Mechanical, Electrical, Chemical, olfactory, auditory and visual</p>	16
II	<p>Communication: modes, evolution, Deceit versus honest, specificity of songs, adaptive value Social behaviour and kin selection: Aggregations – schooling in fishes, stocking in birds, lending in mammals. Group selection, Hamilton’s rule for kin selection, altruism and inclusive fitness Reproductive behaviour: Courtship, sexual selection, Intra and intersexual, Pre– and post–copulatory, Cryptic female choice, Different mating systems Parental care: origin and evolution, Patterns, Parent–offspring conflict, Sibling conflict Territorial behaviour: Evolution and Adaptive value, Types of territories</p>	15
III	<p>Biodiversity: concepts and hierarchical levels, Levels of Biodiversity : Species diversity, Genetic diversity, Ecosystem diversity, Species richness and evenness, α- biodiversity, β- biodiversity, γ- Biodiversity, causes of loss of biodiversity, Conservation of biodiversity, Measures of Species diversity: species richness indices such as Margalef’s index, Menhinick’s index, Species proportional abundance based indices: Simpson’s index, Shannon’s index, Biodiversity Hot Spots, Red Data book and its significance, Biodiversity at Global, National and Local level</p>	15
IV	<p>Wildlife Conservation: Wild life as a resource, Wild life conservation: In situ and ex-situ, Protected area: classification (National parks, sanctuaries) and management, Management of endangered species and different animal projects, Conservation strategies: IUCN, Criteria and technology, IBWL; WWF. Wild life (Protection) Act 1972: Salient Features, Short comings of the Act, Amendments</p>	14

Suggested books: 1. Animal Behaviour by McFarland, D. 2. Animal Behaviour: An Evolutionary Approach by Alcock, J. 3. Principles of animal behavior by Dugatkin, L. A 4. Animal behavior by Breed, M. D., & Moore, J. 5. An Introduction to Animal Behaviour by Aubrey Manning and Marian Stamp Dawkins 6. The behaviour of animals by Bolhuis, J. J., Giraldeau, L. A 7. Methods and Practice in biodiversity Conservation by David Hawks worth 8. A Text Book of Biodiversity by K.V. Krishnamurthy 9. Wildlife of India, V.B. Saharia 10. Wildlife Management Manual by Robert Giles 11. Threatened Birds of India by Asad A. Rahmani

Molecular Biology, Immunology and Bioinformatics

Paper Code: B050902T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Chromosomal organization of genes: chromatin structure (nucleosome, solenoid, super solenoid), DNA Replication (in prokaryotes and eukaryotes), Significance of anti-parallel arrangement of DNA strands, role of primer, exonuclease activity of DNA polymerase III, End replication problem, Fidelity and termination of replication, DNA repair and recombination</p> <p>Transcription in prokaryotes and eukaryotes and RNA polymerases</p> <p>Post transcription modification- RNA splicing and processing (5' capping, Poly A adenylation), mRNA editing, inhibitors of transcription.</p>	15
II	<p>Translation (initiation, elongation, termination), control of eukaryotic translation, Effect of antibiotics on protein synthesis, Post translational modifications, protein folding, protein sorting.</p> <p>Regulation of Gene action in prokaryotes and eukaryotes, Operon system: lac, trp, arabinose operons, Intracellular protein degradation, Gene silencing, RNAi</p> <p>Cancer: Fibrosis, cirrhosis, characteristics of transformed cells, protooncogene, c-oncogenes, angiogenesis and metastasis. Tumour suppressor gene (p53) and Two-Hit hypothesis.</p> <p>Apoptosis: definition, intrinsic and extrinsic pathway.</p>	15
III	<p>Innate and acquired immunity. Cells and tissues of the immune system.</p> <p>Immunoglobulins: Structure, types and functions; Monoclonal antibodies.</p> <p>Antibody: affinity, avidity, diversity, Organization & Expression of Immunoglobulin genes.</p> <p>Primary and Secondary Ab responses. Humoral and Cell Mediated Immune response, Maturation and differentiation of T-cells and B cells</p> <p>Structure of MHC molecules and its types</p> <p>Structure and functions of cytokines and the complement system (classical, alternative, lectin) Hyper sensitivity and Vaccines</p> <p>Autoimmunity and Acquired immuno Deficiency disease</p>	15
IV	<p>Introduction and scope of bioinformatics: concept of digital laboratory. Basics of information technology, computer, operating systems, network. Concept of internet protocol (TCP/IP), hypertext, home-page, web-page and uniform resource locators (URL). Introduction to data archiving systems (FASTA format, Accession, and GI-Number). Introduction to data retrieval systems, Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR), Sequence alignments (BLAST and Clustal W) and phylogenetic trees (PHYLIP).</p> <p>Applications of bioinformatics: Clinical informatics, Cheminformatic resources and pharmacoinformatics</p>	15

Suggested books: 1. Frifelder, D. Molecular Biology 2. Molecular biology of the cell by Albert's et al. 3. Lewin, B. Genes XII 4. Immunology by Kuby 5. Essential Immunology by J.M. Roitt 6. Immunology by E. Benjamini, R. Coico and G. Sunshine 7. Introduction to Bioinformatics: A theoretical and practical Approach by Stephen A. Krawetz, David D. Wombli, 8. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. 9. Lodish Molecular Cell Biology 10. Watson Molecular Biology of the Gene 11. Molecular biology by Robert F. Weaver 12. Molecular biology by David P. Clark

Waste management and sustainable development

Paper Code: B050903T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Waste Management and global Health and its implications in Environmental sanitation. Significance of Recycling to waste management, The Environmental impacts of waste Disposal, Types of waste, management evaluating the global of impact of waste management. The impact of solid waste on business Environment. impact of waste management on Economic growth of India. The effectiveness of rural waste management. Recycling of Electronic (E-waste) in India. The waste management and benefits of Renewable Energy. The public perception regarding the waste management.	15
II	Properties of solid waste: Physical and chemical. Solid waste management: Sources, segregation, collection, transportation and disposal Disposal technology: composting (Aerobic, anaerobic and mechanical), Incineration, Sanitary land fill. Hazardous Waste management: classification, treatment technologies, Biomedical wastes and their management	15
III	Sustainable Development, Biosafety, Environmental movements. Sustainable development and green technology. Public awareness of Environment problems, Role of Government for sustainable development. Role of NGO's. Ecological foot print. Organizations, International effects.	15
IV	Concepts of sustainable development, components of sustainable development, Goals of sustainable development. Example of sustainable development: Solar Energy; wind energy, crop rotation, sustainable construction. Elements of sustainable development. Environmental laws and Acts, national Environmental policy Convention on biological diversity. Rain Water Harvesting, Ground water recharge, ECO cities.	15

Suggested books:

1. Manual on Sewage and Sewage treatment by Ministry of works and Housing, New Delhi
2. Introduction to environmental Engineering and Science by Gilbert, M. M.
3. Environmental Engineering by Kiely, G.
4. Handbook of Environmental Management and technology by Gwendolyn Holmes et.al.
5. Environmental Engineering by Howard, P. et al.



Agrochemicals and Pest Management

Paper Code: B050904T

Total Marks:100

Credits: 04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Concept of pest: Definition, classification, morphology and internal systems; Plant pests –weeds, bacteria, fungi, Viruses, nematodes, molluscs, Arthropods, birds, mammals etc.; Causes of outbreak of pest, growth and development; Classification based on nature of damage: Public health pests, Agricultural pests, Domestic pests, Animal husbandry pests, Structural pests</p>	15
II	<p>Agrochemicals/ nutrients for increasing the health of plants: Manures: types, composition and value, sources of manures, Compost- Different composting technologies-Mechanical compost plants-Vermicomposting-Green Manures-Oil cakes, Sewage Sludge-Biogas plant slurry. Chemical fertilizers: Classification and value. N- fertilizers: Manufacturing of Ammonium Sulphate, Ammonium Chloride, Ammonium Nitrate and urea; P- fertilizers: sources, processing rock phosphate, bones for bone meal preparation; K- fertilizers: sources, Potassium Chloride, Potassium Sulphate and Potassium Nitrate; Biofertilizers: Classification and value; viz., <i>Rhizobium</i>, <i>Azotobacter</i>, <i>Azolla</i>, Blue Green Algae, VAM</p>	16
III	<p>Agrochemicals for pest management: Conventional chemicals/ pesticides based on target species: Acaricides, Fungicides, Rodenticides, Nematicides, Molluscicides, Fumigants and Repellents; Based on chemical nature: Organophosphates; Organochlorines, Carbamates etc.; Structure, chemical name, physical and chemical properties; Degradation metabolism, Mode of action, uses, toxicity; Application of Pesticides, devices used; dose estimation for field application.</p>	14
IV	<p>Botanicals and other biopesticides: Potential pesticidal plants; Plant extracts and Bio-organisms: Azadirachtin and its role in pest control; Other biopesticides: Pyrethrins, Pyrethroids, Rotenone, Nicotine and Nicotinoids. Growth inhibitors or physiological antagonists, chemo-sterilants; pheromones and attractants; Insect growth regulators, juvenile hormones, moulting hormones; Chitin synthesis inhibitors. Moulting Inhibitors. BT methodology, genetically modified and transgenic plants.</p>	15

Suggested books:

1. Phytochemical Biopesticides by Koul, O. and Dhaliwal, G.S
2. Insect pest management by Dent, D.
3. Fundamentals of Plant Pest Control by Roberts, D.A.
4. Biological Control of Insect Pests and Weeds by De Bach, P.
5. Entomology and pest management by Pedigo, L.P.
6. Agricultural insect pests of the tropics and their control by Hill, D.S.
7. Agricultural pests of India and south East Asia by Atwal, A. S.

Entomology

Paper Code: B050905T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Classification of insects up to order and suborders. Introduction to primitive insects and fossil insects, cause of success of insects. Insect integument: Structure, composition and functions, Biochemistry of sclerotization, Functional morphology: Head: Sutures and area of the cranium, Tentorium, Gnathal appendages (antenna and mouth parts), thorax: Pterothorax, Legs and their modification Wing types, abdomen and appendages, head segmentation, wing venation. Flight muscles and its functions, Origin and evolution of insects	15
II	Digestive system: Alimentary canal and physiology of digestion. Circulatory system: Anatomy, physiology; composition of haemolymph. Respiratory system: Structure and physiology Excretory system: Functional architecture	15
III	Nervous system: Structure and physiology. Neuro endocrine system. Sense organs: Chemoreceptors, mechanoreceptors, photoreceptors, sound and light producing organs, visual organs and physiology of vision. Reproductive system: Structure and physiology	15
IV	Detailed classification of the following orders emphasizing selected super families and families: Orthoptera, Isoptera, Coleoptera, Homoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera. Economic importance of these orders. Social life in Isoptera and Hymenoptera. Caste determination in social insects	15

Suggested books:

1. Chapman RF. The Insects: Structure and Function
2. David BV & Ananthkrishnan TN. General and Applied Entomology
3. Duntson PA. The Insects: Structure, Function and Biodiversity.
4. Evans JW. Outlines of Agricultural Entomology
5. Richards OW & Davies RG. Imm's General Text Book of Entomology
6. Snodgrass RE. Principles of Insect Morphology

Parasitology

Paper Code: B050906T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Introduction to Parasitology General introduction; basic definitions and concepts; Animal associations (phoresy, symbiosis, mutualism, symbiosis, parasitism) Types of hosts and parasites; Host specificity; Parasitic adaptations</p> <p>Taxonomy and diversity Morphological taxonomic characters of major parasite groups, Kinds of taxonomic literature and databases and their uses, Process of typification and different zoological types, international code of Zoological Nomenclature (ICZN), Biodiversity of parasites at global and national level</p>	15
II	<p>Ecology, evolution, sampling and processing of parasites Parasites population dynamics, Dimensions and saturation of niches of parasites Parasite manipulation of host behaviour Host–parasite coevolution, Host–parasite interactions (tissue damage, tissue changes, immunological adaptations of parasitism) Collection, fixation and preservation of ectoparasites, Collection, fixation and preservation of endoparasites, Staining protocols Preparation of temporary and permanent ‘whole mounts’, Histological techniques</p>	15
III	<p>Protozoan Parasites of Man and domestic animals: General account, morphology, life-cycle of: <i>Entamoeba histolytica</i> and <i>Giardia lamblia</i> Haemoflagellates: <i>Trypanosoma</i> spp, <i>Leishmania</i> spp. <i>Trichomonas</i> spp.</p> <p>Trematode Parasites of Man and domestic animals: Monogenea General morphology, biology, life-cycle of: <i>Diplozoon</i> , <i>Polystoma</i> Digenea General morphology, biology, life-cycle of: <i>Schistosoma</i> sp <i>Fasciolopsis buski</i>, <i>Paragonimus westermani</i>, <i>Dicrocoelium dendriticum</i></p>	15
IV	<p>Cestode Parasites of Man and domestic animals: General morphology, biology, life-cycle of: Intestinal tapeworms (<i>Taenia solium</i>, <i>Diphyllobothrium latum</i>, <i>Hymenolepis nana</i>)</p> <p>Nematode Parasites of Man and domestic animals: General morphology, biology, life-cycle of: <i>Ancylostoma duodenale</i>, <i>Wuchereria bancrofti</i>, <i>Dracunculus medinensis</i>, <i>Trichinella spiralis</i>, <i>Onchocerca volvulus</i></p> <p>Arthropoda Arthropods as vectors of human pathogens, Biting dipterans (mosquitoes, tsetse flies) Non-biting dipterana (common house fly), Fleas, lice, Acarians (ticks and mites)</p>	15

Suggested books: 1. Foundation of Parasitology by GD Schmidt LS Roberts 2. General Parasitology by TC Cheng 3. Helminths, Arthropods and Protozoa of domesticated animals by E.J.L Soulsby 4. Parasitology: The Biology of animal parasites by ER Noble GA Noble 5. Animal Parasitology by JD Smyth 6. General Parasitology by Dogiel, V. A 7. The Trematoda by Dawes, B

Ichthyology

Paper Code: B050907T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Evolutionary Classification (Prepared by Berg and Romer) and its demerits, classification by modern approach, ostracoderms, placoderms. Origin and Evolution of elasmobranchs and bony fishes Origin and Adaptive Radiation of various groups Fish fauna in India with special reference to U.P. and Bihar	15
II	Identification of fishes, study and preparation of identification key of the fish with suitable diagram, Fin formula, local and biological names. Study of differentiating character of pair of fishes with special reference to Fin formula with suitable diagram, local and biological names. Fish decomposition and rigor Mortis	15
III	Zoogeography, distribution of fishes; discontinuous distribution Local fish fauna – food fishes, forage fishes, predatory fishes, insectivorous fishes and wood fishes. Fish preservation and processing Fish genetic resources: Fish Biodiversity, Stock (concept and structuring), Fish chromosome and karyotyping, Chromosome Banding, Chromosome Manipulation (Gynogenesis, Androgenesis and Polyploidy)	15
IV	Migration – Type of migratory fishes, physiological and applied aspects of migration, migration of Eel, Salmon and Hilsa. Types of food and feeding habits, monophagic, stenophagic and euryphagic fishes. Diseases in fishes – fungal diseases, bacterial diseases, protozoan and helminths infections and their control	15

Suggested books:

1. Freshwater Fishery Biology by Lagler KF, Bardach, JE, Miller, RR, Passino DRM
2. Fish Physiology by Hoar WS, Randall DJ and Donaldson EM
3. Fundamentals of Fish Taxonomy by Jayaram KC
4. An introduction to Ichthyology by Moyle PB.
5. Handbook of Fish Biology and Fisheries by Paul J.B. Hart and John D. Reynolds
6. Fish and Fisheries of India by Jhingran VG.
7. Ecology and Inland waters and Estuaries by Reid GR.



Endocrinology

Paper Code: B050908T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Introduction to endocrinology: History, characteristics and classification of hormones, Evolution of Endocrine glands, Cytological and histochemical organization of endocrine cells General organization of Neuro-endocrine organs: Hypothalamo-hypophyseal system, Hormones from Hypothalamus: Chemistry and Physiological actions Regulation of hypothalamic hormone secretion Pituitary gland: development, comparative anatomy and cytology, regulation of Pituitary hormone secretion, Hormones from Adenohypophysis: Chemistry and Physiological action, POMC related peptides. Hormones from Pars intermedia and Pars nervosa: Chemistry and Physiological action</p>	15
II	<p>Pineal Gland, Thyroid and Parathyroid gland: Biological clock and Pineal gland, Synthesis and regulation of melatonin, regulation of Pineal gland by SCN and vice-versa, physiological actions of melatonin Thyroid Gland: Histology Thyroid hormones- Chemistry, secretion, transport, physiological and metabolic functions, physiological functions of Parathormone ANF, Leptin and obesity, hormone and calcium homeostasis</p>	15
III	<p>Adrenal gland: Anatomy, histology, adrenal cortex, Corticosteroids: structure, nomenclature and function, Renin-Angiotensin System Adrenal medulla: Sympatho-adrenal system, general adaptation syndrome, catecholamine: structure, nomenclature and function Endocrine Pancreas: Anatomy and cytology, Insulin: structure, regulation of insulin secretion and physiological actions, Glucagon: structure and physiological actions, Diabetes mellitus-types and management GI Tract Hormones: types, source and functions</p>	15
IV	<p>Gonadal Hormones: Male and Female Sex corticoids: Structure and functions, spermatogenesis, oogenesis. Hormonal regulation of reproductive cycle: Estrus cycle, menstrual cycle, ovulation, foetal -placental unit, hormonal control of pregnancy, parturition and lactation Pathophysiology of Pituitary, Thyroid, Parathyroid, Adrenal glands Ultimobranchial body, Corpuscles of stannius, Urophysis., Insect hormones and their functions</p>	15

Suggested books: 1. Vertebrate Endocrinology by Norris 2. Comparative Vertebrate Endocrinology by Bentley 3. Basic & Clinical Endocrinology by Greenspan and Strewler 4. Williams Textbook of Endocrinology: H. M. Kronenberg, S. Melmed, K. S. Polonsky 5. Neuroendocrinology: Charles B. Nemeroff 6. Essential Endocrinology: Darville Brook, C.G. & Marshall 7. Endocrinology: Mac E. Hadley, Jon E. Levine 8. General and Comparative Endocrinology: John B. Allard 9. Endocrinology Vol 1 and 2 by LESLIE J. DeGROOT J. LARRY JAMESON 10. Harrison's endocrinology by J. Larry Jameson

Environmental biology

Paper Code: B050909T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Definition and scope of ecology in modern perspective. Climatic factors: Temperature, light, precipitation with special reference to biomes. Climate diagrams. Animals' adaptations and performance in response to extreme climatic variables (ecto-, endotherms; dark and light adaptations). Water budget; water conservation and regulation in terrestrial and aquatic environments. Biogeographical zones of India; theory of island biogeography	15
II	Structure and function of ecosystem: Abiotic factors affecting survival and sustenance of organisms e.g., water, temperature, light, pH and salinity. Role of limiting factors in survival of biotic components. Major ecosystems of the world: Ecological features, limiting factors, zonation and classification of organisms of fresh water and marine ecosystems. Introduction to Biome: Ecological features of Tundra, Desert, Savannah and Tropical Rain Forest Biomes. Energy flow in ecosystem, food chain and food web. Productivity. Mineralization and recycling of nutrients: C, N, P & S	15
III	Population ecology; Human population growth- Ecology of populations: Unitary and Modular populations. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves. Unique and group attributes of population: mortality, age ratio, sex ratio, dispersal. Factors regulating population dispersal and growth: Exponential and logistic growth. Population regulation: density-dependent and independent factors; r and k strategies.	15
IV	Environmental degradation; Environmental movement- Environmental ethics; Pollution: Air, water and noise pollution and their control; Natural resources: Mineral, water and forest, their significance and conservation; Types of biodiversity, Hotspots, benefit and threat of conservation strategies; Application of ecology in management and Conservation programmes. Role of gender and cultures in environmental conservation. Environmental movements: Bishnois. Chipko, Silent valley, big dam movements. Environmental education and public awareness	15

Suggested books:

1. Stiling, P. D. Ecology Companion Site: Global Insights and Investigations
2. Kendeigh, F C. Ecology with Special Reference to Animal and Man
3. Southwood, T.R.E. and Henderson, P.A. Ecological Methods
4. Ricklefs, R.E. Ecology
5. Odum, E.P., Fundamentals of Ecology
6. Colinvaux, P. A. Ecology

Animal Cytogenetics

Paper Code: B050910T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	General characteristics of living beings. Cell theory and Cell cycle - mitosis and meiosis. Cell Membrane – modifications and physiology, chemical composition and structure; permeability and transport; plasma membrane specializations (microvilli, cilia, glycocalyx, junctions). Protoplasm -Chemical and physical nature.	15
II	Cell organelles Ultrastructure, chemical composition, function and significance: Nucleus, and all organelles including lysosomes, centrosome and plasmids. Cilia, flagella, basal bodies and Parthenogenesis. Cytoskeleton and cell motility. Cell metabolism - Energy metabolism and biosynthesis of carbohydrates, proteins; lipids, nucleic acids, and their catabolism	15
III	Chromosomes - Giant chromosomes, Isochromosomes, heterochromatin, euchromatin, chromosome proteins, arrangement of chromatin in chromosomes, Nomenclature of mammalian chromosomes; Banding and karyotypes Chromosomal aberrations- Deletion, duplication, translocation and numerical aberration. Sex determination - Primary and secondary sex characters; sex chromosome structure and mechanisms of sex determination, sex chromatin and Y body	15
IV	DNA replication, transcription and translation of genetic information. Transformations of matter and energy demand: catabolism, anabolism, metabolism, Autotrophy, heterotrophy, metabolic pathways and chemical energy. Basic techniques for morphological analysis of cells and tissues; tools and sample preparation for microscopic and sub microscopic analysis	15

Suggested books:

1. Cell Biology by Gerald Carp
2. The Cell by Cooper and Hausman
3. Molecular Biology of Cell by Lodish
4. Cell and Molecular Biology by De Robertes
5. Molecular Cell Biology by Alberts
6. Culture of Animal Cells by Freshney
7. Gene XI by Lewin B.
8. Genetics by Benjamin A. Pierce

Practical Syllabus

Semester III

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B050911P

Practical

Max. Marks 100 (25+75)

The duration of the practical examination will be 04 hours. The distribution of marks will be as follows-

Section A:

- | | |
|--|----|
| 1. Exercises based on B050901T | 10 |
| 2. Exercises based on B050902T | 10 |
| 3. Exercises based on B050903T/ B050904T | 10 |

Section B: (Specialization)

Exercises based on B050905T/ B050906T/ B050907T / B050908T/ B050909T/ B050910T 45

Grand Total = 75

Distribution of marks of Continuous Internal Assessment (CIA):

- | | |
|---|----|
| 1. Examination | 15 |
| 2. Seminar/Presentation/Assignment/Quizzes..... | 10 |

Grand Total = 25



M.Sc. Semester-III

Zoology Practical Examination (ESE)- 20....

Date:

Batch:

Duration: 4 hrs

Max. Marks: 75

Question Paper

Section -A

- Q.No.1.** Any one exercise based on Ethology or Biodiversity **10**
- Q. No. 2.** Any one exercise based on Molecular biology/Immunology **10**
- Q. No. 3.** Any one exercise based on waste management and sustainable development/
Agrochemicals and Pest Management **10**

Section-B (Entomology)

- Q. No. 4.** Dissect the animal provided (.....) so as to expose its **10**
nervous system/digestive system/reproductive system as clearly as possible. Display your
dissection suitably. (Cockroach/ *Gryllotalpa*/ Grasshopper/ *Apis*/ *Vespa*)
- Q. No. 5.** Comment upon Insecticide Application Equipment given **05**
- Q. No. 6.** Identify and comment upon spots. (1-10) **15**
- Q. No. 7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **05**

Section-B (Parasitology)

- Q. No. 4.** Make a suitable permanent stained preparation of any Protozoan provided. Identify it **05**
- Q. No. 5.** Make a suitable permanent stained preparation of any Cestode provided. Identify it **05**
- Q. No. 6.** Make a suitable permanent stained preparation of any Trematode provided. Identify it **05**
- Q. No. 7.** Make a suitable temporary glycerine preparation of any Nematode provided. Identify it **05**
- Q. No. 8.** Identify and comment upon spots. (1-10) **10**
- Q. No. 9.** Viva-voce **10**
- Q. No.10.** Practical record/ Collection/ Chart **05**



Section-B (Ichthyology)

- Q. No. 4.** Dissect the animal provided (.....) so as to expose its **08**
Cranial nerves/pituitary gland as clearly as possible. Display your dissection suitably.
(*Mystus/Dasyatis/Labeo/Torpedo*)
- Q. No. 5.** Make a suitable permanent stained preparation offrom the **04**
material / animal..... provided
- Q. No. 6.** Identify and comment upon the **specimen A** (Local fish) **specimen B** (Estuarine/ Marine Fish) **04**
- Q. No. 7.** Any one exercise from Physiological and Biological experiments **04**
- Q. No. 8.** Identify and comment upon spots. (1-10) **10**
- Q. No. 9.** Viva-voce **10**
- Q. No.10.** Practical record/ Collection/ Chart **05**

Section-B (Endocrinology)

- Q. No. 4.** Dissect the animal provided (.....) so as to expose its **10**
Any one endocrine gland as clearly as possible. Display your dissection suitably.
- Q. No. 5.** Make a suitable permanent stained preparation of from the **05**
material / animal..... provided
- Q. No. 6.** Any one exercise based on Immunohistochemistry/Scatchard analysis/RIA **05**
- Q. No. 7.** Identify and comment upon spots. (1-10) **10**
- Q. No. 8.** Viva-voce **10**
- Q. No.9.** Practical record/ Collection/ Chart **05**

Section-B (Environmental Biology)

- Q. No. 4.** Estimation of Soil/water quality (Chemical) **10**
- Q. No. 5.** Estimation of Plankton number in a given sample (Qualitative and Quantitative) **10**
- Q. No. 6.** Any one exercise based on determination of frequency of individual species **10**
- Q. No.7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **05**



Section-B (Animal Cytogenetics)

- Q. No. 4.** Make a suitable stained preparation of Polytene chromosomes from the animal provided **05**
- Q. No. 5.** Make a suitable stained (Methyl Green pyronin Y) preparation of nucleolus/Chromatin **05**
- Q. No. 6.** Make a suitable stained preparation of mitochondria using Janus green **05**
- Q. No. 7.** Make a suitable preparation of stages of Meiosis using squash technique **05**
- Q. No. 8.** Identify and comment upon spots. (1-10) **10**
- Q. No. 9.** Viva-voce **10**
- Q. No.10.** Practical record/ Collection/ Chart **05**

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Detailed Syllabus of Semester III

B050901T Ethology, Biodiversity and Wildlife Conservation

1. To study phototaxis in *Pheretima* and house fly
2. To study geotaxis behaviour in earthworm
3. To study olfactory behaviour in house fly
4. To construct an ethogram
5. Nests and nesting habits of the birds and social insects
6. To measure the species diversity through species richness indices
7. Identification and study of common insects, fish, birds, mammals of a particular area
8. Sampling methods (including diversity assessment) for invertebrates (Insects, snails) and vertebrates (birds)
9. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report

B050902T Molecular Biology, Immunology and Bioinformatics

1. Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs)
2. Isolation of genomic DNA by ethanol precipitation method
3. Identification of various stages of meiosis in the testes of grasshopper
4. Study and interpretation of electron micrographs/ photograph showing
(a) DNA replication (b) Transcription (c) Split genes
5. Detection of polytene chromosome in salivary gland cells of the larvae of the *Chironomus*
6. To stain mitochondria in human cheek epithelial cells using Janus green
7. Histological study of spleen, thymus and lymph nodes through slides/photographs
8. Principles, experimental set up and applications of immuno-electrophoresis, ELISA, RIA, FACS

B050903T Waste management and sustainable development

1. Prepare a model/chart showing the importance of rain water harvesting
2. Diagrammatic presentation of recycling of plastic in an ideal condition through a chart/model
3. Visit to a solar plant to learn their working
4. Visit to a wind mill at village area to learn and make project about wind energy
5. To collect the underground water from various surrounding sites and test the physico-chemical properties for the domestic and agricultural use
6. To study acidity and alkalinity of sample water by methyl orange and phenolphthalein
7. To determine Cl, SO₄, NO₃ in soil and water samples from different locations
8. Study of solid waste management through charts

B050904T Agrochemicals and Pest management

1. Identification of common natural enemies of crop pests (Parasitoids, predators, microbes)
2. Study the damage caused by the commonly occurring insect pests – Infected plant/plant parts
3. Sampling of fertilizers and pesticides
4. Quick tests for identification of common fertilizers, Identification of anion and cation in fertilizer
5. To study and identify various formulations of insecticide available in the market



B050905T Entomology:

(A) Major Dissection:

Digestive system, Nervous system, reproductive system of following insects-

1. Cockroach
2. *Gryllotalpa*
3. Grasshopper
4. *Apis*
5. *Vespa*

(B) Minor Dissection:

1. Tentorium, Tympanum and spiracles of Grasshopper
2. Gizzard, Endocrine system, Heart and blood vessels of Cockroach
3. Cardiac glands of *Gryllotalpa*
4. Aristate antenna and Haltere of *Musca*
5. Sting apparatus of *Apis* and *Polistes*

(C) Study of Museum specimens and prepared slides of important Insects (Selected from the Orders of insects as per theory course for the purpose of identification)

(D) Exercises on growth and development of insects using following biostatistical calculations; Chi-square test, Growth index, Dyar's law, Howe's index values, critical differences, standard deviation, standard error, Transformed and Angular values.

(E) Study of histological preparations of Grasshopper viscera exposed to easily available insecticides/Pesticides

(F) Study of Insecticide Application Equipment's:

1. Fumigators
2. Sprayers
3. Dusters

(G) Collection and identification of Insects:

1. Pests
2. Parasitoids
3. Predators
4. Other beneficial Insects
5. Insect of Taxonomic importance

B050906T Parasitology:

1. Study of methods of collection and preservation of Parasites (Protozoans, Helminths and Arthropods)
2. To collect and preserve parasites from different invertebrate/vertebrate hosts in Lab
3. Study of prepared slides of protozoan parasites, Helminths and Arthropod Parasites
4. **Permanent stained preparation and identification of Protozoans**
(Rectal ciliates, *Monocystis*, Blood film for *Plasmodium*, *Leishmania*, *Trypanosoma*, *Herpetomonas*)
5. **Permanent stained preparation and identification of Cestodes**
(*Raillietina*, *Cotugnia*, *Stilesia*, *Moniezia*, *Avitellina*)
6. **Permanent stained preparation and identification of Trematodes**
(*Fasciola*, *Fasciolopsis*, *Gastrothylax*, *Gastrodiscoides*, *Paramphistomum*, Redia larva, Cercaria larva)
7. **Temporary glycerine preparation and identification of Nematodes**
(*Ancylostoma*, *Ascaridia*, *Trichuris trichura*, *Bunostomum*, *Oesophagostomum*, *Enterobius*)
8. **Permanent preparation and identification of arthropod parasites**
(*Pediculus*, *Haematopinus*, *Cimex*, larval forms, Ticks, Mites)
9. Detection of presence or absence of cholesterol in the solution provided

B050907T Ichthyology:

1. Major Dissection:

Mystus – Cranial nerves
Dasyatis – Cranial nerves
Labeo – Cranial nerves
Torpedo – Cranial nerves
Exposure of Pituitary from a fresh water fish

2. Minor Dissection:

Accessory respiratory organs of *Heteropneustes*, *Channa* and *Anabas*
Eye and eye muscles
Weberian ossicles of fresh water fish

3. Permanent Preparations:

Ampullae of Lorenzini of *Dasyatis*
Different types of scales
T.S. of spine of *Dasyatis*
Weberian ossicles of *Labeo*
Blood film
Nerve fibre
Hand section of Olfactory organs

4. Study of various methods of fishing (Nets and Gears) through charts/Photographs

5. Taxonomic identification:

- (a) Collection, preservation and identification (up to species level) of Local Ichthyofauna
- (b) Study of Important Estuarine and Marine fishes from museum specimen

6. Study of prepared slides of fishes (Histology)

7. Study of endoskeleton of a bony fish (Disarticulated bones)

8. Physiological and Biological experiments:

- (a) Comparative study of Dissolved Oxygen (DO) of the sample of tap water and pond water
- (b) Comparative study of alkalinity of the sample of pond water and river water
- (c) Estimation of Hardness, Chloride, Planktons in the sample of water provided
- (d) To determine the relationship between body length and body weight (g) of the given sample of fish

B050908T Endocrinology

1. Dissection of a suitable vertebrate to show Pituitary, Thyroid, Adrenal, Pancreas and Gonads
2. Surgical procedures of Orchidectomy, Bilateral ovariectomy, Thyroidectomy and adrenalectomy in Rat
3. Study of histological slides of endocrine glands from fish to mammals
4. Preparation of microtomic permanent slides of endocrine glands from fish to mammals (at least 20)
5. Study of Parabiosis in Rat
6. Study of Radio Immuno Assay and Scatchard analysis
7. Study of Immunohistochemistry to visualize the expression pattern of hormone or receptor



B050909T Environmental Biology

1. Determination of minimum size of Quadrate (Species area curve)
2. Determination of minimum number of quadrates
3. Study of life tables and plotting of survivorship curves of different types from the hypothetical data
4. Determination of frequency of individual species: Line transect method, point frame method
5. 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), Chemical Oxygen Demand and free CO₂
6. Study of biomass of producers in the field
7. Study of physical and chemical characteristics of soil
8. Study of different ecosystems to construct ecological pyramids
9. Exercises on population, toxicology and genetics on the basis of provided data
10. Observations and studies on planning and management of Zoological Garden, Wild life sanctuaries and national parks for the conservation of animals

B050910T Animal Cytogenetics

1. Study of somatic chromosomes preparation from bone marrow of rat
2. Demonstration of preparation of polytene chromosomes from salivary glands of *Drosophila melanogaster* larva OR larva of *Chironomus*
3. Staining of nucleolus (RNA) and chromatin (DNA) with methyl green-pyronin Y
4. Stained preparation of the mitochondria in striated muscle cells/cheek epithelial cells using Janus green
5. Use of colchicine in arresting anaphase movement (onion root tips)
6. Preparation of chromosome squashes from grasshopper testes/Rat testis for the observation of stages of meiosis
7. Preparation of permanent slide to show the presence of Sex chromatin in female rat
8. Study of prepared slides and photomicrographs showing ultrastructure of cell and cell organelles of prokaryotes and animal eukaryotic cells
9. Study of lethal hereditary syndromes in man with the help of chart
10. Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures

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Semester-IV

       

Ecology and Toxicology

Paper Code: B051001T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Ecology: its relevance to human welfare, sub divisions and scope. The environment: physical environment, biotic environment. Biotic and abiotic interaction.</p> <p>Climate, soil and vegetation patterns and organizations: Life zones, major biomes, Vegetation, Soil types, concept of community, Ecological Succession</p> <p>Ecosystems organization structure and functions, primary production, energy dynamics, litter fall and decompositions, Global BGC Cycles, mineral cycles in terrestrial and aquatic ecosystems. Concept of Habitat and Niche</p>	15
II	<p>Biological Interactions: Predation: Predator-Prey interaction, Host parasite interaction, Types and theories of competition, commensalism and mutualism, Plant- Pollinator and animal-animal interactions</p> <p>Environmental pollution: types, Sources effects on plant and animal ecosystems</p> <p>Greenhouse gases, Ozone layer and ozone hole, consequences of climatic changes.</p> <p>Ecological management: concepts, sustainable development, sustainability indicators, degraded ecosystems and their regeneration with special reference to waste lands, forests and aquatic ecosystems</p>	15
III	<p>Definition, history, scope & sub-divisions of toxicology.</p> <p>Dose-effect and dose-response relationship- acute toxicity, chronic toxicity reversible & irreversible effects.</p> <p>Classification of toxic agents, natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins.</p> <p>Factors affecting toxicity – species and strain, age, sex, nutritional status, hormones, environmental factors, Toxicity Tests: Acute toxicity tests for terrestrial and aquatic animals, Chronic toxicity tests, Concept of maximum acceptable toxicant concentration (MATC) and safe concentration</p>	15
IV	<p>Absorption and distribution of toxicants-portals of entry-skin, gastro intestinal tract, gills and respiratory system.</p> <p>Bio-distribution, biomagnification biotransformation of xenobiotics- brief introduction to Phase-I and Phase-II reactions. Safety evaluation of xenobiotics</p> <p>Antidotal therapy</p> <p>Reactions of toxins with target molecules- Covalent binding, non-covalent binding, Hydrogen abstraction, Electron transfer, Enzymatic reactions</p> <p>Elimination of toxicants-renal, hepatic, DMES, pulmonary systems, milk, egg and foetus</p>	15

Suggested books:

1. Odum, E. P. Basic Ecology
2. Stiling, P. Ecology: Theories and Applications.
3. Begon, M.: Harper, J. L. & Townshend. C. R. Ecology
4. Kormondy, E. J. Concepts of Ecology
5. Ecological Modeling. Grant, W.E. and Swannack
6. Derelanko & Auletta. Handbook of Toxicology
7. Casarett & Doull's Toxicology: The Science of Poisons

Public health and Hygiene

Paper Code: B051002T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Maintenance of personal hygiene: Introduction to public health and hygiene- determinants and factors. Pollution and health hazards; water and air borne diseases. Radiation hazards: Mobile Cell tower and electronic gadgets (recommended levels, effects and precaution). Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.	15
II	Nutrient deficiency diseases: Classification of food into micro and macro nutrients. Balanced diet, dietary plan for an infant, normal adult, pregnant woman and old person. Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia (Iron and B12 deficiency), Kwashiorkor, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure). Substitution of diet with required nutrients to prevent malnutrition disorders	15
III	Non-communicable diseases and cure: Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles (cause, symptoms, precaution and remedy) etc. Obesity (Definition and consequences). Mental illness (depression and anxiety). Oral and lung cancer and their preventive measures.	15
IV	Communicable and contagious diseases: Infectious agents responsible for diseases in humans. Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chikungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, whooping cough, diphtheria, leprosy. Sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases	15

Suggested books:

1. Gibney, M.J. Public Health Nutrition.
2. Wong, K.V. Nutrition, Health and Disease.
3. Mary Jane Schneider. Introduction to Public Health.
4. Muthu, V.K. A Short Book of Public Health.
5. Detels, R. Oxford Textbook of Public Health



Human nutrition and therapeutics

Paper Code: B051003T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	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. Nutritional Biochemistry: Macronutrients. Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role. Micronutrients. Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions	15
II	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.	15
III	Food hygiene: Potable water- sources and methods of purification at domestic level. Food and 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.	15
IV	Therapeutic Nutrition: Therapeutic adoption of normal diets (normal, soft & fluid diets) factors to be considered in planning therapeutic diets, drugs & diet interaction, special feeding methods, pre& post operative diets, role of dietician, dietary calculation using food exchange lists, high & low-calorie diet, high protein, high fat, & low carbohydrate diets Therapeutic Diets: Etiology, physiological disturbances, biochemical & clinical manifestations & dietary management of: Fever & infection, Allergy & skin disturbances, Hepatitis, cirrhosis, Diabetes mellitus, cardio vascular disorder. Hyper-lipidemia & Atherosclerosis, Heart disease, hypertension, Coma, Trauma	15

Suggested books:

1. Gopalan, C., Ramasastri, B.S. & Balasubramanian, S.C. Nutritive value of Indian foods.
2. Ghosh, S. The feeding care of infants and young children
3. Swaminathan, M. Handbook of food and nutrition.
4. Swaminathan, M. Essentials of food and nutrition. Vol I & II

Microbiology

Paper Code: B051004T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Microbiology: A brief account of pathogenic bacteria and viruses. Brief history of microbiology- germ theory of disease, discovery of penicillin. Diversity of microbes- viruses and bacteria. Host pathogen interaction: invasion, antigenic heterogeneity, toxins and enzymes secretions. Kinetics of bacterial growth and staining techniques.	15
II	Diseases caused by Microbes: Viral diseases: polio, rabies, hepatitis, influenza, dengue, AIDS, chicken pox, swine flu, chikungunya with emphasis on their causative agents, pathogenesis, diagnosis, prophylaxis and chemotherapy. Bacterial diseases caused by <i>Bacillus anthracis</i> , <i>Streptococcus pyogenes</i> , <i>Streptococcus pneumoniae</i> , <i>Salmonella typhi</i> , <i>Escherichia coli</i> , <i>Helicobacter pylori</i> , <i>Mycobacterium tuberculosis</i> , <i>Vibrio cholerae</i> . Fungal diseases: Ringworm infection, aspergillosis, candidiasis.	15
III	Microbes in air and water Aero microbiology: Intramural and extramural aero-microbiology, Aerosols and Bioaerosols: Sources and launching, Diversity and Survival of microbes in air, control, Aeroallergens, Pollen allergy, Hypersensitivity, effect of climate change on pollen and spore discharge. Aquatic microbiology: aquatic environment; fresh, brackish and marine waters and their microbiology, hydrothermal vents, hot spring, Arctic and Antarctic environment	15
IV	Nutrient recycling and manuring: Biogeochemical cycling: Carbon, Nitrogen, Phosphorus and Sulphur; Importance. Biofertilizers: Definition, types, mass cultivation, inoculums preparation, quality control, significance and applications. Vermicomposting	15

Suggested books:

1. Pepper, I.; Gerba, C. and Gentry, T. Environmental Microbiology
2. Jawetz, M. and Adelberg. Medical Microbiology
3. Brock Biology of Microorganisms by Michael T. Madigan
4. Microbiology: An Introduction by Tortora et al.
5. Microbiology: Laboratory Theory & Application by M. Leboffe

Biotechnology

Paper Code: B051005T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Animal and Medical Biotechnology: Introduction and scope of Animal Biotechnology, Transgenic and knockout animals and their importance. Genome editing- CRISPR/Cas9, TALEN and ZFN. Nano-medicine, artificial blood, Vaccines and therapeutics, Monoclonal antibodies, Gene therapy	15
II	Stem cells and Regenerative Medicines: Embryonic stem adult and Cancer stem cells. Stem cells and renewal in epithelial tissues, fibroblast and their reformation. Genesis and regeneration of skeletal muscle, blood vessels, lymphatics and endothelial cells. Regeneration and repair, cell reprogramming and pluripotent stem cells.	15
III	Recombinant DNA, Genomics, DNA Fingerprinting and Forensic Analysis: rDNA technology and its applications, Brief account of restriction endonucleases: types and classification. Cloning vectors, Difference in cDNA and genomic library, C-value paradox. Some examples of the useful recombinant proteins: Insulin, Streptokinase, enzymes, antibodies, vaccines, Labelling of nucleic acids, DNA fingerprinting.	15
IV	Aquatic Biotechnology, Biotechnological regulations and Bioethics: Introduction. Transgenic fish-from Glofish to Giant Trout, Transgenic Salmon, Zebra fish, GFPs, Antifreeze proteins, Drugs and medicines from marine sources FDA guidelines-phase testing. Introduction to patents. CPCSEA Regulations, Bioethical issues.	15

Suggested books:

1. Primrose, S.B. and Twyman, R. Principles of Gene manipulation and Genomics
2. Nicholl, D.S.T. An introduction to Genetic Engineering
3. Watson, J.D. Recombinant DNA
4. Brown, T.A. Gene Cloning and DNA Analysis: An Introduction
5. Introduction to Biotechnology by Theinman & Palladino
6. Biotechnology for Beginners by Reinhard Renneberg
7. Biotechnology by Elley Daugherty



Applied Entomology

Paper Code: B051006T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Effects of physical factors: population dynamics, Intraspecific and interspecific relations: host plant insect – interactions, Biochemical adaptation to environmental stress. Pheromonal control of fertility in insects. Embryology: Embryonic and post embryonic development: diapause, types of larvae, pupae and metamorphosis. Role of endocrine glands in growth and development, viviparity and parthenogenesis	15
II	General idea of damage caused by pests. Principle methods of pest control. Insecticides: Types, mode of action and methods of application. General idea of appliances used in the insecticide treatment and their safe handling A general account of chemosterilants, attractants, repellents, pheromones, growth regulators and such other compounds. Development of resistance to pesticides Insecticide synergists and antagonists	15
III	Life history, damage caused and control of three major pests of each of the following crops: Wheat, paddy, maize, jowar, millet, sugarcane, cotton, mustard and soyabean. Stored grain and milled product pests: <i>Sitophilus</i> , <i>Rhyzopertha</i> , <i>Tribolium</i> , <i>Trogoderma</i> , <i>Oryzaephilus</i> . An elementary idea of storage Pests of veterinary and medical importance. preliminary idea of insect borne diseases. Life cycle of aphid and locust and their control.	15
IV	A general idea of plant protection organizations in India; forensic entomology with special reference to human and wild life. Beneficial insects: Silk worm, honey bee, lac insect; their economic importance and industries related to them. Role of genetics in insect vector control. An elementary idea of IPM	15

Suggested books:

7. Chapman RF. The Insects: Structure and Function
8. David BV & Ananthkrishnan TN. General and Applied Entomology
9. Duntson PA. The Insects: Structure, Function and Biodiversity.
10. Evans JW. Outlines of Agricultural Entomology
11. Richards OW & Davies RG. Imm's General Text Book of Entomology
12. Snodgrass RE. Principles of Insect Morphology



Clinical Parasitology

Paper Code: B051007T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Causes, Symptoms, Diagnosis, Treatment and control of following diseases: (i) Amoebiasis, Trpanosomiasis, Leishmaniasis, Malaria, Trichomoniasis, Giardiasis (ii) Schistosomiasis, Faciolopsiasis, Dicrocoeliasis, Paragonimiasis	15
II	Causes, Symptoms, Diagnosis, Treatment and control of following diseases: (i) Taeniasis, Diphyllbothriasis, Hymenolepsiasis, Human hydatidosis, Human cysticercosis Hook worm disease, Filariasis, Dracunculiasis, Trichinosis, Onchocerciasis	15
III	Immuno-parasitology: Immunology in relation to Parasitism, Immunity and parasitic populations, immunomodulation by parasites, Immunodiagnosis, Intradermal test and their significance, Immunopathology in parasitic infection Parasitism and Vaccination Vaccines against protozoan and helminth parasites	15
IV	Physiology and biochemistry of Parasites: Physiological basis of Parasitism Absorptive, secretory and excretory features of tegument Physiology of digestion, excretion and respiration Metabolism of protein, lipid and carbohydrate In Vitro cultivation of Parasites (Trematodes, Cestodes and Nematodes) Physiology of egg-shell formation	15

Suggested books:

1. Clinical Parasitology by Craig, C. F., and Faust, E. C.
2. Parasitic Diseases by Katz, M., Despommier, D.D., and Gwadz, R.
3. The Physiology of Nematodes by Lee, D. L.
4. The Physiology of Cestodes by Smyth, J. D. & Macmanus
5. H u n t e r ' s Tropical Medicine by Strickland, G. T.
6. Biochemistry of Parasites by von Brand, T.
7. A text book of clinical parasitology by Belding
8. Physiology of Trematodes by Smyth & Halton
9. Immunology of Parasitic Infections by Cohen & Warren
10. Immunity to parasite By Derek Wakelin
11. Clinical parasitology by Beaver PC, Jung, RC, Cupp, EW
12. Medical Parasitology by Markell EK, Voge M, John, DT
13. Molecular Parasitology by JE Hyde
14. Manson's Tropical diseases
15. Basic clinical parasitology by Franklin A. Neva & Brown
16. Clinical Parasitology by Zeibig

Applied Ichthyology

Paper Code: B051008T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	<p>Fisheries of India; study of marine, freshwater, estuarine and cold-water fisheries. Riverine fisheries with special reference of north India and their fisheries.</p> <p>Prawn Fisheries – fishing method, culture methods, pollution in prawn fisheries in India.</p> <p>Pond culture: types of fish farming, planning and construction of fish farm, physiological and biological characteristics of fish farms; and their maintenance and improvement.</p>	15
II	<p>Fishing Method: Seawater fishing method (Crafts of east and west coast, tackles, electric fishing, light fishing and by eco-sounders), inland waters fishing (Crafts and tackles)</p> <p>Principal cultivable fishes: Indigenous and exotic species, procurement of seed, collection, identification and transport of seed.</p> <p>Tagging of fishes</p> <p>Fish marketing and their transport</p>	15
III	<p>Induced Breeding: stripping, hypophysation technique, bund fisheries, indoor hatcheries and hapa technique.</p> <p>Fish products like oil, fish sauce, fish glue, etc.</p> <p>Relationship between age, growth, length and weight</p>	15
IV	<p>Development – Gastrulation, neurulation, organ formation, larval development and metamorphosis.</p> <p>Seasonality, prolific breeders; oviparity and viviparity, fecundity.</p> <p>Endocrinal regulation, embryogenesis of any carp fish, parental care in fishes</p>	15

Suggested books:

8. Freshwater Fishery Biology by Lagler KF, Bardach, JE, Miller, RR, Passino DRM
9. Fish Physiology by Hoar WS, Randall DJ and Donaldson EM
10. Fundamentals of Fish Taxonomy by Jayaram KC
11. An introduction to Ichthyology by Moyle PB.
12. Handbook of Fish Biology and Fisheries by Paul J.B. Hart and John D. Reynolds
13. Fish and Fisheries of India by Jhingran VG.
14. Ecology and Inland waters and Estuaries by Reid GR

Molecular Endocrinology

Paper Code: B051009T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Chemical nature and properties of hormones Purification and characterization of hormones- RIA, ELISA, HPLC, Immunoassay, Immunocytochemistry, assay methodologies, Analysis of gene expression in endocrine system, animal model of endocrine research Modern endocrine technologies: RNA extraction, RT-PCR, Hormone Localization-Northern blot, ISH	15
II	General class of hormones: Peptide, steroid, amines, neurohormones, Pheromones, Chalcones etc. Biosynthesis of peptide hormones: production of Insulin and GH hormones by r-DNA technology. Biosynthesis of catecholamines, Chemistry and synthesis of Steroid hormones, steroid hormone metabolism, biosynthesis of thyroid hormones	15
III	General mechanism of hormone action: Receptor and types, cytosolic receptor, surface receptor, nuclear receptor Signal transduction, second messenger, G protein, phosphorylated proteins as physiological effectors Multiple membrane messengers- PIP3, DAG, protein kinase C. Mode of action of Steroid and Thyroid hormone, Receptor regulation, Termination of hormone action	15
IV	Hormone and behaviour- Hormone disruptors chemicals, cellular and molecular action of semiochemicals, pharmacokinetics of Hormones. Eicosinoid: Structure, synthesis and actions. Hormones as therapeutics agents, recombinant protein hormones: production and their application design and production of hormonal contraceptives, Current development in hormone research	15

Suggested books:

1. Vertebrate Endocrinology by Norris
2. Comparative Vertebrate Endocrinology by Bentley
3. Basic & Clinical Endocrinology by Greenspan and Strewler
4. Williams Textbook of Endocrinology: H. M. Kronenberg, S. Melmed, K. S. Polonsky and P. R. Larsen
5. Neuroendocrinology: Charles B. Nemeroff
6. Essential Endocrinology: Darville Brook, C.G. & Marshall
7. Endocrinology: Mac E. Hadley, Jon E. Levine
8. General and Comparative Endocrinology: John B. Allard
9. Endocrinology Vol 1 and 2 by LESLIE J. De GROOT J. LARRY JAMESON
10. Harrison's endocrinology by J. Larry Jameson

Applied Environmental Biology

Paper Code: B051010T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Environmental aspects of Human population demography, growth factors regulating human population. The impacts on environmental imbalance. Environment and development in India, Challenges and Efforts, Land degradation, Water management, urbanization and Industrialization. Global Warming and Climate change, Urban Water management: Sources, Water quality, Solid particles, Content and their types criteria standards, Sewage and Waste water treatment and disposal. Degradation of Natural Resources and the environmental problems.	15
II	Natural Resources and Degradation of Natural Resources, Deforestation and its impact on various forestry's Fauna and flora of India. Soil Resource, Land use in India, Types of Soil in India and soil degradation. Integrated Land use, planning and integrated land. Land degradation. Limitation of Water resource. National waste land Development Board, Role of voluntary Agencies and Non-Government Organization (NGO's) for conservation. Forest Resources. Forest Survey of Indian, Conservation and agroforestry in India. National conversation strategy (NCS) world conservation strategy (WCS).	15
III	Climatic and Topographic Factors, Edaphic (Soil) and Biotic factor, Basic concepts of populations, Populations Characteristics and population dynamics. Ecological succession. Structure and function of Ecosystem. Wild life of India and it's conservation (Brief) Environmental pollutants. Various Source of pollutants, Carbon and Sulphur Compounds, Nitrogen Oxide, Acid Rain, Ozone layer and it's protection. Hydrocarbons, metals and photo chemical product. The black cloud of pollutant. Prevention and control of Air pollution	15
IV	Noise pollution, water pollution and their source. Ground and marine pollution. Mercury, Fluoride and lead pollution. Ganga Action Plan (GAP), Measurement of water quality & management in India. Prevention and control of water pollution. Control of water and Air	15



pollution through Laws, Wetland Conservation, Solid waste pollution and their management.

Radiation and Chemical Toxicology, Chemical Toxicants and their effects on Industrial and agricultural wastes. Eco toxicology: Ecological change and disease, Role of water in human health urbanization, stress and health. Bioindicators and environmental monitoring. Environmental Organization in India. Environmental Organization and agencies, Man and Biosphere programme (MAB), Indian Environmental laws. National Environmental Policy

Suggested books:

4. Stiling, P. D. Ecology Companion Site: Global Insights and Investigations
5. Kendeigh, F C. Ecology with Special Reference to Animal and Man
6. Southwood, T.R.E. and Henderson, P.A. Ecological Methods
7. Ricklefs, R.E. Ecology
8. Odum, E.P., Fundamentals of Ecology
9. Colinvaux, P. A. Ecology

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Clinical Cytogenetics

Paper Code: B051011T

Total Marks:100

Credits:04

Total No. of Lectures:60

Unit	Topics	Total No. of Lectures
I	Concept of gene: Fine structure of gene, split genes, pseudogenes, noncoding genes, overlapping genes and multigene families. Genome organization in viruses, prokaryotes and eukaryotes: Organization of nuclear and organellar genomes. C value paradox, Repetitive DNA satellite DNAs and interspersed repeated DNAs, Transposable elements, LINES, SINES, Alu family and their application in genome mapping.	15
II	Linkage, and crossing over - types of linkage, linkage maps and groups, detection of linkage; cytologic basis of crossing over, crossing over between, three linked genes, gene conversion. Chromosomal compliments in human nomenclature, morphology, karyotype and chemical composition; types of chromatins of different regions of the chromosomes. Dupraw model of human chromosome structure	15
III	Lethal hereditary diseases in man - Sickle cell anaemia, Phenyl - ketonuria, Huntington's chorea, albinism and Galactosemia. Sex chromosomes and abnormalities, Klinefelter's syndrome, Turner's and Down's syndrome, testicular feminization and aged eggs. Genetic and chemical aspect of Rh disease, A, B, O, incompatibility and control, effect of IQ score and phenocopy.	15
IV	Effect of environment on development of characters -external, internal environment. Population genetics - Factors affecting genes, gene frequencies, migration, mutations, selection, fitness, random drift, gone pool, Hardy Weinberg law. Malignancy and its effects.	15

Suggested books:

1. Cell Biology by Gerald Carp
2. The Cell by Cooper and Hausman
3. Molecular Biology of Cell by Alberts et al
4. Cell and Molecular Biology by De Robertes
5. Molecular Cell Biology by Lodish et al
6. Culture of Animal Cells by Freshney
7. Gene XI by Lewin B.
8. Genetics by Benjamin A. Pierce

B051012P

Practical

Max. Marks 100 (25+75)

The duration of the practical examination will be 04 hours. The distribution of marks will be as follows-

Section A:

- | | |
|--|----|
| 1. Exercises based on Ecology and Toxicology B051001T | 10 |
| 2. Exercises based on public health and Hygiene B051002T/
Human nutrition and therapeutics B051003T | 10 |
| 3. Exercises based on Microbiology B051004T/ Biotechnology B051005T | 10 |

Section B (Specialization):

- | | |
|--|-----------|
| 4. Exercises based on B051006T/ B051007T/ B051008T/ B051009T/ B051010T/ B051011T | 45 |
| Grand Total = | 75 |

Distribution of marks of Continuous Internal Assessment (CIA):

- | | |
|---|-----------|
| 1. Examination | 15 |
| 2. Seminar/Presentation/Assignment/Quizzes..... | 10 |
| Grand Total = | 25 |

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Section-B (Molecular Endocrinology)

- Q. No. 4.** Any one exercise based on Scatchard analysis/RIA **05**
- Q. No. 5.** Any exercise based on Hormone assay **05**
- Q. No. 6.** Identify and comment upon spots. (1-10) **15**
- Q. No.7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **10**

Section-B (Applied Environmental Biology)

- Q. No. 4.** Comment upon Ecosystem model **05**
- Q. No. 5.** Estimate the DO/Chlorides/dissolved organic matter in a sample **05**
- Q. No. 6.** Identify and comment upon spots. (1-10) **15**
- Q. No.7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **10**

Section-B (Clinical Cytogenetics)

- Q. No. 4.** Any one exercise based on Pedigree analysis **05**
- Q. No.5.** Any one exercise based on Hardy Weinberg Law **05**
- Q. No. 6.** Identify and comment upon spots. (1-10) **15**
- Q. No.7.** Viva-voce **10**
- Q. No.8.** Practical record/ Collection/ Chart **10**

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Detailed Syllabus of Semester IV

B051001T Ecology and Toxicology

1. Study of decomposition of various organic matters and nutrient release mechanisms/role of arthropods and other micro- and macro-fauna in decomposition
2. Study of ecological succession by studying various stages of vegetation/community assemblages' development
3. Identification of aquatic organisms of different trophic levels and construction of food chain and food web
4. Estimation of LC⁵⁰ and LD⁵⁰
5. Dose response relationship curve
6. Study of effects of toxicant on opercular movement of fish

B051002T Public health and Hygiene / B051003T Human nutrition and therapeutics

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
2. Estimation of Lactose in milk
3. Ascorbic acid estimation in food
4. Estimation of Calcium in foods

B051004T Microbiology / B051005T Biotechnology

1. Preparation of culture media, sterilization
2. Study of Bacterial growth curve
3. Culturing methods (bacterial plating, making stab, slant and growing liquid culture)
4. Staining and identification of Gram positive and Gram negative bacteria
5. Construction of restriction digestion maps from data provided
6. Genomic DNA isolation from *E. coli*
7. Plasmid DNA isolation (pUC 18/19) from *E. coli*

B051006T Applied Entomology:

1. Study of various types of social insects and their nests
2. Collection and identification of economically important insects and various stages of their life history
3. Ecology: Measuring insect microclimate
4. Life tables/population dynamics modelling in insects
5. Identification and anatomical studies of major vector species of Anopheles, Culex and Aedes

B051007T Clinical Parasitology

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods
2. Identification of various types of immune cells in peripheral blood smear
3. Histological study of spleen, thymus and lymph nodes through slides/photographs
4. Detection of IgG by precipitation ring test
5. Test for Cholestral



B051008T Applied Ichthyology

1. Collection and identification of aquatic weeds and aquatic insects
2. Determination of age and growth; Gonadosomatic index
3. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India
4. Study of fishing gears and nets with the help of models
5. Quantitative and qualitative analysis of phytoplankton and zooplankton from natural resources
6. Display of visceral organs; preparation of fish skeleton; alizarine preparation

B051009T Molecular Endocrinology

1. Steroid and thyroid hormone assay by ELISA
2. Identification of different neuropeptides and area of its localization in brain following immunohistochemical (IHC) methods
3. Isolation of testicular cells and ovarian follicular cells in Rat
4. In vivo bio- assay for estrogen or testosterone
5. In vitro biochemical assay for a hormone (LH or PRL)
6. Calcium estimation in VitD3 treated Rat

B051010T Applied Environmental biology

1. To measure microclimatic variables *viz.*, temperature, humidity and light conditions in a microhabitat
2. Making an ecosystem in a wide-mouthed bottle
3. Constructing distribution map of species of a genus through GPS by estimating the coordinates
4. Estimation of the ratio of the producers and consumers

B051011T Clinical Cytogenetics

1. Demonstration of multiple allelism by showing mutants of white eye series in *Drosophila*
2. Pedigree analysis of some human inherited traits
3. To calculate allelic frequencies by Hardy-Weinberg Law
4. Linkage maps based on data from *Drosophila* crosses
5. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photographs

