

M.Sc. Syllabus
ZOOLOGY [2018-2020]

(Faculty of Science)
[Choice based Credit System (CBCS)]

DEPARTMENT OF ZOOLOGY

PURNEA UNIVERSITY
PURNIA - 854301

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06.06.2020
Head
Zoology Dept
Purnea Univ
Purnia

***SEMESTER-I**

Course Code-PUZOO 501

Core Course[(CC-1) Functional Biology of invertebrates and Chordates

Time-3 hrs

Full Marks – 70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (four to be answered) of 5 marks each . Part C will consist of five long questions [three to be answered] 10 marks each

Unit-1

L Organization of coelom and its significance

1.2 Patterns of feeding and digestion in Invertebrates

3 Larval forms of Trematodes, Crustacea and Echinodermata

Unit - 11

1 Respiratory pigments in different phylogenetic groups

2.2 Organs of respiration in invertebrates :Gills, Lungs and Trachea

2.3 Mechanism of respiration in invertebrates

Unit - II

3.1 Organs of respiration in vertebrates: Gills ARO and Lungs

3.2 Principles of gaseous exchange and Fick's modified equation

3.3 Transport of gases in blood and body fluid

3.4 Regulation of respiration (Neural and chemical control)

3.5 Respiratory adaptation at higher altitude and in diving mammals

Unit - IV

4.1 Lateral line system in fishes

4.2 Bioluminescent in fishes

4.3 Electric organ in fishes

4.4 Parental care in fishes and amphibians

4.5 General organization and affinities of Rhynchocephalia

Unit - V

5.1 Migration in birds

5.2 Mimicry in birds

5.3 Dentition in mammals

5.4 Aquatic adaptations in mammals

5.5 Characters and classification of primates

Suggested Reading

1. Barrington, EWJ: Invertebrates Structure and Function Thomas Nelson and Sons Ltd. London

2. Russel-Hunter, W.D. A Biology of Higher Invertebrates. The Macmillan Co. London

3. Barnes. R. D. Invertebrates Zoology, 11th Edition. WB Saunders Co. Philadelphia

4. Parker. T.J. and Haswell, W.A: Text Book of Zoology, Vol. I and II, Macmillan Co, London

5. Read, C.P.: Animal Parasitism Prentice Hall Inc. New Jersey

6. Potts and Borraidaile: Invertebrates

7. Romer and Parsons: The Vertebrate Body, Saunders

8. Pandey B.N. and Mathur V. Biology of Chordates, PHI Learning, (P. Ltd.)

9. Kotpal. R. L. Modern Text book of Zoology (Invertebrates and Vertebrates) Rastogi Publications

10. Hyman, L. H.: The Invertebrates, Vol.2 and 8 Mcgraw Hill Co., New York

11. Waterman. A. J Chordate structure and function. MacMillan Co., New York

12. Pechenik. J A Biology of Invertebrates. Tata Mcgraw Hill Publishing Company Lt. India



13. Meglitsch. P. A. and Schran, F. R Invertebrates Zoology. Oxford Univ. Press, Inc. NewYork
14. Walter Sayle: Biology of Vertebrates Prosser and Brown: Comparative Animal Physiology, Wiley
15. Nielson: Animal Physiology, Cambridge
16. Eckert, R: Animal Physiology: Mechanisms and Adaptation, W. H. Freeman & Company
17. Ganguli, Sinha and Adhikari: Biology of Animals (Vol. I & II). New Central Book AgencyKolkata



SEMESTER-I

Course Code-PUZOO 502

Core Course (CC-2): Molecular Cell Biology

Full Marks - 70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered]10 marks each

Unit:I

(A) Bio membrane

1.1 Molecular composition, arrangement and functional consequences

1.2 Model of bio-membrane

1.3 Transport across bio-membrane: diffusion, active transport and membrane pumps (P- type pump, V-type pump and ABC transporter)

1.4 Cotransport by symporters and antiporters

(B) Cytoskeleton

1.5 Microtubules and microfilaments, Structure and dynamics

1.6 Role of Kinesin and Dynein in intracellular transport

1.7 Axon transport and cell movement (with respect to non-muscle motility)

Unit II: DNA replication

2.1 Outline of prokaryotic replication

2.2 Replication features of single stranded phages

2.3 Mechanism and machinery of replication in eukaryotes

2.4 DNA damages and repair mechanisms

Unit III: Transcription

3.1 Outline mechanism of prokaryotic transcription

3.2 Organization of eukaryotic transcription mechanism

3.3 General and specific transcription factors

3.4 Regulatory elements & DNA binding domains of transcription apparatus

3.5 Processing of primary transcript & RNA editing in eukaryotes

Unit IV: Translation

4.1 Genetic code: Codon assignment and features

4.2 Outline of prokaryotic translation

4.3 Eukaryote translation Machinery [Ribosome & t RNA]

Eukaryote translation mechanism (initiation, elongation termination)

Unit-V Intracellular protein trafficking

5.1 Targeting proteins to ER: Signal hypothesis

5.2 Co- and Post-translational modifications of proteins

5.3 Trafficking mechanisms

[a] Vesicular transport

[b] Protein sorting

[c] Endocytosis and exocytosis

Suggested Reading

1. Albert B. Bary D. Lewis, J. Rall. M Roberts, K. and Watson, JD Molecular Biology of the Cell. Garland Publishing Inc. New York

2 Ambrose, A Cell Biology.

4. Barnel, J, Lodish H. and Baltimore D. Molecular Cell Biology. Scientific American Book

3. Con Elements of Cytology Lodish H. and Baltimore D. Molecular Cell Biology. Scientific American Book

5 De Robertis and De Robertis: Cell and Molecular Biology Lea &Febiger, Philadelphia.

6. Giese: Cell Physiology, WB Saunders

7 Meyers, RA Molecular Biology and Biotechnology, VCH Pub. New York

8, C.B. Power Cell Biology. Himalaya Publication. Mumbai

9. Styrer: Cell and Molecular Biology
- 10 Tom Strachan, Andrew Read: Human Molecular Genetics Garland Science
- 11 Brown, TA Introduction to Genetics A Molecular Approach. Garland Science
- 12 Weaver, Robert F. Molecular Biology. Mcgraw Hill International Edition
- 13, Paul Ajay Text book of Cell and Molecular Biology. Books and Allied (P) Ltd. Kolkata
14. Allison Lizabeth Fundamental Molecular Biology. Blackwell Publishing
15. Twyman, R. M. Advanced Molecular Biology Viva Books Pvt.



SEMESTER-I

Course Code-PUZOO 503

Core Course (CC-3): Genetics

Full Marks - 70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit I Organization of Chromosomes

- 1.1 Organization of prokaryotic Chromosomes
- 1.2 Organization of eukaryotic chromosome: Nucleosome as functional particle, 30 nm chromatin fibre, higher order structure chromatin
- 1.3 Organization of centromere and kinetochore, Organization of telomere and its maintenance
- 1.4 Heterochromatin: Types, organization, formation and significance
- 1.5 Structural organization and functional significance Polytene and Lampbrush chromosomes

Unit-II Microbial Genetics

- 2.1 Transformation, conjugation, transduction and sex-duction in bacteria
- 2.2 Construction of linkage map in bacteria
- 2.3 Molecular mechanism of recombination

Unit-III Cell cycle

- 3.1 Stages and check points cell cycle
- 3.2 Genetics of cell cycle regulation: Role of cyclins and CDKs
- 3.3 Molecular basis of cellular check points

Unit IV: Sex determination and dosage compensation

- 4.1 Genetics and Molecular basis of sex determination *Coenorhabditiseiegans*, *Drosophila* & human

4.2 Genetic basis of dosage compensation *Caenorhabditis elegans*, *Drosophila* and mammals

Unit V: Techniques & Methods in Genetics

5.1 DNA sequencing: Base destruction method, chain termination method and automated sequencing. pyro-sequencing and whole genome shotgun sequencing

5.2 DNA amplification: Polymerase chain reaction, its application and limitations

5.3 DNA finger printing and DNA microarray

5.4 Apoptosis, Transposons and Prions

Suggested Reading

1. Alberts, B., Bery D. Lewis, J. Raff, M. Roberts, K. and Watson, J.D. Molecular Biology of the Cell. Garland Publishing Inc. New York
2. Barne, J., Lodish H. and Baltimore, D.: Molecular Cell Biology Scientific American book Inc. USA
3. Watson, J.D. Hopkins, N.H., Robert, J.W. Stetiz, J.A. and WEINER, A.M.: Molecular Biology of the Gene. The Benjamin Cummings Publishing Co Inc. California.
4. Dabre, P.D. Introduction to Practical Molecular biology John Wiley and sons Ltd N.Y
5. Snudstad, D.P. and Simmons, M.J. Principles of Genetics. John Wiley and sons .Inc.
6. Klug, W. S. and Cummings, M. R: Concepts of Genetics .Prentice Hall
7. Jha, A.P.: Genes and Evolution, Oxford Publication Press
8. Korf, B.: Human Genetics and genomics. Blackwell Science, U.K.
9. Strachan. Tom and Read, Andrew: Human Molecular Genetics Garland Science/Taylor and Francis Group. Oxford
- 10 Benjamin A. Pierce: Genetics: A Conceptual Approach
11. Mark F. Sanders and John L. Bowman: Genetic Analysis: An Integrated approach Kindle Edition

12. Hartwell, Leland, H. Genetics, From Genes to Genomes. Mcgraw Hill International Edition
13. Paul, Ajay: Text book of Genetics from Genesto Genomes Books and Allied (P) Ltd. Kolkata
14. Lesk, Arthur M.: Introduction to Genomics. Oxford University Press
15. Dale, J. W. and malcom von Schantz: From Genes to Genomes John Wiley and Sons Ltd.

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SEMESTER -I

Course Code-PUZOO 504

Core Course (CC-4) Practica

IFull Marks-70

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Squash preparation using any of the following 10

- (a) Chironomus/Drosophila larvae for polytene chromosomes
- b) Onion root tip for mitosis and mitotic index
- (c) Grasshopper testes for meiosis and related features

2. Experimental demonstration (any one of the following) 10

(A) Enumeration of RBC

(B) Enumeration of WBC (TC and DC)

(C) Preparation of histological slide of the given paraffin section/whole mount of any invertebrate larva 05

3. Identification and comment upon spots (cytological slides: Nos 02) 05

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4. Identification and comments upon spots (invertebrate slide 03, vertebrate slide - 02)

5. Genetics (any of the following)

(a) Solving problems on Mendelian principles and sex linked inheritance

(b) Preparation of linkage map based on data from *Drosophila* crosses and tetrad analysis in *Neurospora*

(c) Pedigree analysis in human

6. Class records/charts/models and field collection

7. Viva-voce

SEMESTER-II

Course Code-PUZOO 505

Core course (CC-5) Environmental Science

Full Marks - 70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit I: Concept of Dynamics of ecosystem

1.1 Abiotic factors and Biotic factors

1.2 Energy flow

(a) Lindemann's rule of trophic dynamics

(b) Energy flow models

1.3 Biogeochemical cycles Nitrogen, Carbon, Sulphur and Phosphorous cycle

1.4 Hydrological cycles

Unit II: Principles pertaining to limiting factors

2.1 Liebig's Law of minimum, Shelford's Law of tolerance

2.2 Concept & Law of limiting factors

Unit III: Population growth. Population and Regulation

3.1 Demography: Life tables, Generation time, Net reproductive rate, Reproductive value

3.2 Population growth: Exponential growth

3.3 Population regulation extrinsic and intrinsic mechanisms

3.4 Concept of niche, niche width and overlap. fundamental and realized niche

Unit IV: Global Environmental Issues

4. Climate change

4.2 Carbon Footprint

4.3 Water Security - conservation of surface and ground water

4.4 Wildlife

[a] Causes of extinction

(b) National and International efforts for conservation (CITES, IUCN, CBD)

(c) National parks sanctuaries

[d] Biosphere reserves

(e) Wildlife protection Acts

Unit V: Pollution Biology

5.1 Pollutants, their sources and classification

5.2 Causes -effects and control of Water and Air Pollution

5.3 Biomagnification and Eutrophication

5.4 Thermal and Radioactive pollution

5.5 Bio-indicators as index of pollution and their significance

Suggested Reading

1. Odum, EP. Fundamentals of Ecology. W. B. Saunders Company, USA
2. Jorgensen S. E. Fundamentals of Ecological modeling, E. Sevier New York
3. Lenderen, D. Modelling in behavioural ecology. Chapman & Hall, London (U.K.)
4. Barcley. GW Techniques of Population Analysis. Wiley, New York
5. Kormondy, E J. Concepts of Ecology. Prentice Hall, Englewood Cliffs, N.J
6. Subrahmanyam, N. S and Sambamurty: Ecology Narosa Publishing House PVL Lid. NewDelhi
7. Richard Brewer: The Science of Ecology. Brook Cole Publishers
8. Pullin: Conservation Biology, Cambridge
9. Negi: An introduction to Wildlife Management.



10. Rao, C.S.: Environmental Pollution Control Engineering. New Age International, New Delhi
11. Arnold J. Bloom: Global Climate Change. Sinauer Associates, Inc.
12. Andrew Dessler: Introduction to Modern Climate Change. Cambridge University Press
13. Odum. P E and Barrett: Fundamentals of Ecology Brooks Cole
14. Richard Brewer: The Science of Ecology Brooks Cole
15. Gerry Closs: Freshwater Ecology A Scientific Introduction. Wiley Publisher
16. Rana, S. V. S. Essentials of Ecology and Environmental Science. PHI Learning Pvt.Ltd.New Delhi

SEMESTER -11

Course Code-PUZOO 506

Core-Course [CC-6] Bio-instrumentation& Biostatistics

Time -3hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of marks each Part B will consist of short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each.

Unit-I

1.1 Principles and use of analytical instruments- pH meter, colorimeter. Spectrophotometer. Ultra-centrifuge.

1.2 Microscope-Phase contrast Photomicrography

Unit-II

(A) Separation techniques

2.1 Electrophoresis: SDS, PAGE Agarose gel electrophoresis

2.2 Chromatography Column, GLC, HPLC

2.3. Organelle separation by centrifugation

2.4 Cell separation by flow cytometry and density gradient centrifugation

(B) Immunological techniques

2.5 Radio-immunoassay (RA)

2.6 Enzyme linked Immunosorbent assay (ELISA)

Unit-III

3.1 Basic concept Biostatistics [sample designing, data collection and scaling techniques)

3.2 Mean, Arithmetic, Geometric & Harmonic mean

3.3 Standard deviation



3.4 Standard error

3.5 Analysis of Variance (ANOVA)

Unit IV

4.1 Correlation (Karl Pearson and Rank's correlation)

4.2 Regression

Unit -V

5.1 Rules of probability

5.2 Binomial probability distribution

5.3 Poisson probability distribution

5.4 Normal probability distribution

5.5 Test of significance

(a) Chi-square test

(b) Student 't' test

Suggested Reading

1. Robert Baron, Introduction to Instrumental Analysis: Mcgraw Hill
2. Locquin and Langeron: Handbook of Microscopy, Butterwaths, 1983
3. Wilson and Walker: Practical Biochemistry, Cambridge, 2000
4. Clarke and Swizer: Experimental Biochemistry. Freeman, 2000
5. Cooperi: The Cell - A Molecular Approach, ASM, 1997
6. John. R W. Masters: Animal Cell Culture - A practical approach, IRI, Press
7. A Biologist Guide to Principles and Techniques of Practical Biochemistry: K. Wilson and K.H. Goulding EIBS Edn.
8. Sneedor, G.W. and W.G. Cochran : Statistical methods, Affiliated East, West Press, New Delhi (Indian Edn)
- 9 Murray, J.D. Mathematical Biology, Springer Verlag Berlin

10. Lewis, A. Biostatistics
11. Mahajan, K.: Methods in Biostatistics, Jaypee Brothers, New Delhi
12. Sokal, R.R and F.J. Rohlf: Biometry, Freeman San Francisco
13. Milton and Tsokos: Statistical Methods in Biological and Health Sciences, Mc Graw Hill
14. Stoel & Torrie: Principles & Procedure of Statistics. Mc Graw Hill
15. Rosner, Bernard: Fundamentals of Biostatistics. Duxbury (BK and DSK. Ed, Boston
16. Zar, J.H: Biostatistical Analysis: Pearson Education Ltd, India
17. Sunder Rao, Richard: Introduction to Biostatistics and Research Methods. PHI Learning Pvt.Ltd, New Delhi

SEMESTER -11

Course Code-PUZOO 507

Core Course (CC - 7) Biochemistry

Full Marks – 70

Time - 3 hrs

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each: Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit-1: Bioenergetics

- 1.1 Laws of thermodynamics, internal energy, enthalpy, entropy
- 1.2 Concept of free energy, redox potential, energy rich compounds
- 1.3 Mitochondrial electron transport chain and oxidative phosphorylation

Unit - II: Biochemistry of Carbohydrates

- 2.1 Monosaccharides and Disaccharides. Types and properties
- 2.2 Polysaccharides: Homopolysaccharides and Heteropolysaccharides
- 2.3 Glycolysis, Krebs cycle, Glyconeogenesis and Glycogenolysis

Unit -III: Biochemistry of Proteins and Lipids

- 3.1 Primary, secondary, tertiary, quaternary and domain structures
- 3.2 Stabilizing forces in protein structure
- 3.3 Biosynthesis of urea
- 3.4 β - Oxidation of long chain fatty acids

Unit - IV: Enzyme Biochemistry

- 4.1 Enzyme: Classification and nomenclature
- 4.2 Mechanism of enzyme action
- 4.3 Kinetics of enzyme catalyzed reaction
- 4.4 Non-genetic regulation of enzyme activity
 - (a) Feedback inhibition

(b) Allosteric inhibition

4.5 Isoenzymes

Unit - V: Principles of Histology and Histochemistry,

5.1 General principles of fixation and types of fixatives

5.2 General principles of staining and types of dyes

5.3 General principles of histochemistry

(a) Carbohydrate

(b) Protein

(c) Lipid

Suggested Reading

1. Lehninger: Principles of Biochemistry, Worth Publishers Inc.
2. Stryer: Biochemistry, Freeman & Co.
3. Zubay, Biochemistry. W.C.B.
4. Cohn and Stump: Biochemistry
5. Satyanarayana: U Biochemistry Books and Allied (P) Ltd. Kolkata
6. Voet, D. & Voet, J.G. Biochemistry, John Wiley & Sons Ltd, NY
7. Harper's Review of Physiological Chemistry
8. Talwar and Srivastava (Ed.): Text book of Biochemistry and Human Biology.
9. Bell, G. H. et al., Textbook of Physiology and Biochemistry. ELBS and Churchill Livingstone
10. Lal, H. and Pandey, R. :A Textbook of Biochemistry. CBS Publisher
11. Pearse: Histochemistry
12. Lilley: Histochemistry
13. Bancroft, D. Histochemical Techniques. Butterworth-Heinemann
14. Purnia. Textbook of Histochemistry. Pearl Books
15. Richard W. Horobin: An explanatory outline of Histochemistry and Biophysical Staining,

SEMESTER-II

Course Code-PUZOO 508

Core Course (CC-8) Biosystematics and Evolution

Time 3 hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit -I Biosystematics and Evolution

- 1.1. Definition and basic concept of Biosystematics and taxonomy, its importance and application in biology
- 1.2. Hierarchy of categories, outline of classification of animals, important criteria used for classification up to classes in each phylum
- 1.3 International code of Zoological nomenclature (ICZN): operative principles and important rules, Zoological nomenclature and scientific name of various taxa
- 1.4. Trends in Taxonomy: Chemotaxonomy, Cytotaxonomy and Molecular taxonomy

Unit- II: Pattern of genetic variation and natural selection

- 2.1 Genetic polymorphism, variation in chromosome structure, protein structure and nucleotide sequences
- 2.2 Concept of Natural selection (Darwinian and Neo- Darwinian), mode of its operation: stabilizing directional and disruptive modes of Natural selection

Unit - III: Molecular evolution

- 3.1 Variation in the evolution of protein and DNA sequences
- 3.2. Neutral theory of molecular evolution
- 3.3 Origin of new genes and evolution of multi gene family

Unit - IV: Mechanism of speciation

- 4.1. Patterns and mechanisms of reproductive isolation and its role in evolution

4.2. Models of speciation

Unit – V Population genetics

- 5.1 Concept of Gene pool, allele frequency and genotype frequency
- 5.2. Hardy- Weinberg principle of genetic equilibrium and its mathematical derivation
- 5.3. Detailed account of destabilizing forces of genetic equilibrium Natural selection, Mutation, Migration, Meiotic driver and Genetic drift

Suggested Reading

1. Dunn, L.C Genetics of Origin of Species
2. Sinnot, Dunn and Dobzhansky: Principles of Genetics
3. Jha, A. P. Genes and Evolution, Oxford Publication Press
4. Lull: Organic Evolution
5. Mayer, E Elements of Taxonomy
- 6 Simpson Principles and Practices of Animal Taxonomy
7. Kapoor Principles and Practices of Animal Taxonomy
8. Strickberger Evolution, CBS Publ. 1994
9. Ridley, M. (2004). Evolution III Edition, Blackwell Publishing
- 10 Douglas, J. Futuyma (1997) Evolutionary Biology. Sinauer Associates
11. Minkoff. E. (1983). Evolutionary Biology Addison-Wesley.
12. Lindell Bromham: An introduction to Molecular Evolution and Phylogenetics. Oxford University Press
13. Dan Graur, Wen-Hsiung Li Fundamentals of Molecular Evolution. Oxford University Press
14. Roger Prior: Taxonomy (Biology - Study - Guides), Kindle Edition



SEMESTER -11

Course Code-PUZOO 509

Course (CC-9) Practical

Time 6 hrs

Full Marks -70

1st sitting

1. Biochemical experiment (any one of the followings) 10
- [a] Determination of salivary amylase activity
 - [b] Colorimetric estimation of glucose, uric acid or albumen in the given sample
 - [c] Separation of amino acids by paper chromatography
 - [d] Biochemical detection of glucose, starch, protein or lipids in a given sample
2. Identify and comment upon the spots of evolutionary significance (any one of the following) 10
- (a) *Archaeopteryx*
 - (b) Darwin finches
 - [c] Serial homology in cephalothoracic appendages in prawn
 - (d) Homology vs Analogy
 - [e] Adaptive radiation in beaks of birds
3. Histochemistry : Histochemical demonstration involving the following reagents: 10
- PAS, Alcianblue, Sudan black B Sudan III/IV, Methylgreen, Pyronin, Mercury bromophenol
- or
- Preparation of temporary mount of any two of the specimen of plankton

2nd sitting

4. Environmental studies (any one of the following) 10
- (a) Measurement of pH
 - (b) Estimation of dissolved O₂
 - (c) Estimation of free CO₂
 - (d) Estimation of carbonate & bicarbonate alkalinity
 - (e) Composition and assessment of the taxonomic diversity/biodiversity in a habitat (grassland, arid & wetland)
 - (f) Estimation of the total hardness
5. Biostatistics 10
- Standard deviation, Standard error, Correlation, Regression, 't' test
6. Class record 10
7. Viva-voice 10



SEMESTER-III

Course Code-PUZOO 510

Core Course (CC-10) Vertebrate Immunology

Time 3 hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit-I: Innate and Acquired Immunology

- 1.1 Cell types of innate and adaptive immunity, Lymphocyte trafficking
- 1.2 Phagocytosis and inflammation
- 1.3 Humoral immunity: β cell activation and differentiation, primary and secondary humoral response
- 1.4 Cell mediated immunity: T-cell development and T-cell activation, CTL and NK cell mediated immunity

Unit-II : (A) Nature of Antigens

- 2.1 Antigenicity and immunogenicity and the factors influencing it
- 2.2 Characteristics of β and T cell epitopes and haptens
- 2.3. Antigen processing and presentation
- 2.4 MHC complex

(B) Structure and functions of Antibodies

- (a) Gross and fine structure
- (b) Classes and sub-classes
- [c] Antibody mediated effector functions and monoclonal antibodies

Unit III: (A) Antigen-antibody interaction and Complement system

- 3.1 Antibody affinity and antibody avidity
- 3.2 Precipitation reactions

3.3 Agglutination reactions

3.4 Complement system activation pathway, biological function and complement deficiencies

3.5 ELISA

(B) Classification and function, Cytokines receptors

Unit - IV: Organization and expression of Ig genes

4.1 Organization of Ig genes

4.2. Generation of antibody diversity

4.3. BCR and Generation of T-cell receptor diversity

Unit - V: Immunology and Diseases

5.1 Hypersensitivity Type I, II, III and IV)

5.2 Auto-immunity

5.3. Immune responses to infectious agents - bacterial, viral and parasitic infection

5.4 Immunodeficiencies

Suggested Readings:

1 Kuby: Immunology. W.H. Freeman, USA

2. Charles, Janeway, Jr and Paul Travers. Immunobiology - the immune system in health and disease. Garland Publishing, Inc.

3. Abul K. Abbas and Andrew H. Lichtman: Basic Immunology. Saunders

4 Kumar Arvind Text book of Immunology. The Energy and Resources Institute (TERI). Press, New Delhi

5. Paul, W. Fundamentals of Immunology

6. Roitt's Essential Immunology, ELBS Edition

7 Barrett Immunology

8. Annadurai, B. A Textbook of Immunology and Immunotechnology, S. Chand and Company Ltd., India

9 Bhattacharya, S. and Sinha, J: A Textbook of Immunology Academic Publishers, Kolkata

10. Rao, V. V. Immunology: A text book. Narosa Publishing House, India

11. Bona. C A. and Bonilla, F A Text Book of Immunology. Fine Arts Press, North Ryde



SEMESTER-III

Course Code-PUZOO 511

Core Course [CC-11] Gamete and Developmental Biology

Time 3 hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit-1: Gamete Biology

- 1.1 Cellular basis of spermatogenesis and Biochemistry of semen
- 1.2 Ovarian follicular growth and differentiation
- 1.3 Oogenesis and vitellogenesis
- 1.4 Ovulation and ovum transport
- 1.5 Molecular events during fertilization

Unit-II (A) Multiple ovulation and Embryo transfer technology

- 2.1 In vitro oocyte maturation
- 2.2 Super ovulation
- 2.3 In vitro fertilization
- 2.4 Collection and preservation of gametes
- 2.5 ICT, GIFT & immune-contraception

Unit-III: Basic concept of development

- 3.1 Potency, Commitment, specification, induction, competence and differentiation
- 3.2 Morphogenetic gradients, cell fate and cell lineages

Unit - IV: Differentiation, morphogenesis and organogenesis

- 4.1 Cell differentiation: morphogenesis and organogenesis
- 4.2 Gene amplification and rearrangement during development

Unit-V: Stem cell Biology

- 5.1 Definition and characteristics of stem cell
- 5.2 Type of stem cell (embryonic, adult and cancer stem cell)
- 5.3 Nuclear reprogramming of induced pluripotent stem cell, test for pluripotency
- 5.4 Potential application of stem cells, therapeutic cloning

Suggested Readings

1. Austen, C.R. and Short R.V. Reproduction in animals
2. Gilbert, S.F: Developmental Biology. Sinauer Associates, Inc.. Massachusetts
3. Alfonso Martinez Arias and Alison Stewart: Molecular Process of Animal Development
4. Edwards, R. G. Human Reproduction
5. Torrey. T W Morphogenesis of Vertebrates
6. Schatten and Schatten. Molecular Biology of Fertilization
7. Berril. Developmental Biology, McGraw-Hill. Indian ed
8. Jain, PC: Development Biology:
9. Robert Lanza and Anthony Atala (Edn.). Essentials of Stem Cell Biology
10. Paul Knoepfler: Stem Cell: An Insider's Guide, World Scientific Publishing Ltd
11. Sarah Hake and Fred Wilt: Principles of Developmental Biology. W. W. Norton &Comp.Inc.

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SEMESTER-III

Course Code-PUZOO 512

Core Course (CC-12) Vertebrate Endocrinology

Time 3 hrs

Full Marks -70

Questions to be set in three types representing all the five units Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit -I:

- 1.1 History, Aims and scope of Endocrinology
- 1.2 Hormones as messenger
- 1.3 Chemical nature and gross features of hormones
- 1.4 Neuroendocrine system and neurosecretion
- 1.5 Hypothalamus as a neuro-endocrine organ

Unit - II:

- 2.1 Gastro-intestinal hormones
- 2.2 Hormonal regulation of carbohydrate, protein and calcium metabolism.
- 2.3 Gonads and Hormonal regulation of reproduction
- 2.4 Prostaglandins

Unit - III

- 3.1 Biosynthesis of steroid hormones
- 3.2 Biosynthesis of T₄ and epinephrine

Unit - IV: Hormones Receptors

- 4.1 B-adrenergic receptor
- 4.2 Insulin receptor
- 4.3 Steroid hormone receptor



Unit - V: General principles of hormone action (signal transduction)

5.1 Second messenger concept (G proteins, Nucleotides (cAMP, cGMP), Calcium, Calmodulin Phospholipids)

5.2 Lipid soluble hormones and intracellular receptor

5.3 Lipid insoluble hormones and intracellular signaling

Suggested reading

1 Barrington, E.W.J: General & Comparative Endocrinology. Oxford Press, W. B. Saunders

2 Martin, CR.: Endocrine Physiology. Oxford Press

3 Hadley: Endocrinology

4. Laycock and Wise, P.H: Essential Endocrinology. Oxford University Press,

5. Hadley, M.E Endocrinology. Pearson Education Pvt. Ltd. Singapore

6. Gorbman Comparative Endocrinology

7. Turner Comparative Endocrinology

8 Williams R. H Textbook of Endocrinology. W. B. Saunders

9. Bentley P.J. Comparative Vertebrate Endocrinology. Cambridge University Press

10. Mala Dharmalingam: Textbook of Endocrinology, Jaypee Brothers, Medical Publishers Pvt. Limited,

11. Michael T McDermott: Endocrinology Secrets. Elsevier Inc.

SEMESTER-III

Course Code-PUZOO 513

Core Course(CC-13) Animal Behaviour

Time 3 hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each, Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part C will consist of five long questions (three to be answered) 10 marks each

Unit-I: Basics of Animal Behaviour

1.1. Ethology: Definition, Branches, Significance

1.2 Approaches and methods of study of Behaviour

1.3 Patterns of Behaviour (a) Innate behaviour, Kinases/Taxes, Simple reflex, Comparison of reflex, Trial and error learning. Reasoning and Cognition

Unit -II: Social Behaviour

2.1. Social behaviour of insects (Honey bees, Ants and Termites)

2.2 Schooling in fish, Flocking in birds

2.3 Social organization of Primates

2.4 Nest building in birds

2.5 Brooding behaviour in birds

Unit-III: Reproductive Behaviour

3.1 Evolution of sex and reproductive strategies

3.2 Mating system

3.3 Courtship and Parental behaviours, Parental care and Parental investment

Unit - IV: Biological Rhythms

4.1. Circadian, Circannual, Lunar, Tidal and Epicycles



4.2 Navigation including orientation

4.3 Migration of fishes and birds

Unit - V: Control of Behaviour

5.1 Neural control of behaviour

5.2 Hormones and behaviour

Suggested Readings:

1. McFarland: Animal Behaviour.

2. Drickamer & Vessey: Animal Behaviour Concepts, Processes and Methods (2nd ed.): Wadsworth: 1986

3. Alcock Animal behaviour Sinaur Associates, Inc. 1989.

4. Goodenough et al. Perspectives on animal behaviour. Wiley & Sons, New York.

5. Grier : Biology of animal behaviour, Mosby 1984.

6. Halliday. TR. Animal Behaviour Vol. I & 2 Communication. 1983.

7. MP Arora Animal behaviour. Himalayan Publishing house

8. Aubrey Manning Marian Stamp Dawkins: An Introduction to Animal Behaviour. Cambridge University Press

9. Shukla, J. P. Fundamentals of Animal Behaviour, Atlantic Publishers. New Delhi

11. Goodenough, J: Perspectives on Animal Behaviour. John Wiley & Sons, Inc.

12. Scott Graham: Essential Animal Behaviour. Blackwell Science, Inc.

13. Nordell Animal Behaviour. Oxford University Press

14. Roland Siiter: Introduction to Animal Behaviour Brooks/Cole Publishing Co

15. Mandal Fatik Baran: Text Book of Animal Behaviour. PHI Learning Pvt Ltd

Course Code-PUZOO 514

SEMESTER - III

Core Course (CC - 14) Practical

Time 6 hrs

Full Marks-70

- Any one of the following immunological experiments 10
- (a) Demonstration of blood group using ABD antigens
 - (b) Preparation of blood film and identification of blood cells of immunological importance
 - (c) Hormonal assessment of T3/Testosterone/Oestrogen by ELISA reader
2. Identify and comment upon the given spots 10
- (a) Endocrinological slides - 03
 - (b) Embryological slides -02
3. Prepare a permanent mount of chick embryo or Identify and comment upon the exposed endocrine glands in a mammal 10
4. Comment upon the behavioral aspects of specimens provided (any two) (a) Parental care (Hippocampus, Cichlids, Alive. Hyla, ichthyophis) (b) Caste system (Honey bee/Termites/Ants) and its significance (c) Dance as a means of communication in honey bees 10
5. Identification and comment upon the given embryonic stages(any two) 10
6. Class record 10
7. Viva-voce

Course Code-PUZOO 515

SEMESTER - IV

C-14 Elective paper: Cell and Molecular Biology

Time 3hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part will consist of five long questions (three to be answered) 10 marks each

Unit - I. (A) Regulation of gene expression in bacteria

1. Induction system: Lac operon with negative control and Positive control CAP/CAMP regulation

2. Repressible system: Tryptophan operon and mechanism of attenuation in *E coli* and *B subtilis*

3. The arabinose operon

B) Levels of gene regulation in eukaryotes

4. Transcriptional control involving chromatin remodelling and genome imprinting

5. Post transcriptional control involving alternative polyadenylation and alternative splicing

6. Translation control involving Ribosome selection, translational inhibition, mRNA degradation and gene silencing (RNA interference)

Unit - II: (A) Cancer Biology

1.1 Cytology of cancer cells and types of cancer

2.2 Genetic basis: Oncogenes and tumour-suppressor genes

2.3 Chromosomal abnormalities associated with cancer

(B) Apoptosis

2.4 Machinery of programmed cell death

2.5 Extrinsic and intrinsic pathways

2.6 Control of programmed cell death

Unit - III: (A) Nucleus

3.1 Functional architecture of interphase nucleus and nuclear envelope

3.2. Ultrastructure of nucleolus: organization of Rdna

3.3 Nucleolar function: synthesis of rRNA, its processing and biogenesis of ribosomes

3.4 Mechanism nuclear cytoplasmic exchange

3.5 Signaling from plasma membrane to nucleus Types of signal [G Protein and protein kinase]target cells and effector organs

Unit -IV (A) Genomics

4.1 Functionalgenomics : Predicting gene and protein function by sequence analysis

4.2 Genome organization inHuman : The Human Genome Project, main features of human genome.

4.3 Comparative genomics: Features of model prokaryotic, eukaryotic and organelle genomes

[B] Recombinant DNA Technology

4.4 Construction and Screening of DNA libraries

4.5 Application of recombinant DNA technology

Unit - V: Transposable genetic elements and epigenetics

5.1 Discovery and definition: Ac/Ds elements in maize

5.2 Prokaryotic elements: Insertion sequences and transposons

5.3 Retrotransposons and DNA transposons in eukaryotes

5.4 Mechanism of transposition (conservative and replicative)

5.5 Epigenetics: Definition, molecular basis, mechanism and functional consequences

Suggested Reading

1. Alberts, B. Bary D. Lewis, J. Roberts, K. and Watson, J.D. **Molecular Biology of the Cell**. Garland Publishing New York
2. Bernal, Lodish H. and Baltimore **Molecular Cell Scientific American Book, Inc. USA**
3. Watson, J.D. Hopkins, N.H., J.A. and **Molecular Biology of the Gene**. The Benjamin/Cumming Publishing Co., Inc. California.
4. Sambrook Fritsch, and Maniatis, T: **Molecular Cloning**. Cold Spring Harbor Laboratory Press, NY
5. Ambrose: **Cell biology**
6. Freifelder. **Essentials of Molecular Biology**
7. De Robertis and De Robertis: **Cell and Molecular Biology**. Lea &Febiger, Philadelphia
8. Giese: **Cell Physiology**, WB Saunders
- 9 Meyers, RA. **Molecular Biology and Biotechnology** VCH Pub.. New York
- 10 Korf, B. **Human Genetics and Genomics** Blackwell Science, UK
11. Styrrer. **Cell and Molecular Biology**
12. Strachan, Tom and Read, Andrew: **Human Molecular Genetics** Garland Science/Taylor and Francis Group, Oxford
13. Matt Ridley **Genome**. Harper Collins, India
14. Lesk, Arthur M. **Introduction to Genomics**. Oxford University Press, New York
15. Brown, T. A. **Genomes. An Introduction to Genomes**. 2nd edition. Oxford: Wiley-Liss
16. Jordanka Zlatanova, Kensal E van Holde: **Molecular Biology: Structure and Dynamics of Genomes and Proteomes**. Garland Science
17. Angstrom. L, **Epigenetics**. Garland Science

SEMESTER - IV

Course Code-PUZOO 522

EC - 2A Elective paper (Practical) Cell and Molecular Biology

Time - 6 hrs

Full Marks -70

1" sitting

- | | |
|--|----|
| 1. Cytochemical demonstration of protein/lipid/carbohydr/nucleic acids | 15 |
| 2. Vital staining of secretory rules and mitochondria | 10 |
| 3. Identify and comments upon spots (1-5). Cytological Slides | 10 |

2 sitting

- | | |
|---|----|
| 4 Any one of the following | 10 |
| (a) Identification of sex-chromatin from buccal epithelial cells/leucocytes | |
| (b) Estimation of sperm count from epididymal wash of laboratory mammals | |
| (c) Studies of abnormalities in the head morphology vertebrate sperm | |
| (d) Isolation of DNA and its separation by agarose gel electrophoresis (demonstration only) | |
| (e) PCR amplification of known DNA/RAPD (demonstration only) | |
| 5. Practical record (including slides, charts, models. field work) | 05 |
| 6. Dissertation and Viva Voice | 20 |



SEMESTER IV

Course Code-PUZOO 516

EC - 1B Elective paper: Fish and Inland Fisheries

Time 3hrs

Full Marks -70

Questions to be set in three types representing all the five units. Part A will consist of 10 objective questions of 2 marks each Part B will consist of five short questions (Four to be answered) of 5 marks each part. Part will consist of five long questions (three to be answered) 10 marks each

Unit-(1A) Taxonomy and evolution

- 1.1 Classification of fishes
- 1.2 Origin and evolution of Teleosts
- 1.3 Crossopharygii: distribution, structure and affinities

(B) Fish Anatomy

- 1.4 Integument Structure and function
- 1.5 Alimentary canal & its modification in relation feeding habit
- 1.6 Acoustico-lateralis system
- 1.7 Air bladder and its modification

Unit- II [A] Fish Physiology

- 2.1 Mechanism of gill respiration
- 2.2 Accessory respiratory organs
- 2.3 Sound production
- 2.4 Excretion and osmoregulation
- 2.5 Reproduction in fish

(B) Fish endocrinology

- 2.6 Pituitary
- 2.7 Thyroid

2.8 Adrenal

Applied Fisheries

Unit - III: Freshwater Aquaculture

- 3.1 Construction and layout plan of different types of ponds and their management
- 3.2 Aquatic weeds and their control
- 3.3 Collection and transport of fish seeds from riverine sources
- 3.4 Fish food organism: Types and culture, supplementary feeding
- 3.5 Pollutants and their effects on fisheries

Unit - IV: (A) Fish Pathology

- 4.1. Nutritional diseases
- 4.2 Bacterial diseases in fish and their control
- 4.3 Fungal and viral diseases in fish and their control
- 4.5 Parasitic diseases in fish and their control

(B) Fish Biotechnology

- 4.6 Cryopreservation of fish gametes
- 4.7 Induced breeding in fish using carp pituitary extract (CPE) and new generation drugs
- 4.8 Androgenesis, Gynogenesis and transgenic fish
- 4.9 Cytogenetic techniques in aquaculture
- 4.10 Integrated fish farming

Unit - V: (A) Fisheries resources

- 5.1 Riverine fisheries resources of India
- 5.2 Estuarine fisheries in India

(B) Post harvest technology

- 5.3 Principles and methods of inland fishing crafts and gears

54 Fish spoilage and methods of fish preservation

55 Fish by-products

5.6 Fish marketing

Suggested Readings

1. Khanna, S. S. An introduction to Fishes
2. Pandey and Shukla: Fish & Fisheries
3. Gupta, S. K. Fish & Fisheries
4. Pandey, P.D.: Fish & Fisheries
5. Viswas K. P. Fish and Fisheries,
6. Rath, R. S. Freshwater aquaculture
7. Jhingaran: Fish and Fisheries of India
8. Shrivastava, G.: Fishes of U.P. & Bihar
9. Srivastava C.B. I.: Fishes of India
10. Kumar. H. D. Sustainability & Management of Aquaculture & Fisheries
11. Santam, R: qA Manual of Freshwater Aquaculture
12. Mainan, A. J. K: Identification of Fishes
13. Khanna, S S. and Singh H. R:A Text Book of Fish Biology and Fisheries. Narendra Publishing House
14. Paul J.B. Hart John D. Reynolds (Edn.): Handbook of Fish Biology and Fisheries: Fish Biology. Volume / Blackwell Science Ltd.
15. Biswas, KP.: A Text Book of Fish, Fisheries & Technology. Narendra Publishing House
16. William F. Royce: Introduction to Fishery Sciences. Academic Press

SEMESTER - IV

Course Code-PUZOO 523

EC - IIB Elective paper (Practical) Fish and Inland Fisheries

Time - 6 hrs

Full Marks -70

1st sitting

1. Any of the following experiments 10
- (a) O₂ consumption in relation to body size
 - (b) Haematological analysis (Hb estimation, RBC counting)
 - (c) Estimation of pH using pH meter. Dissolved oxygen, Total alkalinity. Total hardness

2 Spotting 5x2 = 10

- (a) Museum Specimens -01
- [b] Bones -01(c) Slides -02
- (d) Fishing gears/aquatic weeds 01

3. Microtomy/paraffin sectioning and permanent slide preparation 10

or

Mounting of scales, olfactory lamella, respiratory epithelium

2nd sitting

4. Taxonomic identification of local available fish up to species level (based on morphometric, meristic analysis and identification key) 05

5. Any one of the following 10

(a) Biological analysis of water including Phytoplankton, Zooplankton, Macrophytes and Zoomacro-benthos

(b) Identification of representative fish parasites and their life histories

(c) Identification of fish fry and fingerlings of major cultivated species of freshwater fish

6. Practical records (including slides/chart/model field work) 05

7. Dissertation and Viva 20

SEMESTER-IV

Course Code-PUZOO 521

EC-16 Elective paper: Comparative Endocrinology

Time: 3 hrs

Full Marks-70

Questions to be set in three parts representing all the five units, Part A will consist of 10 objective questions of 2 marks each. Part will consist of five short questions (Four to be answered) of 5 marks each Part C will consist of five questions (three to be answered) of 10 marks each.

Unit-I

- 1.1 Chemical nature and gross features of Hormones
- 1.2 General mechanism of hormone action with special reference to receptors: membrane receptors, cytosolic receptor, nuclear receptors and second messenger molecules. cAMPKinases, Phosphatases. Phosphatidyl inositol, Ca⁺⁺. Prostaglandin
- 1.3 Comparative anatomy of pituitary gland in vertebrates
- 1.4 Histology and physiology of pituitary gland in mammals
- 1.5 (a) Adenohypophysis: cell types and anatomy
(b) Chemistry, physiological function, mechanism of action and regulation of secretion of its hormones
- 1.6 (a) Neurohypophysis: Neurohypophyseal peptide, phylogeny
(b) Regulation of secretion, mechanism and action of neurohypophyseal peptides
- 1.7 Anatomy of hypothalamus, hypothalamo-hypophyseal circulation, hypophysiotropic hormones
- 1.8 Hypothalamic neurotransmitters and their role in release of hypophyseal hormones

Unit-II

- 2.1 Comparative anatomy and Histology of endocrine pancreas in vertebrates
(a) Chemistry, biosynthesis. Regulation of secretion, mechanism of action and physiological action of Insulin



(b) Chemistry, Biosynthesis, Regulation of secretion, mechanism of action and physiological action of Glucagon

2.2 Nature, source and physiological action of gastro-intestinal hormones in higher vertebrate

Unit-III

3.1 Comparative anatomy of thyroid gland in vertebrates

3.2 Biosynthesis, physiological action and regulation of secretion of thyroid hormone in mammals

3.3 Comparative anatomy of parathyroid gland in vertebrates.

3.4 Biosynthesis and regulation of secretion of parathyroid hormone in mammals.

3.5 Mechanism and physiological action of parathyroid hormones on bone, kidney and vitamin D activation

Unit-IV

4.1 Comparative morphology and anatomy of vertebrate adrenal and its homologues

4.2 Steroid structure, nomenclature, chemistry and biosynthesis of corticosteroids.

4.3 Mode of action physiological action control of secretion of Gluco and mineralocorticoids.4.4 Ultrastructure of chromaffin cells

Unit V- .Endocrinology of Testis

5.1 Comparative Histomorphology of testis in vertebrates

5.2 Interstitium, Ultrastructure and function of sertoli cell.

5.3 Ultrastructure and function of Leydig cells.

5.4 Hormonal regulation of spermatogenesis in mammals.

[B] Endocrinology of Ovary

5.5 Comparative histo-morphology of ovary in vertebrate

5.6 Estrous cycle, menstrual cycle, Hormonal regulation of cycles.

5.7Endocrinology of folliculogenesis, ovulation, Luteinization

5.8, Endocrinology of pregnancy, parturition and lactation in mammals.

SEMESTER IV

Course Code-PUZOO 528

3-2G Elective paper: Comparative Endocrinology

Time: 6 hrs

Full Marks-70

. Operation

10

1. Hysterectomy in mice

2. Vasectomy in mice

3. Thyroidectomy in mice

[a] Estrous cycle

08

b] Sperm counts, sperm head morphology

c] Measurement of epithelial cell height of thyroid

3. Biochemistry

10

3.1 Alkaline phosphatase activity in the uterus of normal mice

3.2 Fructose Index in seminal vesicle of castrated mice

4. Effect of epinephrine/Alloxan treated mice on the blood glucose level in mice

5. Histochemistry

07

5.1 Histochemical localization of chromaffin cells

5.2 Histochemical localizations of steroid lipids in adrenal cortex, testis and ovary

5.3 Histochemical localization of thyrotrophs and gonadotrophs in pituitary

6. Histology

05

[a] Identification of cells of spermatogenic cycle, Leydig cell and fibroblast

[b] Identification of corpus luteum

7. Identification of histological slides (5 spots)

5x2=10

8. Project work

10

9. Viva-voice

05

10. Field work and Class record

05

-Description of Papers for M.Sc.(Zoology) degree in the faculty of Science under CBCS

Semester	Course/Paper code	Name of Paper	Marks	Marks of CIA	Marks of DSE	Passing criterion	Qualification criterion	Credit
Semester-1	CC-1	Functional Biol. of Invertebrates& Chordates	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-2	Molecular Cell Biology	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-3	Genetics	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-4	Practical	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
Semester-2	AEC-1 Ability Enhancement Compulsory Course (AEC-1)	Environmental sustainability & Swachh Bharat Abhiyan Activities	100	30	70	45% marks in CIA 45% marks in ESE	Qualifying	3+2=5
	CC-5	Environmental Sci.	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-6	Bioinstrumentation andbiostatistics.	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-7	Biochemistry	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-8	Biosystematics & Evolution	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
Semester-3	CC-9	Practical	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	AEC-1 Ability Enhancement Course (AFC)	*Yoga Science Tourism and Hospital Management Environmental Law	100	30	70	45% marks in CIA 45% marks in ESE	Qualifying	3+2=5
	CC-10	Vertebrate Immunology	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-11	Gamete and Developmental biology	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-12	Vertebrate. Endocrinology	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
Semester-4	CC-13	Animal Behaviour	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	CC-14	Practical	100	30	70	45% marks in CIA 45% marks in ESE	Marks decided Class/CGPA	5
	AEC-1 Ability Enhancement Compulsory Course AEC-1	Human values and Gender Sensitization	100	30	70	45% marks in CIA 45% marks in ESE	Qualifying	3+2=5
	EC-1 Elective Course	Cell and Molecular Biology, Fish and Inland Fisheries	100	30	70	45% marks in CIA 45% marks in ESE	Marks decide Class/CGPA	5
	FC-2 Elective Course	Practical	100	30	70	45% marks in CIA 45% marks in ESE	Marks decide Class/CGPA	5
	DSE -1 Discipline Specific Elective Course DSE		100	30	70	45% marks in CIA 45% marks in ESE	Qualifying	5
	Or-GE-1 Generic Elective [GE]		100	30	70	45% marks in CIA 45% marks in ESE	Qualifying	5