

BUNDELKHAND UNIVERSITY, JHANSI
Institute of Basic Sciences

Ordinance for Post Graduate courses

1A. Courses:	Eligibility
(a) M.Sc. (Physics)	B.Sc. with Physics; 50% marks
(b) M.Sc. (Chemistry)	B.Sc. with Chemistry; 50% marks
(c) M.Sc. (Botany)	B.Sc. with Botany; 50% marks
(d) M.Sc. (Zoology)	B.Sc. with Zoology; 50% marks

Note: Eligibility for SC / ST students to appear in the Entrance Examination will be 45%.

1. Intake- 90 seats for M.Sc courses in Basic Sciences

Note: Reservation: as per state government / university rules.

2. Duration: Minimum 2 years (4 semesters)

3. Criteria of admission: Admission of eligible candidates will be strictly on basis of entrance test/ merit list.

Note: 15% marks obtained in entrance test will be awarded as additional marks to all candidates who pass the B.Sc. Examination with more than 50% marks from any institution affiliated to Bundelkhand University.

4. Medium of Instruction and examination: English

5. Fee:

(i) **Tuition and other fee:** As prescribed by the university from time to time.

(ii) **Refund of fee:**

(a) Request for refund of fee should be made to the Vice Chancellor, Bundelkhand University within 3 weeks of deposition of fee. On approval such candidate will be entitled for refund of 50% of prescribed fee.

(b) Request for refund of fee shall not be entertained under any circumstances if made after three weeks from the date of deposition of admission fee by the candidate.

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6. Examination Schedule:

- July 15 - Start of Teaching for Semester I and III classes.
October 31- Teaching ends
November 15- Start of Semester Exams for Semesters III and I
December 1- End of Examinations
December 15- Start of Teaching for Semesters II and IV.
March 30- Teaching ends
April 15 – Start of Exams for Semesters II and IV.
April 30 – End of Exams.

It is suggested that Practical Examinations be conducted before the Theory Examinations.

(i) **Attendance:** Minimum attendance required to become eligible to appear in the examination for each paper shall be 75% of the class lectures (for each of Theory and Practical). In case a student is short of attendance due to illness, participation in sports, extra curricular activities etc. the following rules shall apply:

- (a) Shortage of attendance of up to 10% shall be condoned by HOD on specific recommendations of the course instructor.
- (b) A shortage of attendance of up to 25% can be condoned by the Vice Chancellor on specific recommendations of the HOD.

(ii) **Process of Evaluation:** Minimum passing marks of Theory Semester Exam and Sessionals combined will be 40% for each paper.

(a) Theory Papers:

Semester Examination shall be conducted by the university as mentioned in the academic calendar of the Department. The question papers will be set by examiners appointed by Vice Chancellor based on recommendations of Board of Studies. At least 50% of question papers should be set by examiners from other universities running the curriculum suggested by Curriculum Development Committee (CDC), University Grants Commission, New Delhi. The pattern of question papers will be decided by the university. The weightage of Theory Semester Exam will be 70% for each paper.

(b) Sessional Examination:

The paper instructor shall conduct Sessional Examination for each Theory paper within 50- 60 days of the start of the Semester. The questions should be so set to test the understanding of the subject by the student as well as problems from Tutorials. The weightage of Sessional Examination will be of 20 marks and that of Assignments(Seminar in First Sem)/ Attendance(in II III VI sem) Attendance will be of 10 marks Sessionals are to be conducted by the concerned instructors teaching that paper, the average marks of two sessional will be considered for the result. The second sessional will conducted after the completion of the course. The Sessional marks should be submitted to Department Head.

(c) Practical Examination:

Practical Examinations shall be conducted by examiners appointed by Vice Chancellor on recommendations of Course Committee of Department / Board of Studies. The practical examination will be conducted at the end of each semester. Minimum passing marks in practical paper will be 40%.

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Special Paper: There are 6 special papers in each specialization and maximum intake of student in each specialization is 10.

Name of Special paper:

A - Fisheries

B - Entomology

C - Endocrinology

D - Cell Biology

E - Environmental Biology

F- Applied Zoology

Educational Tours: Educational tours for students of some Departments should be conducted by the concerned Departments between Semesters I and II as a compulsory part of Curriculum and should be funded by the University.

Submission of assignment

The topic assignment is a compulsory part for the student of MSc. IV semester and it carries 100 marks; out of which 50 marks will be for presentation and viva- voce. The student will have to submit his assignment in three copies for evaluation in a given format. The evaluation will be done by DRC.

Qualifying Marks and Promotion:

The minimum passing marks shall be 40% in each paper. The division shall be awarded on the basis of percentage of total marks secured in the aggregate of all years by a candidate, as per details given below:

(a) First division: 60% or more .

(b) Second division: 50% or more than but less than 60%

(c) Third division: 40% or more than but less than 50%

A candidate having back paper/s can be provisionally promoted to the next semester if he fulfills the following condition:

If he has obtained 40% marks in the aggregate of all papers but has failed to secure 40% marks in each theory paper, sessional, practical, industrial visit and project work.

Declaration of results and award of degree:

After completion of the evaluation process, the university will declare result. Candidates declared successful will get the provisional certificate from the Registrar/ Vice-Chancellor of the University immediately after the declaration of the result. Formal Degree will be conferred at the time of convocation to be held annually. However, degree may be issued to a candidate in any special case such as a case of employment or foreign assignment etc. if Hon'ble VC is convinced.

Back Paper and Improvement:

In case, a candidate is unable to clear maximum of two theory papers in a semester examination, he will be promoted to next year on the condition that he has to clear back paper/s, which shall be conducted along with the scheduled exam of back paper for University students. In case a student fails to appear in Theory or Practical examination, he will be given a chance to appear in the back paper examination. But a prior request has to be made by the student and the permission for the same should be granted by Director of the concerned Institute or Dean (Academic). Such candidate will be given a maximum of two attempts to clear these back papers. Further the student has to pay additional fee to

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appear in the back paper examination as fixed by the university. Special back paper also conducted by the Head of Depts. Hon'ble Vice Chancellor is Convinced

A student may be allowed one chance to improve his/her division for a maximum two papers in subsequent examination of concerned papers. The improvement of percentage will be allowed in both Previous and Final years. For improvement of percentage in Semester examinations, a candidate can take examination of only one paper in each semester. The improvement of percentage will be done only at the end of the academic year.

Ex-Student:

In case a student fails in the examination as per relevant provision, he/she may be allowed to re-appear in the subsequent examination as an ex-student, without attending classes. He/she shall be required to appear and clear all papers, exam etc. as per provision of the syllabus in that year.

In such case the marks obtained by the student in Dissertation and Practical exams obtained earlier would be carried over.

Scrutiny:

Scrutiny facility will be given to the student in two papers on payment of prescribed fee as decided by the University from time to time.


Amendment:

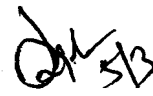
Any ordinance, fee structure and eligibility is subjected to amendment from time to time as may be decided by appropriate body of the University.

Course structure of M.Sc.(Zoology):

The Department of Zoology, Bundelkhand University will be currently running the following specializations. The student has to choose any one of the specializations mentioned below at III and IV semester level.


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- A - Fisheries
- B - Entomology
- C - Endocrinology
- D - Cell Biology
- E - Environmental Biology
- F- Applied Zoology

Course Content for M.Sc. (Zoology)

Semester I

Paper	Paper Code	Paper Name	Sessional marks	Theory Marks	Total Marks
1.	ZOY 101	Biosystematics and taxonomy	30	70	100
2.	ZOY 102	Quantitative Biology	30	70	100
3.	ZOY 103	Tools and Techniques	30	70	100
4.	ZOY 104	Molecular Cell Biology	30	70	100
5.	ZOY 105	Practical-I			100
6.	ZOY 106	Educational Tour			100

Total 600

Semester II

Paper	Paper Code	Paper Name	Sessional marks	Theory Marks	Total Marks
7.	ZOY 201	Structure and function of invertebrates	30	70	100
8.	ZOY 202	General and comparative physiology of vertebrates	30	70	100
9.	ZOY 203	Biochemistry and Structural Biology	30	70	100
10.	ZOY 204	Population ecology and Environmental physiology	30	70	100
11.	ZOY 205	Practical-II	30	70	100

Total 500

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Semester III

Paper	Paper Code	Paper Name	Sessional marks	Theory Marks	Total Marks
12.	ZOY 301	Comparative anatomy of Vertebrates	30	70	100
13.	ZOY 302	Molecular Cytogenetics	30	70	100
14.	ZOY 303 FishA/EntoA/EndoA/ EnvA/CellBioA/AppZooA	Special Paper- 1 st A/B/C/D/E/F	30	70	100
15.	ZOY304 FishB/EntoB/EndoB/ EnvB/CellBioB/AppZooB	Special Paper-2 nd A/B/C/D/E/F	30	70	100
16.	ZOY 305	Practical-IV Special Paper			50
17.	ZOY-306	Practical General			50

Total 500

Semester IV

Paper	Paper Code	Paper Name	Sessional marks	Theory Marks	Total Marks
18.	ZOY 401	Biology of parasitism and Vertebrate Immune System	30	70	100
19.	ZOY-402	Animal Behavior	30	70	100
20.	ZOY 403 FishA/EntoA/EndoA/ EnvA/CellBioA/AppZooA	Special Paper- 3 rd A/B/C/D/E/F	30	70	100
21.	ZOY 404 FishA/EntoA/EndoA/ EnvA/CellBioA/AppZooA	Special Paper-4 th A/B/C/D/E/F/	30	70	100
22.	ZOY 405- 406	Summer Project			100
23.	ZOY406- 405	Spl. Practical-V			100

Total Marks = 2200

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M.Sc. (ZOOLOGY)

Semester I

Paper-1 ZOY101: Biosystematics and Animal Taxonomy

Unit- I

Definition and basic concepts of biosystematics and taxonomy

- (a) Historical Resume of systematic
- (b) Importance and applications of biosystematics in biology.
- (c) Theories of taxonomy.

Unit- II

Trends in biosystematics concept of different conventional and new aspects.

- (a) Different kind of taxonomic and conventional taxonomy concept characters
- (b) Cytotaxonomy
- (c) Chemotaxonomy

Unit -III

Dimensions of Speciation

- (a) Species - different types of species.
- (b) Sub species - different kinds of sub species
- (c) Hierarchy of categories
- (d) Mechanism of speciation

Unit -IV

Procedure keys in taxonomy

- (a) Taxonomic procedures-taxonomic collection preservation, curation and identification.
Taxonomic keys-different kinds of taxonomic keys.
- (b) Systematic publications-different kinds of publication
International code of zoological Nomenclature (ICZN), formation of scientific name of various taxa.
- (c) Types – Typification & different Zoological types

Unit – V Reference works in taxonomy

- (a) Zoological record
- (b) Abstracts and review
- (c) Directories and dictionaries
- (d) Guides to journals
- (e) Books

Suggested reading material:

1. M.Kato. The biology of Biodiversity, Springer
2. J.C. Avise. Molecular markers, natural history and evolution, Chapman & Hall, New York
3. E.O. Wilson, Biodiversity, academic Press, Washington
4. G.G. Simpson, Principle of animal taxonomy, Oxford IBH, Publishing Co.
5. E. Mayer. Elements of taxonomy.
6. E.O. Wilson. The diversity of life (The College edition), W.W. Northern & Co.
7. B.K. Tikadar. Threatened animals of India
8. E,Mayr & Peter D, Ashlock, Principles of systematic zoology.

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Paper-2 ZOY 102: Quantitative Biology

Unit- I

- (a) Basic concept of Biostatistics
 - (i) Mean
 - (ii) Median
 - (iii) Mode
- (b) Classification and Survey of Data.

Unit -II General concept and Significance of Biostatistics of Biosciences

- (a) Probability distribution and their properties
- (b) Analysis of frequency
- (c) Regression
- (d) Correlation

Unit -III

- (a) Analysis of Variance
- (b) F-test and Chi-square
- (c) T-test and sampling
- (d) Mean deviation, standard deviation, coefficient of variation

Unit- IV

• Basic Mathematics for Biologist

- (a) Matrices and Vectors
- (b) Differential equation and Intermigration

Unit- V

General application of Computer

- (a) MS word and Power point
- (b) MS Office
- (e) Excel and internet E-mail

Suggested Reading Material

1. Batschelet, E. Introduction to mathematics for life scientists. Springer-Verlag, Berlin.
2. Jorgenson, S. E. Fundamentals of ecological modeling Elsevier, New York
3. Lenderen, D. Modelling in behavioural ecology. Chapman & Hal, London, UK
4. Green, R.H. Sampling design and statistical methods for environmental biologists John Wiley & Sons, New York.

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Paper-3 ZOY103 : Tools and Techniques

Unit- I

Principles & use of analytical instruments

- (a) pH meter
- (b) Centrifugation
- (c) Microtome

Unit- II

- (a) Spectrophotometer
- (b) Chromatography
- (c) Colorimeter

Unit III

- (a) Electrophoresis,
- (b) Light Microscope
- (c) Electron microscope
- (d) Phase contrast microscope

Unit- III

Microbiological techniques

- (a) Media Preparation & sterilization
- (b) Use of fermenters
- (c) Cell culture techniques

Unit- IV

Surgical techniques

- (a) Organ ablation (eg. Ovariectomy, adrenalectomy etc.)
- (b) Perfusion techniques

Suggested Reading Material

1. Animal cell culture- A practical approach, Ed. John R.W.Masters, IRL Press
2. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Editions.
3. A Biologists guide to principles and techniques of practical biochemistry, K. Wilson & K. H. Goulding, ELBS Edn.

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Paper-4 ZOY 104: Molecular Cell Biology

Unit- I Biomembrane

- (a) Transport across cell membrane diffusion active transport & pumps, uniport Symport & antiport.
- (b) Membrane Potential
- (c) Co-transport by symporters or antiporters.
- (d) Transport across epithelia.

Unit- II Cytoskeleton

- (a) Microfilaments & microtubules structure & dynamics.
- (b) Microtubules & mitosis
- (c) Cell movement intracellular transport, role & kinesin & dynein, signals transduction mechanism.

Unit- III Cell-Cell signaling

- (a) Cell surface receptors
- (b) Second messenger system
- (c) MAP kinase pathway
- (d) Signaling from plasma-membrane to nucleus

Unit- IV Cell-Cell adhesion & communication

- (a) Ca^{++} dependent homophilic cell-cell adhesion
- (b) Ca^{++} independent homophilic cell-cell adhesion
- (c) Gap junction & connexins

Unit- V Cell matrix adhesion & Cell Cycle

- (a) Integrins
- (b) Collagen
- (c) Non collagen component
- (d) Auxin & cell expansion
- (e) Cellulose fibril synthesis & orientation
- (f) Cyclines & cyclin dependent kinases
- (g) Regulation of CDK-cycline activity

Suggested Reading Material

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore. Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
3. Cell and Mol. Biology- Gerald Karp

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Paper-5 ZOY105 : Practical-I

Unit- I

Biostatistical problems: Preparation of charts, diagrams (bar, histogram, pie, graphs etc.), Computation of mean, mode, median, standard deviation, standard error if simple & classified data of chi square, t- test & ANOVA.

Unit- II : Computer application in statistical problems.

Unit- III : Determination of pH indicator & pH meter.

Unit- IV : Absorption spectrum of coloured solution using spectrophotometer/ colorimeter.

Unit- V : Separation & detection of dyes / amino acids / sugars using paper chromatography/ TLC.

Unit- VI : Study of permanent slides of cytology.

Unit- VII : Experiments in Cytology & Genetics.

- (a) Study of mitosis from onion root tips by making temporary squash preparation (staining with acetocarmine/ acetoorein).
- (b) Study of chromosomes (meiosis & mitosis) from testicular tissue of *Chrotogonus* (grass hopper / gryllids/ cockroach) etc.
- (c) Salivary gland squash preparation for the study of polytene chromosomes of *Chironomus/ Anopheles/ Drosophilla*.
- (d) Study of Mendelian ratios from the seed coat colour pattern of seed (monohybrid & dihybrid ratios).

Practical marks distribution

1. Biostatistical Problem	10
2. Computer Application & Bioinformatics	10
3. Cytological/ Genetics Exercise	10
4. Determination of pH , colorimeter or spectrophotometric estimation of Carbohydrate or Protein.	10
5. Chromatographic Separation. – Paper/ Thin layer/ Electrophoresis	10
6. Spotting & Identification & Comment on Cytology Slides.	10
7. Microtomy	
(a) Sectioning & Stretching	
(b) Staining & Mounting	20
8. Viva voce	10
9. Practical Record	10

Total Marks - 100

100 Marks

Paper-6 ZOY 106 Educational Tour

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Paper-8 ZOY 202: General and comparative physiology of ~~physiology of~~ Vertebrates

Unit-I

1. Respiratory pigments through different phylogenetic groups
2. Transport of oxygen and carbon dioxide in blood and body fluids
3. Regulation of respiration.

Unit-II

1. Comparative physiology of digestion 1-10
2. Osmoregulation in different animal groups
3. Thermoregulation in homeotherms, poikilotherms and hibernation.

Unit-III

1. Comparative study of Photoreception 11-20
2. Comparative study of Chemoreception 21-30
3. Comparative study of Equilibrium reception 31-40
4. Physiology of impulse transmission through nerves and synapses

Unit-IV

1. Pheromones and other chemicals as means of communication among animals
2. Audio signals as means of communication among animals 41-63
3. Chromatophores and regulation of their function among animals
4. Hormones, their classification and chemical nature & Mechanisms of hormone action

Unit - V

1. Pituitary gland its hormones and significance
2. Hormonal regulation of spermatogenesis
3. Hormonal regulation of oogenesis

Suggested Reading Material

1. C.L. Presser. Comparative animal physiology. W.B. Saunders and co.
2. R. Eckert. Animal physiology-mechanisms and adaptation. W.H. Freeman and Co.
3. W.S. Hear. General and comparative Animal physiology
4. Schiendts-Neilsen. Animal Physiology: Adaptation and Environment, Cambridge
5. C.L. Prosser. Environmental and metabolic physiology. Wiley-Liss, New York

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~~Metabolic~~
Paper-9 ZOY 203: Biochemistry and Structural Biology

Unit-I

1. Primary, Secondary, Tertiary and Quaternary structures of Proteins. Protein folding & denaturation
2. DNA & RNA: Double helical structure of DNA, RNA structure and its role in gene expression.
3. DNA replication, Recombination and repair
4. Functional importance of lipid storage & membrane lipids

Unit-II

1. Basic concept of Metabolism: coupled and interconnecting reactions of metabolism; cellular energy resources and ATP synthesis
2. Glycolysis and Gluconeogenesis

Unit -III

1. Citric acid cycle
3. Oxidative phosphorylation: the protein and its regulation
4. Fatty acid metabolism: Synthesis and degradation of fatty acids

Unit-IV

1. Biosynthesis of Amino acids
2. Biosynthesis of nucleotides
3. Biosynthesis of membrane lipids and steroids

Unit-V

1. Enzymes: Terminologies, classification and basics of enzyme kinetics
2. Mechanism of enzyme catalysis
3. Regulation of enzyme action

Suggested Heading Material

1. D. Voet and G. Voet. Biochemistry, John Wiley and Sons.
 2. D. Freifelder, Essentials of Molecular Biology
 3. K. Wilson and K.H. Goulding. A Biologists guide to principles and techniques of practical biochemistry
 4. R.H. Garret and C.M. Grisham. Biochemistry, Saunders college publishers.
 5. Lehninger's Biochemistry- Nelson and Cox
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Paper-10 ZOY 204 : Population ecology and Environmental physiology

Unit-I

1. Populations and their characters
2. Population Growth: Growth of organisms with non-overlapping generations, stochastic and time lag models of population growth, stable age distribution.

Unit-II

1. Adaptation: Levels of adaptation, mechanisms of adaptation, significance of body size
2. Physiological adaptations to fresh water environments.
3. Physiological adaptations to Terrestrial environments.
4. Physiological adaptations to parasitic habitats.

Unit-III

1. Environmental limiting factors
2. Biodiversity: Flora and fauna
3. Biodiversity: Significance and conservation
4. Role of predation in nature, evolution of mutualism,
5. Animal - animal interactions and plant-pollinator interaction.

Unit-IV

1. Environmental pollution and human health.
2. Conservation management of natural resources.
3. Environmental impact assessment
4. Ecological modeling- Fundamentals of constructing models and testing them.

Unit - V

1. Animal distribution
2. Biogeographical realms
3. Altitudinal distribution
4. Distribution in open

Suggested Reading Material

1. Cherrett J.M. Ecological Concepts. Blackwell Sci. Publ., Oxford, U.K.
2. Elseth, B.D. and K.M. Baumgartner, Population biology. Van Nostrand Co., New York
3. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York
4. Krebs, C.J. Ecology. Harper BRow. New York
5. Krebs, C.J. Ecological Methodology. Harper a Row, New York
6. Eckert S R. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman and Co., New York
7. Hochachka, P.W. and Somero, G.N. Biochemical Adaptation. Priceton, New Jersey.
8. Schiemdt Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.

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Paper-11 ZOY 205 : Practical-II

Invertebrates, Physiology, Biochemistry, Ecology, Environmental Physiology

1. Detection of carbohydrates, proteins and lipids in the given sample
2. Counting of red blood corpuscles & white blood corpuscles in the blood of rat or man.
3. Determination of hemoglobin percentage in the blood of rat or man.
4. Detection of blood groups and Rh- factor in rat or man.
5. Determination of blood clotting time.
6. Preparation of haemin crystals.
7. Separation of Serum and tissue protein with the help of electrophoresis.
8. Demonstration of reflects action.
9. Quantitative determination of biological components (Protein, glycogen and blood sugar, RNA and DNA) with the help of colorimeter
10. Water analysis for dissolved oxygen, free carbon dioxide, chloride, pH, hardness and alkalinity.
11. Problem related to evolution, population genetics etc. (H.W. Principle, natural selection adaptation, trends and evolution, genetic polymorphism etc.)
12. Major & Minor Dissection of Invertebrates.
13. To determine the length of earthworm from the different body region.

Distribution of Marks

1. Major Dissection	10
2. Minor dissection	10
3. Spotting	20
4. Experiment on Hematological parameter	10
5. Experiments of Environmental Biology&	
6. Measermnt of animal body	10
7. Mounting	10
8. Viva	10
9. Record	10

TOTAL 100

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Semester III

Courses of general studies

Paper-12 ZOY 301 Comparative anatomy of Vertebrates

Unit-I

1. Origin of Chordata – Concept of Protochordata
2. Vertebrate morphology: Definition, scope and relation to other disciplines and importance of study of vertebrate morphology.
3. Origin and classification of vertebrates.
4. Development, structure and functions of vertebrate integument and its derivatives (Glands, scales, feathers and hairs).
5. Respiratory system: Characters of respiratory tissue, external and internal respirations, comparative account of respiratory organs.

Unit-II

1. Evolution of heart
2. Evolution of Aortic arches and portal systems
3. Blood circulation in various vertebrate groups

Unit-III

1. Evolution of Urinogenital system in vertebrates
2. Comparative account of Organs of olfaction and taste
3. Comparative anatomy of brain and spinal cord (CNS)
4. Comparative account of Peripheral and Autonomic nervous system

Unit-IV

1. Comparative account of simple receptors
2. Comparative account of Electroreception
3. Comparative account of Lateral line system

Unit - V

1. Flight adaptations & Aquatic adaptations in vertebrates
2. Terrestrial adaptation in vertebrates

Suggested Reading Material

1. Young, J.Z. Life of Vertebrates. Oxford University Press, London
2. Young, J.Z. Life of mammals, Oxford University Press, London
3. Colbert, E.H. Evolution of the vertebrates, John Wiley and Sons Inc, New York
4. Kent, C.J. Comparative anatomy of vertebrates.
5. Woldstenholmf, E.W. and Knight, J. (Ed.) Taste and smell in vertebrates, J & A Churchil, London.
6. Walters. H.A. and Sayles, L.D. Biology of Vertebrates. Macmillan & Co. New York.
7. Waterman, A.J. Chordata structure and function, Macmillan Co. New York.
8. Montagna. W. Comparative anatomy, Clarendon press, Oxford.

Paper-13 ZOY 302: Molecular Cytogenetics

Unit- I- Biology of Chromosome

- (a) Molecular anatomy of eukaryotic chromosomes
- (b) Metaphase chromosome: Centromere, Kinetochore, Telomere & its maintenance
- (c) Heterochromatin & Euchromatin
- (d) Giant chromosomes : Polytene & Lampbrush Chromosome.

Unit -II- Human Cytogenetics

- (a) Human karyotype banding nomenclature
- (b) Numerical & Structural abnormalities of human chromosome: Syndromes
- (c) Mendelian & chromosome based heritable diseases in humans
- (d) Human Genome.

Unit - III- Transcription

- (a) Prokaryotic Transcription
- (b) Eukaryotic Transcription
- (c) RNA polymerase
- (d) General and specific transcription factors
- (e) Regulatory elements and mechanisms of transcription regulation

Unit - IV- Post-transcriptional modification in RNA

- (a) 5'-cap formation
- (b) Transcription termination
- (c) 3'-end processing and polyadenylation
- (d) Splicing, editing
- (e) Nuclear export of m- RNA
- (f) m-RNA stability

Unit - V- Translation

- (a) Genetic code
- (b) Prokaryotic & Eukaryotic translation
- (c) The translation machinery
- (d) Mechanism of initiation, elongation, and termination
- (e) Regulation of translation

Suggested Reading Material

- a. Brooker, R. J. Genetics: Analysis & Principle. Benjamin/ Cumming, Longman Inc.
- b. Gardner, E. J., M.J. Simons & D. P. Snustad. Principle of Genetics. John Wiley & Sons, Inc, NY.
- c. Lewin, B. Genes VI. Oxford University Press, Oxford New York Tokyo.
- d. Molecular Cell Biology, J. Darnell, H. Lodish, & D. Baltimore Scientific American Books, Inc., USA.
- e. Gene VI, Benjamin Lewin, Oxford Press, UK.
- f. Principle of genetics- Snustad and Simmons

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Courses of Specialization

- (A) Fish Biology And Fisheries**
- (B) Entomology**
- (C) Endocrinology**
- (D) Cell Biology**
- (E) Environmental Biology**
- (f) Applied Zoology**

Fish Biology and Fisheries

Paper-14 ZOY 303 Fish (A): Special Paper- 1st

(A) Fish Structure And Function

Unit-I

1. Structure and function of skin.
2. Structure and function of scales, determination of growth age.
3. Different types of fins and their specific modification.

Unit-II

1. Locomotion in fish.
2. Structure and function of swim bladder.
3. Different types of feeding and feeding habits of fish.

Unit-III

1. Structure, function and homologies of Weberian ossicles.
2. Hill stream adaptation in fish.
3. Deep sea fishes and their adaptation

Unit – IV

1. Migration in fish.
2. Chemical communication in fish.

Unit-V

1. Structure and functions of electric organs and electroreceptors
2. Structure and function of luminous organs.
3. Structure and function of sound producing organs and sound reception.
4. Poisonous and Venomous fish.

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Paper-15 ZOY 304 Fish (B) Special Paper-2nd
(B) Fish Morphology, Anatomy, And Physiology

Unit-I

1. Chromatophores: Classification, ultra structure, and functional significance.
2. Colour changes: Types Neural and Endocrine control mechanisms.
3. Respiratory organs: Kinds and physiology of aqueous breathing.
4. Digestive system: Anatomy and physiology of alimentary canal.

Unit-II

1. Nervous system: Brain its functional organization with ecological bearing.
2. Nervous system: Nerves and their supply.
3. Lateral line system: structure, modifications and significance.

Unit - III

1. Circulatory system in fish
2. Heart in fishes
3. Venous and arterial system

Unit-IV

1. Neuroendocrine integration in fish.
2. Anatomy and physiology of the pituitary gland.
3. Anatomy and physiology of the thyroid gland.
4. Pineal organ, interrenal tissue, and caudal neurosecretory system.

Unit-V

1. Environmental and hormonal control of reproduction.
2. Parental care *and courtship*
3. Early development of a teleost.
4. Osmo-regulatory organs and mechanisms.

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SPECIAL PAPER PRACTICAL

Paper-16 ZOY 305: Practical – IV

(A) Fish Biology And Fisheries

Duration 6Hours

- | | |
|---|----------|
| 1. Determination of age of fish through the scale of fish.. | 05 |
| 2. Identification of fishes <i>with the help of keys.</i> | 10
05 |
| 3. Behavior of fish | 05 |
| 4. Length of fish from different region | |
| 5. Histological permanent slides. | 05 |
| 6. Study of museum specimens of fish. (<i>including bones + slides</i>) | 10 |
| 7. Viva | 05 |
| 8. Record | 05 |

Total- 50

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(B) Entomology

Paper-14 ZOY 303 Ento (A) Special Paper- 1st

(A) General Entomology and Insect Morphology

Unit-I

1. Insect diversity and their outline classification.
2. Collection, preservation & culture of Insects
3. General organization insect body Head, thorax, abdomen & their appendages

Unit-II

1. Mouthparts and relationship with feeding habits of insects.
2. Wings: Origin, structure & venation
3. Structure of flight muscles and flight mechanisms in insects.

Unit-III

4. Coloration and mimicry in insects.
5. Light producing organ & its mechanism
6. Sound producing organ & its mechanism

Unit-IV

1. Phase theory of locusts.
2. Polymorphism in insects.
3. Methods of insect communication.

Unit-V

1. Insect & Abiotic environment.
2. Insect & biotic environment.
3. Insects & humans

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Paper-15 ZOY 304 Ento (B) : Special Paper-2nd

(B) Insect Anatomy and Physiology

Unit-I

1. Structure and functions of insect integument.
2. Head and its Appendages
3. The digestive system.

Unit-II

1. Respiratory system.
2. Circulatory system.
3. Excretory System

Unit-III

4. Nervous system
5. Endocrine System
6. Reproductive System

Unit-IV

1. The Development
2. The Sense organs
3. Visual organs

Unit-V

1. Insect Parasitism
2. Dispersal & migration in insects
3. Behavior: Orientation, innate & parental.

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SPECIAL PAPER PRACTICAL

Paper-16 ZOY 305: Practical – IV

General Entomology

1. Dissection of various organ systems (nervous, digestive, reproductive, neuroendocrine etc.) in available insects like grasshopper, cricket, cockroach, beetle, bug, wasp, honey bee, butterfly, moth, dragonfly etc.
2. Preparation of permanent stained mounts of insects, their body parts and dissected organs.
3. Study of permanent slides of insects, their body parts, organs and histological preparations.
4. Study of insect specimens showing colouration, mimicry, light production, polymorphism, sound production and reception and other morphological modification.
5. Physiological/Biochemical experiments in insects like extirpation and implantation of endocrine organs, parabiosis, ligation of dipteran/lepidopteran larvae, preparation of isolated abdomen demonstration of digestive enzymes, excretory products, Chitin & cuticular lipids etc.
6. Microtomy of insect material.

Scheme Practical Examination

Duration: 6 hrs.

1. Dissection with display and diagram.	10
2. Minor dissection/experiment with display and diagram	05
3. Mounting with identification, diagram and comments	05
4. Spotting	10
5. Physiological/Biochemical Experiments	05
6. Microtomy	05
7. Viva-Voce	05
8. Practical record	05

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(C) Endocrinology

Paper-14 ZOY 303Endo(A) : Special Paper- 1st

(A)Comparative Endocrinology

Unit-I

1. History and scope of endocrinology
2. Endocrine methodologies.
3. General and comparative structure of pituitary gland.
4. General and comparative structure of neurohypophysis.
5. General and comparative structure of thyroid gland.

Unit-II

1. General and comparative structure of parathyroid gland.
2. General and comparative structure of pancreas.
3. Structure of mammalian pineal gland
4. General and comparative structure of adrenal medulla and chromaffin tissue.
5. General and comparative structure of adrenal cortex and inter renal tissue.

Unit-III

1. Neurosecretion and neuroendocrine mechanisms in annelida.
2. Neuroendocrine system in crustacea.
3. Neuroendocrine system in Insects.
4. Neuroendocrine system in Mollusca.

Unit-IV

1. Caudal neurosecretory system in fish.
2. General structure of thymus and ultimobranchia body.

Unit - V

1. Hormones and environment.
2. Care and breeding of laboratory animals-rat, mice.
3. Hormones, hormones like substances and their evolution.

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Paper-15 ZOY 304 Endo (A): Special Paper-2nd

(A)Endocrine Physiology

Unit-I

1. Role of hypothalamus and neuroendocrine integration in mammals.
2. Hormones of anterior pituitary and their functional significance.
3. Growth hormone and its physiological significance.
4. Hormones of neurohypophysis and their functional significance in mammals.
5. Hormones of pars-intermedia and control of pigmentary function in vertebrates.

Unit-II

1. Evolution of thyroid function and synthesis of thyroid hormones.
2. Regulation of thyroxine secretion and its physiological significance.
3. Thyroxine and its influence of development and metamorphosis.
4. Parathyroid hormone and its physiological significance.
5. Calcitonin, thyrocalcitonin and their functional significance.

Unit-III

1. Catecholamines (Epinephrine and non-epinephrine) their biosynthesis and physiological influence on metabolism.
2. Biosynthesis and metabolism of adrenal steroids.
3. Physiological significance of mineralocorticoids and glucocorticoids
4. Gastrointestinal hormones and their physiological significance.

Unit-IV

1. Physiological significance of insulin in carbohydrate metabolism.
2. Physiological significance of glucagon in carbohydrate metabolism.
3. Insulin and insulin like peptides and their role in early mammalian Development.

Unit – V

1. Synthesis and significance hormones in insects
2. Synthesis of brain hormones and regulation in insects.

Suggested reading material

1. C.B. Turner and J.T. Bagnare. General Endocrinology W.B. Saunders.
2. P.J. Bentley. Comparative Vertebrate Endocrinology. Combridge Univ. Press.
3. M.E. Hadley. Endocrinology.
4. Garbman, et. al.. Comparative Endocrinology, John Wille & Sons.

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SPECIAL PAPER PRACTICAL

Paper-16 ZOY 305: Practical – IV

General and Comparative Endocrinology

1. Dissection of endocrine glands in vertebrate and invertebrates (cockroach, grasshopper and butterfly)
2. Determination of proteins and glycogen in the endocrine material using colorimeter.
3. Microtomy of endocrine material (preparation of paraffin blocks, sectioning and staining).
4. Identification of endocrine slides.
5. Identification of chemical structures of peptides and steroid hormones.
6. Determination of blood sugar level.

Schème of Practical Examination

Duration : 6.00 Hours

- | | |
|---|----|
| 1. Dissection of endocrine glands in Vertebrate/invertebrates with display and diagram. | 10 |
| 2. Biochemical estimation of proteins, glycogen in endocrine tissue with colorimeter, | 05 |
| 3. Determination of blood sugar level | 05 |
| 4. Microtomy of endocrine material | 10 |
| 5. Identification and comments of spots (Slides-3, Molecular structure of hormones-2, | 10 |
| 6. Viva-voce | 05 |
| 7. Practical record | 05 |

TOTAL 50

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M. J.
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R. K.
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(D) Cell Biology

Paper-14 ZOY 303 Cell Bio (A): Special Paper- 1st

(A) Methods in Cell and Molecular Biology

Unit -I

1. Principal and application of light and phase Contrast microscopy
2. Principal and uses of fluorescence and dark field microscopy.
3. Principal and application of scanning and transmission electron microscopy.
4. Basic Principle and application of micro-photometry.

Unit-II

1. Autoradiography: Principle, methods and applications.
2. Centrifugation : Principle and applications: Types of rotors, Clinical, High Speed and Ultracentrifuges
3. Tissue Culture : Media, sterilization ,monolayer and suspension culture, cell counting and infection.

Unit-III

1. Electrophoresis: Types, principles, methods and applications.
2. Chromatography: Types, principle, methods and applications.
3. Spectro-photometry: Principles and applications.

Unit-IV

1. Preparation of recombinant DNA (Gene cloning). Restriction enzymes and modifying enzymes.
2. Preparation of genomic and c-DNA libraries. General idea of expression library ; screening of gene libraries.
3. Methods in gene analysis: Hybridization technique (Southern ,Northern, Western Blotting, RFLP and finger printing. → DNA
4. PCR and its applications

Unit- V

1. Methods of protein purification.
2. DNA Foot printing.
3. Chromosome banding: principle, methods and applications
4. RNA Silencing

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Paper-15 ZOY 304 Cell Bio (B) : Special Paper-2nd

(B) Cellular Structure and Molecular Organization

Unit – I

1. General organization and characteristics of mycoplasma viruses(HIV & SV 40) bacteriophages and viroids.
2. Bacteria: Gene transfer in bacteria (methods of recombination and gene mapping)
3. Molecular organization of respiratory chain assemblies, ATP/ADP Translocase and F₀ F₁ ATPase.

Unit-II

1. Cytochemistry of Golgi complex and its role in protein trafficking.
2. Structure and biogenesis of ribosomes.
3. Intracellular digestion : Ultrastructure and function of lysosomes and peroxisomes.

Unit-III

1. Mitochondrial DNA : structure, expression and variability from genomic DNA.
2. Genomic complexity : C-value paradox
3. C₀t value and its significance .

Unit-IV

1. General idea of oncogene and cancer : Transforming agent, protooncogenes and oncoproteins.
2. Differences between normal cell and cancer cell: Biochemical ,cytoskeletal cell surface changes.
3. Human cancer : Genetic basis and chromosomal abnormalities.

Unit- V

1. Interferons: Structure ,function and significance.
2. Hormones in relation to cancer cells
3. Evolutionary origin of cancer

BOOK RECOMMENDED:

1. Cell and Mol. Biology- Gerald Karp
2. Genes VIII- B Lewin
3. Principle of Genetics- Snustad and Simmons

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Paper-16 ZOY 305 : Practical – IV

Cell Biology

1. Histochemical demonstration of lipids, proteins (including enzymes), carbohydrate and nucleic acids (DNA/RNA).
2. Chromosome staining of grasshopper testis and polytene chromosomes from salivary glands of *Drosophila*.
3. Gel electrophoresis of nucleic acid (DNA/RNA) Isolation and detection of DNA/RNA on agarose gel
4. Study of permanent slides of meiosis

SCHEME OF PRACTICAL EXAMINATION

Duration: 6.00 hours

- | | |
|---|----|
| 1. Histology and Histochemistry -
Demonstration of Biomolecules / meiotic slides | 10 |
| 2. Chromosome staining of grasshopper testis / Polytenę chromosome | 10 |
| 3. Gel Electrophoresis of DNA | 10 |
| 4. Viva- Voce | 10 |
| 5. Record | 10 |

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(D) Environmental Biology

Paper-14 ZOY 303 Env (A): Special Paper- 1st

(A) Ecosystems and Environmental Physiology

Unit – I Ecosystem

1. Introduction to ecosystem.
2. Biotic and abiotic components and their interrelationships
3. Productivity and energy flow and energetic efficiency
4. Ecological pyramids
5. System ecology and ecosystem modeling- (a) Modelling, (b) Simulation (c) System analysis (d) System theory.

Unit –II Terrestrial Ecosystem

1. Grasslands including grazing lands.
2. Forest : characteristics of alpine, temperate and tropical forests.
3. Deserts: Type and ecological attributes of deserts species adaptation.
4. Tundra : Ecological attributes of species adaptations.

Unit – III Freshwater Ecosystem

1. Physiochemical characteristics of freshwater ecosystem
2. Zonation
3. Classification -Standing water bodies & Running water bodies

Unit – IV Marine & Estuarine Ecosystem

1. Physiochemical characteristic of marine environment.
2. Classification of marine environment-Pelagic zone, Benthic zone and deep sea system
4. Faunal adaptations in marine ecosystem.
5. Estuarine ecosystem-Introduction, Ecological peculiarities adaptations including impact of fauna

Unit V Population and community ecology

1. Relation within the population
2. Dynamics of populations
3. Biotic community- Dynamics & Structure
4. Ecological succession

Unit VI Environmental physiology

1. Impact of environment at cellular level: cellular interaction with environment
2. Environmental physiology:
 - i. Physiological mechanism of regulation of body temp.
 - ii. Concept of homeostasis
 - iii. Osmoregulation in aquatic and terrestrial animals
 - iv. Basal metabolism and Basal Metabolic Rate

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**Paper-15 ZOY-304 Environ (B) Special Paper-2nd
Environmental Management**

Unit-I

Pollution (sources, effect and control)
Water
Air
Sound
Radiation
Pesticide

Unit-II

Water management
Forest Conservation
Agriculture production management
Wild life management
Solid Waste Management
Energy resources

Unit-III

Environment & Human Health
Urban health problems
Rural health problems
Natural disaster

Unit -IV

Analysis of physical parameters
Analysis of chemical parameters
Statistical methods

Unit -V

Concept and importance of biodiversity
Types of biodiversity
in situ & *ex situ* conservation,
hotspots of biodiversity

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SPECIAL PAPER PRACTICAL

Paper-16 ZOY 305 : Practical – IV (Environmental Biology)

- g. To study the qualitative analysis of Zooplanktons in water samples collected from different depths.
- h. To estimate the acidity in different samples of water
- i. To estimate the alkalinity in different water samples.
- j. To estimate chloride in given water samples.
- k. To estimate dissolved oxygen contents in different samples of water by Wrinkler's Idometric method.
- l. To prepare sulphur dioxide of known concentration by method described by Singh and Rao (1979).
- m. To prepare Nitric oxide of known concentration method described Saltzman (1954) and modified by Levaggi *et al.* (1972).
- n. Monitoring techniques.
- o. Study of pond ecosystem

i. Quantitive analysis of zooplankton in given water samples	10
ii. Estimation of chemicals in given water sample	10
iii. Preparation of a gas of given concentration	05
iv. Monitiring techniques	10
v. Mounting	05
vi. Viva voce	05
vii. Record	05

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Paper-14 ZOY 303 App. Zool. (A): Special Paper- 1st

(A) Aquaculture

Unit -I

1. Scope and importance of Applied Zoology.
2. Various branches of Applied Zoology
3. Types of aquaculture

Unit - II

1. Fish species to be culture
2. Stocking pond management
3. Marketing and economics
4. Fish byproducts

Unit - III

1. Mariculture
2. Finfish culture
3. Prawn culture
4. Oysta culture
5. Pearl culture

Unit - IV

1. Duck
2. Freshwater prawn culture
3. Induced breeding of cultivated fishes

Unit V

1. Savage and its treatment
2. Suitable species for fish culture in sewage fed water
3. Fish culture in brackish water
4. Collection of fry from natural resources

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Paper-15 ZOY 304 App. Zool. (B): Special Paper-2nd

(B) Medical Zoology

Unit - I

Brief introduction and life history, mode of infection and pathogenicity of the following;

- a. Brief Introduction to pathogenic microbes Viruses and Bacteria.
- b. Pathologic protozoan's : Entamoeba, Trypanosoma, Leishmanin, Giardia, Trichomonas, Plasmodium.

Unit - II

Pathogenic helminthes Faciolosis Schistosoma, Echinococcus, Ancylostoma, Trichinella, Wuchereia, Taenia, Ascaris

Unit -III

Distribution, biology and control of following;

- a. Artropods vectors of human diseases, Malaria, Yellow Fever ,Dengue Fever(aedes) Filariases, Plague,Encephalitis
- b Changes in organs in relation to diseases such as Tumour ,cancers.

Unit IV

Epidemic diseases such as typhoid ,cholera, small pox, their occurrence and eradication Programmes.

Unit V

Brief introduction to human defence mechanisms ,antigens and antibodies .

BOOK RECOMMENDED:

Introduction to Parasitology – J.D. Smith
Parasitology – T.C. Cheng
Biology of Parasites – E.J.W. Soulsbey
Medical Parasitology – K.D. Chatterjee

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Applied Zoology Practical

Paper-16 ZOY 305: Special Paper Practical – IV

- | | |
|--|----|
| 1. Identification of aquaculture animals and Study of permanent slides and specimens of parasite protozoans, helminthes and arthropods . | 10 |
| 2. Estimation of growth of fishes and analysis of blood group
A, B, O, Rh factor in human | 10 |
| 3. Demonstration of preparation of and maintenance of display equarium | 10 |
| 4. Field trips and preparation of reports. | 10 |
| 5. Identification of fish scales | 5 |
| 6. Viva Voce and Record | 5 |

Total 50

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Paper-17 ZOY 306 : Practical-III (General Paper)

Vertebrates and Molecular Cytogenetics

1. Study of disarticulated skeletal of dogfish, bony fish and amphibians.
2. Study of permanent slides of Urochordata, Cephalochordata elasmobranchs, teleosts and amphibians
3. Classification of chordata and study of representatives of various groups.
4. Dissection of different organ system of the following animals Frog/ rat /fish.
5. Study of disarticulated skeletons of vertebrates.
6. Study of metaphase chromosomes from the bone marrow of rat/mice
7. Study of karyotype and its preparation from microphotographs
8. Study of polytene chromosome preparation by temporary squash preparation from the larvae of *Drosophila/ Chironomous*.

Distribution of marks:

1. Dissection of organ-systems and display with diagram of Herdmania, Amphioxus, Cartilagenous fish, bony fish, lizard snake, pigeon, rat. 10
2. Cytogenetics practical 10
3. Mounting 05
4. Spotting (10) Identification and comments (Bones-2, Slides-2, Museum specimens-2, Cytological- 4 10
5. Viva-voce 10
6. Record 05

Total Marks:50

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Semester IV

Paper-18 : ZOY 401 Animal Behavior

Unit-I

2. Introduction:
 - (a) Ethnology as a branch of biology
 - (b) Difference between Animal psychology and Animal behaviour
3. Reflexes and complex behaviour
4. Perception of the environment: Mechanical, Electrical, Chemical, Olfactory, Auditory and Visual.

Unit-II

1. Neural and hormonal control of behaviour
2. Motivation: Drive, different types of biological drive. Neurophysiology of motivation, Psychological motives.
3. Communication: Chemical, Visual, Light and Audio; Evolution of language (Primates)

Unit-III Ecological aspects of behaviour:

- (1) Habitat selection,
- (2) Homing & territoriality dispersal
- (3) Food selection
- (4) Optimal foraging theory
- (5) Anti-predators defenses & Host-parasite relations
- (6) Aggression

Unit - IV

2. Biological rhythms: Circadian and circannual rhythms
3. Orientation and Navigation
4. Migration of fishes, turtles and birds.
5. Learning and memory: Conditioning, Habituation, Insight learning, Association learning, Reasoning.

Unit-V

1. Reproductive behaviour: Evolution of sex and reproductive strategies, Mating systems, Courtship, Sexual selection, Parental care.
2. Social behaviour: Aggregations - schooling in fishes, flocking in birds, herding in mammals, Group selection, Kin selection, Altruism, Reciprocal altruism, inclusive fitness, Social organization in insects and primates.

Suggested Reading Material

1. Hinde, R.A. Animal Behaviour: A synthesis of ethology and comparative psychology. McGraw-Hill, New York
 2. Alcock, J. Animal Behaviour: An evolutionary approach Sinauer Assoc. Sunderland, Mass. USA
 3. Bradbury, J.W and S.L. Vehrencamp. Principles of animal communication. Sinauer Assoc. Sunderland, Mass., USA
- Eibl-Eibesfeldt, I. Ethology. The Biology of Behaviour. Holt, Rinehart & Winston, New York

Paper-19 ZOY 402 : Biology of parasitism and Vertebrate Immune System

Unit-I

1. Parasitism: Concept: origin, evaluation, advantages and disadvantages in the parasitic life.
2. Classification of parasites, according to habitat, microenvironment and host specificity.
3. Modes of parasitic invasion: passive, mechanical, active, contact, transovarial pathways of entry and sites of habitation.
4. Host specificity, Host-parasite system & Host reactions to parasites.

Unit-II

1. Antigens & Antibody .
2. Cells & organs of immune system.
3. Immunoglobuline
4. Innate and acquired Immunity

Unit-III

1. Major histocompatibility complex
2. Nature of immune response
3. Maturation, Activation, regulation & receptors of Lymphocytes (T- Lymphocytes & B- Lymphocytes)
4. Cytokines:

Unit- IV

1. Antigen-Antibody interactions:
2. Complement system
3. Effector of mechanism of cell mediated immunity
4. Immunological techniques.

Unit- V

1. Vaccines.
2. Transplant Immunology
3. Tumour immunology
4. Immunodeficiency disorders: Primary immunodeficiencies, Secondary or acquired immunodeficiencies (AIDS)

Suggested study material

1. Chandler, A.C. and C.P. Read, Introduction to parasitology. Wiley Eastern, New Delhi
2. Croll, N.A. Ecology of parasites. Heinemann, London
3. Dogiel, V.A. General parasitology. Oliver and Boyd, Edinburgh, London.
4. Jones, A.W. Introduction to parasitology, Addison-Wesley Reading, Mass
5. Kuby, Immunology, W.H. Freeman, USA
6. W. Paul, Fundamentals of Immunology
I.M. Roitt. Essential Immunology. ELBS edition.

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Courses of Specialization

(A) Fish Biology and Fisheries

Paper-20 ZOY 403 Fish Bio(A): Special Paper-3rd

(A) Taxonomy, systematics and Ecology of Fishes

Unit-I

1. Outline Classification of fishes as proposed by Berg.
2. Classification of Elasmobranchii.
3. Classification of Crossopterygii.
4. Classification of Actinopterygii.

Unit-II

1. Systematic survey of fish with particular reference to inland fishes of Bundelkhand.
2. Exotic fishes and their importance.
3. Larvicidal fishes and their importance in public health.
4. Predatory fishes and their significance in fish culture.
5. Common weeds of fish ponds and their control

Unit -III

1. Working and maintenance of fish aquarium.
2. Fish nets and gears and methods of fishing
3. Fish diseases, symptoms and treatment.
4. Fish parasites and their control.

Unit- IV

1. Physico - chemical characteristics of fish pond.
2. Biological characteristics of fish pond.
3. Culturable species of fishes of inland water and basis of their selection.
4. Plankton and their significance in fish culture.
5. Primary productivity of fish ponds and its significance.

Unit - V

1. Food and feeding of fishes
2. Artificial food
3. Rain of fishes.

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Paper-20 ZOY 404 Fish Bio(B): Special Paper-4th

(B) Pisciculture and Economic Importance of Fishes

Unit-I

1. Collection of fish seed from natural resources.
2. Dry bundh breeding of carps.
3. Wet bundh breeding of carps.
4. Induced breeding of Indian Major Carps & Catfishes.

Unit - II

1. Types of ponds required for fish culture farms.
2. Management of hatcheries, nurseries, and rearing ponds.
3. Management of stocking ponds.
4. Composite fish culture..
5. Management of fish germplasm, conservation practices.

Unit-III

1. Fisheries resources of Bundelkhand.
2. Riverine fisheries in India.
3. Coastal fisheries in India.
4. Offshore and deep-sea fisheries in India.
5. Role of fisheries in rural development.

Unit-IV

1. Methods of fish preservation.
2. Marketing of fish in India.
3. Economic importance and by-products of fishes.
4. Shark liver oil industry in India.
5. Transport of life fish and fish seed.

Unit - V

1. Chemical composition of fish liver oil
2. Fish flash quality management
3. Medicinal property of fish by products

Suggested study material:

1. Brown, M.E The physiology .f fishes Vol.1 &11 .Academic press
2. Lagler, KF Bardach, J.E.~ Miller, R.R. and Passino, D.R.M Ichthyology John Wiley Be Sons, New York .
3. Hear and Randall, Fish physiology Vol.1-16.Academic press
4. Nikolsky, G.V. The ecology of fishes. Academic press

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Paper-21 ZOY405: Practical-IV (Special Paper)

(A) Fish Biology and Fisheries


1. Identification of different weeds
2. Pituitary gland collection from the fish
3. Percentage of data catch obtained through each type of gear and represent it in pi digramme from the given data
4. Pie digramme from the data for its presentation
5. The different type of nets and gear
6. Skeletal prepration
7. Peracitological studies in fishes
8. Percentage of fish in Kg. and to prepare a histogram digramme from the data provide
9. Viva
10. Record


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(B) Entomology

Paper-19 ZOY 403(A): Special Paper-3rd

(A) Insect Taxonomy, Ecology and Development Insect Taxonomy, Ecology and Development

Unit-I

1. Classification of Apterygota with distinctive feature, economy importance and example of various orders and their sub divisions.
2. Classification of Pterygota upto orders with distinguishing characters and examples .
3. Classification of Exopterygota upto orders with distinguishing characters and examples .
4. Classification of Endopterygota upto orders with distinguishing characters and examples .

Unit-II

1. Classification of the Dictyoptera upto families with distinguishing characters, economics importance and examples.
3. Classification of the Orthoptera upto families with distinguishing characters, economic importance and examples.
4. Classification of the Hemiptera upto families with distinguishing characters, economic importance and examples.
5. Classification of the Isoptera upto families with distinguishing characters, economic importance and examples.

Unit-III

1. Classification of the Lepidoptera upto families with distinguishing characters, economic importance and examples.
2. Classification of the Diptera upto families with distinguishing characters, economic importance and examples.
3. Classification of the Hymenoptera upto families with distinguishing characters, economic importance and examples.
4. Classification of the Coleoptera upto families with distinguishing characters, economic importance and examples.

Unit-IV

1. Social organization in insects(honey bees ,termite,Ant etc)
2. Influence of climatic factors on insect populations
3. Adaptations of insects to their surroundings (aquatic, terrestrial and parasitic)
4. Insect - host plant relationship.

Unit-V

1. Biotechnological methods for the control of pest & diseases
2. Insects as human food.
3. Types of insect larvae, pupae & metamorphosis.
4. Insect diapauses.

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Paper-20 ZOY 404 App. Ento.(B): Special Paper-4th

(B) Applied Entomology

Unit-I

1. Structure life history, significance nature of damage and control methods of following pests of sugarcane :
(a) *Scirpophaga* (b) *Chilo* (c) *Pyrilla* (d) *Aleurolobus*.
2. Structure, life history, significance of nature of damage and control methods of following cotton pests:
(a) *Sylepla* (b) *Earias* (c) *Peclinophara* (d) *Dysdercus*.
3. Structure, life history, significance, nature of damage and control measures of following oil seed pests.
(a) Mustard aphid (b) saw fly (c) Castor semilooper (d) linseed gall midge.
4. Structure life history significance nature of damage and control measures of following stored grain pests:
(a) *Sitophilus* (b) *Trogoderma* (c) *Rhizopertha* (d) *Tribolium* (e) *Bruchus*
(f) *Sitotrua* (g) *Ephestia*
5. Significance, life history and control measures of following general pests.
(a) Grasshoppers (b) Locusts (c) Termites (d) Aphids (e) Hairy caterpillars.

Unit -II

1. Household pests (Cockroaches, Crickets, Ants, Wasps, Silverfish, Cloth with carpet beetle, furniture beetle, brock lice, cigarette beetles and their control.
2. Role of insect as vectors of human diseases.
3. Mosquitoes as pests of public health importance and their control.
4. Housefly: A human health hazard and its control .
5. Live-stocks pests and their control.

Unit-III

1. Beneficial activities of insects
2. Apiculture
3. Lac Culture
4. Sericulture
5. Types and significance of entomophagous Insects.

Unit IV

1. Detailed information and classification of insecticide and their mode of action.
2. Merits and demerits of chemical insecticides and development of resistance against them.
3. Biological pest control.
4. Different measures of insect pest control and integrated pest management.

Unit V

1. Forest entomology & its pests and control
2. Forensic entomology & its importance
3. Veterinary insects and its controls
4. Medical entomology

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Suggested study material:

1. O.W. Richards and R.G. Davies, Imms' Textbook of Entomology. Methuen and Co., London.
2. R.E. Snodgrass, Principles of insect morphology. Tata MacGraw Hill, Bombay.
3. R.M. Fox and J.W. Fox, Introduction to comparative entomology. Reinhold Publ. Corp., New York.
4. R.F. Chapman, The Insects-structure and function (ELBS, London)
5. K.K. Nayar, T.N. Ananthakrishnan and B.V. David, General and Applied Entomology. Tata MacGraw Hill, New Delhi
6. K.G.V. Smith. Insects and other arthropods of medical importance
7. H.H. Ross. A Textbook of Entomology. John Wiley & Sons, New York
8. M.S. Mani - General Entomology

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Paper-21 ZOY 405 :Practical-IV (Special Paper)

APPLIED ENTOMOLOGY

1. Insect Collection and preservation for systematic studies.
2. Identification of different insect upto orders.
3. Identification of insect upto families of economically important orders as studied in theory course .
4. Identification of insect upto species: Mosquitoes, honeybees and stored grain beetles.
5. Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activities etc.
6. Study of beneficial insects, benefits derived from them and useful products.
7. Study of destructive insects, damage caused by them and damaged products.
8. Study of insecticidal formulatives and insect control appliances.
9. Simple experiments on insect control like LC-50 /LD-50, knock down and recovery effect, repellency / antifeedance tests, percentage damage tests for leaf eating insects, and stored grain pests.

SCHEME OF EXAMINATION

Duration: 6 Hours.

1 Identification of insects (10) upto orders	20
2 Identification of insects (5) upto families	10
3. Identification of insects of special upto species	10
4. Spotting related to applied entomology.	10
5. Experiment on insect control.	20
6. Viva-voce	10
7. Record /collection	10
8. Seminar /Excursion/Field Trip	10

Total

100

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(C) Endocrinology

Paper-19 ZOY 403 Endo (A): Special Paper-3rd

(A) Male Reproductive Endocrinology

Unit -I

1. Differentiation of the testes and male genital ducts.
2. Histology and ultra structure of testis.
3. Spermatogenic function of the testis.
4. Hormonal regulation of Spermatogenesis
5. Structure and functional significance of Sertoli cells and blood testis barrier.

Unit- II

1. Endocrine and paracrine function of Sertoli cells.
2. Structure and functional role of Leyding cells.
3. Metabolism of testicular androgens

Unit -III

1. Biochemistry of semen and analysis of semen.
2. Structure and physiology of male reproductive tract.
3. Effects of environmental factors on reproduction.
4. Inhibin and activin

Unit- IV

1. Structure and ultrastructure of mammalian sperm
2. Metabolic changes in, spermatozoa during maturation
3. Capacitation of Spermatozoa.
4. Testicular disorders and their remedies.

Unit - V

1. Regulation of fertility in male.
2. Contraception through male.

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Paper-20 ZOY404 Endo(B) :Special Paper-4th

(B)Female Reproductive Endocrinology

Unit - I

1. Differentiation of the ovary and female genital ducts.
2. Histology of ovary and ultrastructure of ovum.
3. Estrous cycle in mammals.
4. Menstrual cycle in primates.

Unit-II

1. Puberty and its hormonal control.
2. Implantation and its hormonal regulation.
3. Pregnancy and hormonal regulation of pregnancy.
4. Hormonal regulation of parturition.
5. Lactation and its regulation.

Unit- III

1. Fine structure and Types of plantation and their significance.
2. Placental hormones and proteins, secretions and significance.
3. Corpus leuteum and its functional significance.
4. Control of fertility of female due mechanical, chemical and biological means.
5. Neuroendocrine control of ovarian functions.

Unit- IV

1. Prostaglandins and their role in reproduction.
2. Endocrine control of ovulation and lutenization.

Unit - V

1. Endocrine control of structure and Function of mammalian oviduct.
2. Delayed implantation and its mechanism. 22. Techniques of assisted reproduction.

Suggested study material:

1. C.D. Turner and J.T. Bagnara. General Endocrinology. W.B. Saunders
2. P.J. Bentley. Comparative vertebrate endocrinology. Cambridge university press
3. M.E. Hadley. Endocrinology.
4. Yen et al. Reproductive endocrinology, W.B. Saunders.
5. Gorbman and Barm. Comparative endocrinology
6. Reproductive Physiology of Mammals, A.V. Nalbandov. W.H. Freeman and company.

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Paper-21 ZOY 405:Practical-IV (Special Paper)

Reproductive Endocrinology

1. Dissection of various reproductive glands in vertebrates.
2. Operations in male rat: castration, vasectomy
3. Operation in female rats; Ovariectomy, hysterectomy, adrenalectomy, thyroidectomy, laparotomy.
4. Preparation of vaginal smear, identification and staining with papeniculaou stain.
5. Preparation of Sperm smear and classification of types of sperms with abnormalities.
6. Confirmation of pregnancy in urine using antibody method.
7. Separation of steroidal hormones; using thin layer chromatography
8. Identification of permanent slides or reproductive organs.
9. Identification of chemical structures of steroidal hormones.
10. ~~Study of human embryos at different stages of development.~~

SCHEME OF EXAMINATION

Duration : 6.00 Hrs.

1. <i>Dissection of reproductive gland</i> accessory organ with display and diagrams.	20
2. Experiments in living rats (two) Operation in male and female rats Vaginal smear and sperm studies	10
3. Spotting	20
4. Viva-voce	20
5. Practical Record	10
6. Embryo study	10
Total	100

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(D) Cell Biology

Paper-19 ZOY 403 Cell Bio (A): Special Paper-3rd

(A) Neurobiology, Ageing and Immunology

Unit -I

1. Neuron, General organization and function of nerve fibers.
2. Chemical synaptic transmission. Neurotransmitters and role of synaptic vesicles in nerve transmission.
3. Voltage gated channels in electrically excitable membrane.
4. c-AMP and calcium as second messenger and their role in cellular regulatory mechanism.

Unit-II

1. Chromatophores: Types structure, composition and functional significance.
2. Autonomic neural regulation of melanophores and color change.
3. Aging: Theories of aging and the current concept.
4. Free radicals and age pigments (Lipofuscin & ceroids) and their significance in cellular sequence.

Unit -III

1. Apoptosis and cell death, the current concept and sequence in cellular sequence and aging .
2. Age associated neurodegenerative diseases, Alzheimer's & Parkinson's disease.
3. Change chromatin organization and enzyme activities during aging.

Unit - IV

1. General structure of Immunoglobulin (antibody) molecule.
2. Antibody diversity (rearrangement, recombination in immunoglobulin genes).
3. Cells and Tissues of immune system: General organization and functions.
4. Introductory ideas of innate & adaptive immunity.

Unit V

1. Major histocompatibility (MHC) complex
2. Concept of humoral and cell mediated immune responses.
3. Allergy, autoimmunity Immune response genes and AIDS.

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Paper-20 ZOY 404 Cell Bio (B) : Special Paper-4th

(B) Chromosomes, Genes, and Genetic Engineering

Unit-I

1. Molecular organization of eukaryotic chromatin nucleosomes and higher Order compaction of mitotic chromosomes.
2. Genes, gene mutations and molecular mechanism of occurrence of mutations
3. Organization and significance of hetero-chromatin.

Unit-II

1. Organization of eukaryotic transcriptional machinery, promoter obstructers, enhancers, transcription factors and polymerases.
2. DNA binding domains of transcription apparatus, zinc finger, steroid receptors homeo domains, Halix-loop-Helix and Leucine Zipper,
3. Structural organization of eukaryotic genes: interrupted genes and overlapping genes and their evolution.
4. DNA methylation and DNAs sensitivity in relation to gene activity and chromatin organization.

Unit -III

1. Gene families : Organization, evolution and significance.
2. Environmental modulation of gene activity (stress responses) : Stress genes and stress proteins.
3. Gene therapy : Strategies, application and future scopes.
4. Molecular basis of Thalasseмииs, Muscular dystrophy and Cytic fibrosis.

Unit - IV

1. DNA rearrangement and amplification during development with special Reference to ciliates, chorion gene and SSRNA genes.
2. General plan of embryonic development of Drosophila embryo; Trans-determination.
3. Basic idea of organization and evolutionary significance of homeoboxes.
4. Basic idea of homeotic genes and homeotic mutation,

Unit - V

1. Human genome mapping: History and current development
2. Transgenic animals: Methods and applications
3. Single nucleotide polymorphisms and its significance.

Suggested reading material

1. DeRobertis, Alberts et al.: Cell and Molecular Biology
2. J.D. Watson, Molecular biology of the gene
3. Gerald Karp, Cell biology
4. Lewin, Genes Vol VIII

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Paper-21 ZOY 405:Practical- IV (Special Paper)


CELL BIOLOGY-II

1. Preparation of mitotic chromosomes from rat bone marrow.
2. Study of inversion/ inversion frequency from polytene chromosome of *Drosophila* larvae.
3. Study on antigen antibody reactions : Blood group and Rh factor.
4. Study of Monohybrid and Dihybrid crosses/ sex linkage in *Drosophila*.
5. Study of development (homeotic) and other phenotypic mutants of *Drosophila*.

Scheme of Practical Examination

Duration: 6 Hours

1. Preparation mitotic chromosome from rat bone marrow	10
2. Preparation of polytene chromosomes to study inversions	10
3. Analysis of Mono/ Dihybrid/ sex linkage crosses in <i>Drosophila</i> Experimental in immunology	20
4. Permanent slides	20
a. Development and phenotypic mutants -5	
5. Viva-voce	20
6. Record	20
TOTAL	100


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(E) Environmental Biology

Paper-19 ZOY 403 Envio. Bio. (A): Special Paper-3rd

(A) Environmental legislation & Environmental education

Unit –I Environmental legislation & wild life management

1. Environmental laws.
2. Remote sensing-Principles, types and applications.
3. General study of wild, Wild life in India, Value of wild life, Causes of wild life depletion, Conservation of wild life

Unit – II Energy management

1. Definition of energy sources – exhaustible and inexhaustible energy resources
2. Renewable and non-renewable energy resources
3. Non-conventional energy sources and conventional energy resources
4. Energy use pattern in India

Unit – III Environmental education:

1. Definition of EE
2. Environment and population growth
3. Strategies for EE development.
4. Models for future EE development.
5. UNESCO's man and biosphere programme.

Unit-IV Population and Environment

1. Land degradation and desertification
2. Food supply- scarcity and malnutrition.
3. Toxicology, Ecotoxicology & public health.

Unit - V

1. Environmental planning
2. UNESCO's man and biosphere programme
3. Atmospheric turbidity & Nuclear winter
4. Standards for environmental quality assessment & monitoring.

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**Paper-20 ZOY-404 ENV.BIO (B) Special Paper-4th
Global and National Environmental Issues**

Unit- I

- a. Global climatic change
 - Global warming
 - Ozone layer depletion
 - Acid rain
 - El-nino
- b. Protocol & Convention for Global climatic changes
 - Montreal Protocol
 - Kyoto Protocol
 - Basal Convention

Unit- II

- a. Environmental challenges in India
 - Efforts to meet challenges
 - United nation efforts for environmental protection or Earth Summit 1992 and its outcome
- b. Environmental organization and Agencies
 - International bodies
 - MAB
 - National organization

Unit-III

- a. Major environmental movement in India
 - Chipko movement
 - Silent valley movement
 - Apiko movement
 - Narmada bachao andolan
 - Tehri dam conflicts

Unit-IV

- Environmental monitoring
- Environmental Impact Assessment (EIA)
- Population explosion and birth control measure
- Biosafty issues

Unit-V

- Environmental education
- Role of women in environmental protection management
- Role of information technology (IT) in environment

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Paper-21 ZOY 405:Practical- IV (Special Paper)

Practical

Paper-XXI Special Paper-Environmental Biology

Dissolved oxygen

Biological oxygen demand

Alkalinity

Acidity

Ph of different water sample

Chloride estimation through spectrophotometrically

Gram +ve & Gram -ve

Chart/model related to papers (Environmental Biology)

Record

Viva- Voce

Details required 7.

Total Marks 100

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Paper-19ZOY 403 App. Zool (A) Special Paper-3rd

(A) Applied Entomology

Unit-I

1. Beneficial activities of insects
2. Apiculture
3. Lac Culture
4. Sericulture
5. Types and significance of entomophagous Insects.

Unit-II

1. Insects Pests : Emergence of insect pests, pest out breaks and pest resurgence.
2. Structure life history, significance nature of damage and control methods of following pests of sugarcane :
(b) *Scirpophaga* (b) *Chilo* (c) *Pyrilla* (d) *Aleurolobus*.
3. Structure, life history, significance of nature of damage and control methods of following cotton pests:
(a) *Sylepla* (b) *Erias* (c) *Peclinophara* (d) *Dysdercus*.
4. Structure, life history, significance, nature of damage and control measures of following oil seed pests.
(c) Mustard aphid (b) saw fly (c) Castor semilooper (d) linseed gall midge.
5. Structure life history significance nature of damage and control measures of following stored grain pests:
(d) *Sirophilus* (b) *Trogoderma* (c) *Rhizopertha* (d) *Tribolium* (e) *Bruchus*
(f) *Sitotrua* (g) *Ephestia*
6. Significance, life history and control measures of following general pests.
(e) Grasshoppers (b) Locusts (c) Termites (d) Aphids (e) Hairy caterpillars.

Unit -III

1. Household pests (Cockroaches, Crickets, Ants, Wasps, Silverfish, Cloth with carpet beetle, furniture beetle, brok lice, cigarette beetles and their control.
2. Role of insect as vectors of human diseases.
3. Mosquitoes as pests of public health importance and their control.
4. Housefly: A human health hazard and its control.
1. Live-stocks pests and their control.

Unit- IV

1. Detailed information and classification of insecticide and their mode of action. Merits and demerits of chemical insecticides and development of resistance against them.
2. Biological pest control.
3. Different measures of insect pest control and integrated pest management.

Unit - V

1. Forest Entomology its pests and control
2. Forensic Entomology and its important
3. Veterinary insects and its control

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Suggested study material:

1. O.W. Richards and R.G. Davies, Imms' Textbook of Entomology. Methuen and Co., London.
2. R.E. Snodgrass, Principles of insect morphology. Tata MacGraw Hill, Bombay.
3. R.M. Fox and J.W. Fox, Introduction to comparative entomology. Reinhold Publ. Corp., New York.
4. R.F. Chapman, The Insects-structure and function (ELBS, London)
5. K.K. Nayar, T.N. Ananthkrishnan and B.V. David, General and Applied Entomology. Tata MacGraw Hill, New Delhi
6. K.G.V. Smith. Insects and other arthropods of medical importance
7. H.H. Ross. A Textbook of Entomology. John Wiley & Sons, New York

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