

**PUNJABI UNIVERSITY, PATIALA 147002**

**(INDIA)**

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**Faculty of Life Sciences**

**Outline of Course and Syllabi**

**for**

**M.Sc. Zoology**

**(Choice Based Credit System)**

**2019-20**

**M.Sc. II (Final)  
SEMESTER-III**

|                               |                     |
|-------------------------------|---------------------|
| Theory Classes                | : 18 Hours per week |
| Practical Classes             | : 09 Hours per week |
| Seminars/Library Consultation | : 06 Hours per week |

| <b>THEORY PAPERS</b>                                                                      | <b>Theory</b>             | <b>Internal Assessment</b> |
|-------------------------------------------------------------------------------------------|---------------------------|----------------------------|
| MZ311 Animal behaviour                                                                    | : 44 Marks                | :16 Marks                  |
| MZ312 General Endocrinology                                                               | : 44 Marks                | :16 Marks                  |
| MZ313 Fish and Fisheries                                                                  | : 44 Marks                | :16 Marks                  |
| MZ314 Research Methodology                                                                | : 44 Marks                | :16 Marks                  |
| Specialization Paper-I (Respective specialization)<br>(MZE315, MZC317, MZP 319 & MZPR321) | : 44 Marks                | :16 Marks                  |
| Specialization Paper-II (Respective specialization)<br>(MZE316, MZC318, MZP320 & MZPR322) | : 44 Marks                | :16 Marks                  |
| <b>Total</b>                                                                              | <b>: 264 Mark</b>         | <b>:96 Marks</b>           |
|                                                                                           | <b>Total : 264+96=360</b> |                            |

**Open Elective Subject – Economic Zoology: Qualifying (50 marks)**

**PRACTICAL PAPERS**

**MZ323 Practical paper-V**  
(Pertaining to theory papers MZ311, MZ312, MZ313 & MZ314) : 80 Marks

**MZ324 Practical paper-VI**  
(Pertaining to theory papers of specialization I & II) : 60 Marks

**Total : 140 Marks**

**INTERNAL ASSESSMENT**

|     |                                              |     |                                                       |
|-----|----------------------------------------------|-----|-------------------------------------------------------|
| i   | Attendance                                   | 20% | % of the Total Marks<br>of the Internal<br>Assessment |
| ii  | Assignment/Project/Seminar                   | 40% |                                                       |
| Iii | Two Mid-semester Tests/Internal Examinations | 40% |                                                       |

**Attendance – 20 Marks**

**Assignment/Project/Seminar – 38 Marks**

**MST – 38 Marks**

**Total : 96 Marks**

The consolidated marks, out of maximum 96 marks, shall be supplied to the University through the Head of the Department under internal Assessment.

### TOTAL MARKS FOR SEMESTER – III

|                     |   |           |
|---------------------|---|-----------|
| Theory papers       | : | 264 Marks |
| Practical Papers    | : | 140 Marks |
| Internal Assessment | : | 96 Marks  |

**Total : 500 Marks**

| Course Code                       | Course                                                                                      | Course option | Credits    | Total Marks (Ext+Int) |
|-----------------------------------|---------------------------------------------------------------------------------------------|---------------|------------|-----------------------|
| MZ311                             | Animal behaviour                                                                            | Core-XII      | 3          | 44+16=60              |
| MZ312                             | General Endocrinology                                                                       | Core-XIII     | 3          | 44+16=60              |
| MZ313                             | Fish and Fisheries                                                                          | Core-XIV      | 3          | 44+16=60              |
| MZ314                             | Research Methodology                                                                        | Core-XV       | 3          | 44+16=60              |
| MZE315, MZC317, MZP 319 & MZPR321 | Specialization Paper-I                                                                      | Core-XVI      | 3          | 44+16=60              |
| MZE316, MZC318, MZP320 & MZPR322  | Specialization Paper-II                                                                     | Core-XVII     | 3          | 44+16=60              |
| MZ323                             | Practical – V Pertaining to theory paper MZ311, MZ312, MZ313 & MZ314                        | Practical–V   | 4½         | 80                    |
| MZ324                             | Practical – VI Pertaining to theory paper of specialization-II and specialization paper-III | Practical–VI  |            | 60                    |
|                                   | Seminars/Library Consultation<br><i>Marks already included in Internal assessment</i>       |               | 3          |                       |
|                                   |                                                                                             | <b>Total</b>  | <b>25½</b> | <b>500</b>            |

### SEMESTER-IV November/December 2019-2020 SESSIONS

|                               |                     |
|-------------------------------|---------------------|
| Theory Classes                | : 18 Hours per week |
| Practical Classes             | : 09 Hours per week |
| Seminars/Library Consultation | : 06 Hours per week |

### THEORY PAPERS

|                                                  | Theory     | Internal Assessment |
|--------------------------------------------------|------------|---------------------|
| MZ411 Integrative Organismal Biology             | : 44 Marks | :16 Marks           |
| MZ412 Wild life & its management                 | : 44 Marks | :16 Marks           |
| MZ413 Zoogeography and Evolution                 | : 44 Marks | :16 Marks           |
| MZ414 Limnology (Elective Paper-II)              | : 44 Marks | :16 Marks           |
| MZ415 Biotechnology and Env. (Elective Paper-II) | : 44 Marks | :16 Marks           |

Specialization Paper-III (Respective Specialization) : 44 Marks :16 Marks  
(MZE416, MZC418, 9; MZP 420 & MZPR422)  
Specialization Paper-IV (Respective Specialization) : 44 Marks :16 Marks  
(MZE417, MZC419, MZP421 & MZPR423 )

**Total : 264 Marks :96 Marks**

**Total : 264+96=360**

**Open Elective (Optional) Subject – Economic Zoology : 50 Marks**

### PRACTICAL PAPERS

#### **MZ424 Practical paper-VII**

(Pertaining to theory papers MZ411, MZ412, MZ413, MZ414, MZ415) : 80 Marks

#### **MZ425 Practical paper-VIII**

(Pertaining to theory papers of specialization VI & VII) : 60 Marks!

**Total : 140 Marks**

### INTERNAL ASSESSMENT

|     |                                              |     |                                                       |
|-----|----------------------------------------------|-----|-------------------------------------------------------|
| i   | Attendance                                   | 20% | % of the Total Marks<br>of the Internal<br>Assessment |
| ii  | Assignment/Project/Seminar                   | 40% |                                                       |
| iii | Two Mid-semester Tests/Internal Examinations | 40% |                                                       |

**Attendance – 20 Marks**

**Assignment/Project/Seminar – 38 Marks**

**MST – 38 Marks**

**Total: 96 Marks**

The consolidated marks, out of maximum 96 marks, shall be supplied to the University through the Head of the Department under internal Assessment.

### TOTAL MARKS FOR SEMESTER – IV

Theory papers : 264 Marks

Practical Papers : 140 Marks

Internal Assessment : 96 Marks **Total: 500 Marks**

| Course Code | Course                         | Course option     | Credits | Total Marks (Ext+Int) |
|-------------|--------------------------------|-------------------|---------|-----------------------|
| MZ411       | Integrative Organismal Biology | Core-XVIII        | 3       | 44+16=60              |
| MZ412       | Wild life & its management     | Core-XIX          | 3       | 44+16=60              |
| MZ413       | Zoogeography and Evolution     | Core-XX           | 3       | 44+16=60              |
| MZ414       | Limnology                      | Elective Paper-II | 3       | 44+16=60              |
| MZ415       | Biotechnology and Environment  | Elective Paper-II | 3       | 44+16=60              |

| <b>*MOOC courses</b>                 |                                                                                            |                  |            |            |
|--------------------------------------|--------------------------------------------------------------------------------------------|------------------|------------|------------|
| MZE416, MZC418, 9; MZP 420 & MZPR422 | Specialization Paper-III                                                                   | Core-XXI         | 3          | 44+16=60   |
| MZE417, MZC419, MZP421 & MZPR423     | Specialization Paper-IV                                                                    | Core-XXII        | 3          | 44+16=60   |
| MZ424                                | Practical – VII Pertaining to theory paper MZ411, MZ412, MZ413, MZ414/ MZ415               | Practical – VII  | } 4½       | 80         |
| MZ425                                | Practical – VIII Pertaining to theory paper of specialization -III and specialization - IV | Practical – VIII |            | 60         |
|                                      | Seminars/Library Consultation<br><i>Marks already included in Internal assessment</i>      |                  | 3          |            |
|                                      |                                                                                            | <b>Total</b>     | <b>25½</b> | <b>500</b> |

- \* The subjects which the students can opt from MOOC will be notified by the department semester wise time to time
- \* In addition to the above mentioned subjects there will be an Open Elective as a Optional Subject. The list of open elective subjects will be notified by the department from time to time.

**Semester – III**  
**MZ311**  
**Animal Behaviour**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Animal Psychology- Classification of behavioural patterns
  - 1.1 Analysis of Behaviour (ethogram)
  - 1.2 Innate Behaviour
2. Behavioral Genetics:
  - 2.1 Genes and behavior
  - 2.2 Evaluation of behavior
  - 2.3 Co evolution
3. Control of behaviour:
  - 3.1 Neural
  - 3.2 Hormonal
4. Communication :
  - 4.1 Chemical
  - 4.2 Visual
  - 4.3 Audio
  - 4.4 Evolution of language (primates)

**SECTION-B**

5. Social Behaviour:
  - 5.1 Aggregation
  - 5.2 Schooling in fishes
  - 5.3 Flocking in birds
  - 5.4 Group selection, kin selection, altruism
  - 5.5 Social organization in insects and primates.

- 6 Reproductive Behaviour:
  - 6.1 Mating systems
  - 6.2 Courtship
  - 6.3 Sperm competition
  - 6.4 Parental Care
- 7 Biological Rhythms:
  - 7.1 Circadian and circannual rhythms
  - 7.2 Orientation and navigation
  - 7.3 Migration of fishes & birds
- 8 Learning and memory
  - 8.1 Insight learning
  - 8.2 Association learning
  - 8.3 Reasoning
  - 8.4 Cognitive skills

### **SUGGESTED READINGS**

1. Alcock, J. Animal behavior: An evolutionary approach, Sinauer Assoc., Sunderland, Mass. USA.
2. Bradbury, J.W., and S.L. Verhrencamp. Principles of Animal Communication, Sinauer Assoc., Sunderland, Mass. USA.
3. Clutton-Brock, T.H. The evolution of Parental care, Princeton Univ. Press, Princeton, NJ, USA.
4. Eibl-Eibesfeldt, I. Ethology. The biology of behaviour, Holt, Rinechart & Winston, New York.
5. Gould, J.L. The mechanisms and evolution of behaviour.
6. Hauser, M. The evolution of communication, MIT Press, Cambridge, Mass. USA.
7. Hinde, R.A. Animal behaviour: A synthesis of Ethology and comparative psychology. McGraw-Hill, New York.
8. Krebs, J.R. and N.B. Davies, Behavioural ecology, Blackwell, Oxford, U.K.
9. Wilson, E.O. Sociobiology: The new synthesis, Harvard Univ. Press, Cambridge, Mass. USA.

**Semester – III**  
**MZ312**

**GENERAL ENDOCRINOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Hormones and hormone Action:
  - 1.1 Classification of hormones
  - 1.2 Storage and secretions of hormones
  - 1.3 Mechanism of hormone action:
    - 1.3.1 Membrane bound receptors
    - 1.3.2 Intracellular receptors
    - 1.3.3 Second messengers in hormone action : cAMP, cGMP, calcium ions, phosphoinositides and protein kinase cascade
    - 1.3.4 Control of hormone secretion
    - 1.3.5 Measurement of hormones in blood
2. Hypothalamus and pituitary gland:
  - 2.1 The pituitary gland and its relation to the hypothalamus
  - 2.2 Control of pituitary secretion by hypothalamus
  - 2.3 Physiological functions and regulation of growth hormone
  - 2.4 Abnormalities of growth hormone secretion
  - 2.5 Neurohypophyseal hormones:
    - 2.5.1 Chemical nature and physiological functions of antidiuretic hormone (Vasopressin) and oxytocin.

**SECTION- B**

3. Thyroid hormones:
  - 3.1 Biosynthesis and secretion of thyroid hormones.
  - 3.2 Physiological functions of thyroid hormones

- 3.3 Regulation of thyroid hormones
- 3.4 Antithyroid substances
- 3.5 Abnormalities of thyroid hormones
- 4. Parathyroid hormones:
  - 4.1 Physiological anatomy of parathyroid glands
  - 4.2 Effect of parathyroid hormone on calcium and phosphate metabolism
  - 4.3 Regulation of parathyroid secretions
- 5. Calcitonin and its control on calcium ion concentration.
- 6. Adrenocortical hormones:
  - 6.1 Functions of the glucocorticoids on metabolism
  - 6.2 Regulation of cortisol secretion
- 7. Catecholamines:
  - 7.1 Biosynthesis and metabolism of epinephrine and norepinephrine.
  - 7.2 Physiological effects of catecholamines
- 8. Pancreas and its hormones:
  - 8.1 Insulin and its metabolic effects
  - 8.2 Glucagon and its effect on glucose metabolism.

### **SUGGESTED READINGS**

1. E.J.W. Barrington: General and comparative Endocrinology, oxford, clarendon press.
2. Guyton, AG and Hall J.E: Text book of Medical Physiology 11<sup>th</sup> Ed, Saunders publications. 2006.
3. William F. Ganong: Review of medical physiology, international 21<sup>st</sup> edition M C Graw Hill companies. 2003.
4. P.J. Bentley: Comparative vertebrate Endocrinology, Cambridge University Press, 1976.
5. R.H. Williams: Text Book of Endocrinology, W, B. Saunders.
6. A. Guber manetal: Comparative Endocrinology, John Wiley and sons.
7. Francis. S. Greenspan & David G. Gardner: Basic and clinical endocrinology, 7<sup>th</sup> edition MC graw Hill Co. 2003.
8. Norman Lavin: Manual of Endocrinology and Metabolism, Linncott Williams and Williams.

**Semester – III**  
**MZ313**

**FISH AND FISHERIES**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**Section A**

1. Outline classification of fish
2. Teleostei with special reference to following orders:
  - 2.1 Ceratodontiformes
  - 2.2 Lepidosueniformes
  - 2.3 Acipensiformes
  - 2.4 Amiiformes
  - 2.5 Semionotiformes
  - 2.6 Clupeiformes
  - 2.7 Cyprinodontiformes
  - 2.8 Perciformes
  - 2.9 Anguilliformes
  - 2.10 Beloniformes
  - 2.11 Gasterosteiformes
  - 2.12 Gadiformes
  - 2.13 Pleuronectiformes
  - 2.14 Tetradontiformes
  - 2.15 Echeiniformes
  - 2.16 Ophiocephaliformes
3. Scales : types, structure and functions
4. Coloration : chromatophores, pigments and biological significance of coloration in fish
5. Bioluminescence in fish and its significance
6. Electric organs, their structure and use in fish

### **Section B**

7. Respiratory organs
8. Structure, modification and function of gills
9. Air breathing accessory organs
10. Swim bladder
11. Lateral line organs
12. Ultimobranchial glands
13. Corpuscles of stannius
14. Biochemical composition and preservation of fish
  - 14.1 Biochemical composition of fish
  - 14.2 Nutritional value of fish
  - 14.3 Poisoning toxicity and allergies from fish as food
  - 14.4 Fish preservation

### **SUGGESTED READINGS**

1. Jhingran, V.G. 1978, Fish and Fisheries of India, Hindustan Publishing House (India), New Delhi, India.
2. Talwar, P.K., Jhingran, A.G. 1991, Inland Fishes of India, Vols I & II., Oxford & IBH, New Delhi, India.
3. Karl, F. L., Win, C. 1969, Freshwater Fishery Biology, Brown Company Publication, Iowa.
4. Moyel, P.B; J.J. Jr., Cech. 1988, Fishes: An introduction to ichthyology, Prentice Hall, Englewood, Ciffs, N.J.
5. Nelson, J.S., 1976, Fish of the World, John Wiley and Sons, New York.
6. Biswas, S.P. 2002, Fundamentals of Ichthyology, Narendra Publishing House, Delhi, India.
7. Hoar, W.S; Randall, D.J. 1970, Fish Physiology, Vol. IV, Academic Press, New York.
8. Jayaram, K.C., 1999, The fresh water fishes of the Indian origian region, Narendra Publishing House, Delhi, India.
9. Tyagi, R; Shukla, A. 2002. Encyclopedia of Fish Series, Adaptations in Fishes, 1st Edition. Anmol Publication Pvt. Ltd., New Delhi, India.
10. Miller, S.A., Harley, J.P. 2005, Zoology. 6th Edition, McGraw Hill Publications, New York.
11. Weichert, C.K., 1965. Anatomy of the Chordates, 3rd Edition. McGraw Hill Publications, New York.

**Semester – III**  
**MZ314**

**RESEARCH METHODOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

**1. Principles and applications:**

- 1.1 Phase contrast microscope
- 1.2 Fluorescence microscopy
- 1.3 Scanning electron microscopy (SEM) and transmission electron microscopy (TEM)

**2. Principles and applications:**

- 2.1 Thin layer chromatography
- 2.2 Gas chromatography (GLC)
- 2.3 High pressure liquid chromatography (HPLC)
- 2.4 Ion exchange and affinity chromatography

**3. Principles of biophysical methods for structural analysis of biopolymers:**

- 3.1 UV, fluorescence and circular dichroism (CD) spectroscopy
- 3.2 NMR, ESR and atomic absorption spectroscopy.

**SECTION-B**

**4. Principles and applications of tracer techniques:**

- 4.1 Radio active isotopes and half life of isotopes
- 4.2 Autoradiography

4.3 Liquid scintillation spectrometry.

5. Methods techniques.

5.1 Polymerase chain reaction, Southern, Northern and Western blotting.

5.2 Principle of electrophoresis, polyacrylamide gel electrophoresis and SDS-PAGE, agarose gel electrophoresis.

6. Practice of statistical methods in biological research:

6.1 Basic statistics-average, statistics of dispersion co-efficient of variations

6.2 Probability distribution- binominal, poison and normal

6.3 Tests of statistical significance –simple correlation of regression and analysis of variance.

**SUGGESTED READINGS**

1. Lehninger, A. Nelson, Dand Cox 2003. Principles of Biochemistry. CBS Publishers, New Delhi.
2. Wilson, K and walker John 2005. Principles and Techniques of Biochemistry. Cambridge University Press.
3. Stefen 2005. Basic Techniques in Molecular Biology. Springer Publishers.
4. Ranjit Kumar 2002. Research Methodology; A step by step Guide for beginner's sage publishers.
5. Karp, Gerald 2002. Cell and Molecular Biology, Concepts and Experiments John Willey and Sons. U.K.
6. Gupta, PK 2005. Cell and Molecular Biology. Rastogi Publications. Meerut.
7. Singh, BD 2003. Biotechnology. Kalyani Publishers. New Delhi.
8. Pavia, D.L., Lampmann, N.G.M and Kris, G.S. 2001 introduction to spectroscopy, 3<sup>rd</sup> edn. Harcourt, New York.
9. Gupta, S.C., and Kapoor, V.K, 2001 fundamentals of Applied Statistics. Sultan Chand K Sons, 3<sup>rd</sup> edn, Jan 2001.
10. Pillai, RSN and Bagavathi; V.2001 statistics. S Chand & Company Ltd, 2001

**Semester – III**  
**MZE315**

**INSECT MORPHOLOGY & CLASSIFICATION**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Morphology of facial sutures
2. Morphology of facial region
3. The types of antennae in Insects
4. Morphology of generalized & specialized mouth parts.
5. The neck region in Insects
6. Topography of typical tergum, sternum and pleuron
7. Generalized structure of wing and wing modifications
8. Generalized structure of Insect leg and leg modifications.

**SECTION-B**

9. Pregenital, genital and post genital appendages
10. Insect abdomen generalized structure
11. Generalized structure of external female genitalia
12. Generalized structure of external male genitalia.
13. Origin and evolution of Insects
14. General introduction to insect orders

15. Classification of major Insect orders upto families of economic importance.

### **SUGGESTED READINGS**

1. Snodgrass. R.E. Principles of Insect Morphology, A.D. Imm's General Text-Book of Entomology.
2. Richard & Davis Entomology, 1<sup>st</sup> and 2<sup>nd</sup> Vols.
3. Mayr, E. Principles of Systematic Zoology.
4. Kapoor V.C. theory and Practices of Animal Taxonomy.
5. Henning, W. Insect Phylogeny.
6. Bland & Jaques. How to know the Insects (Practical Book)
7. Matsuda, R. Morphology and Evolution of Insect Head.
8. Du Porte E.M., Manual of Insect Morphology.
9. Matsuda, R., Morphology and Evolution of Insect Thorax.
10. Matsuda, R., Morphology and Evolution of Insect Abdomen.
11. Ross, H.H., Text book of Entomology.
12. M.S. Mani, Modern Classification of Insects.
13. Boudreanx, Arthropod Phylogeny with special reference to Insects.
14. Riedl, R., Order in Living Organisms: A systematic Analysis Evolution.
15. Kapoor V.C., Insect Classification : A History
16. Gutpa A. P., Arthropod Phylogeny

**Semester – III**  
**MZE316**

**INSECT ANATOMY AND PHYSIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Integument:  
Structure  
Synthesis of chitin
2. Metamorphosis:  
Types  
Hormonal control.
3. Digestive system:  
Anatomy of digestive system in various insects  
Physiology of digestion.
4. Excretory system:  
Structure of excretory organs  
Physiology of excretion
5. Circulatory system  
Anatomy and physiology.

**SECTION-B**

6. Respiratory system:  
Structure and physiology.
7. Reproductive system:  
Male reproductive system  
Female reproductive system.
8. Nervous System

9. Sense Organs – Visual, auditory and tactile
10. Endocrine glands

### **SUGGESTED READINGS**

1. Ross, Herbert H. Ross, Charles A. & Ross, June R.P. 1982: Text Book of Entomology, edn.4, John Wiley & Sons, New York.
2. Mani, M.S. 1982: General Entomology, Edn.3 Oxford & IBH Publishing Co., New Delhi.
3. Wigglesworth, V.B. 1965: The Principles of insect physiology, English Language Book Society & Methune & Co. Ltd.
4. Chapman, R.F. 1984: The Insect Structure and Function, English University Press.
5. Beament: J.W.L. Treherne, J.E. & Wigglesworth, V.B. (Eds.) 1963: Advances in Insect physiology, Academic Press, New York.
6. Snodgrass R.E. 1938: Principles of Insect Morphology, McGraw hill, New York.
7. Imms, A.D. Richard, O.W. & Davies, R.G. (Eds.) 1977: General Textbook Entomology, 10<sup>th</sup> Edn., Chapman & Hall, London.
8. S.J. Counce and C.H. Waddington: Developmental System, Insects, Vol. I & II : Academic Press, London & New York.
9. Anderson, D.T., The Development of Hemimetabolous Insects in Development Systems. Anderson, D.T., Embryology and physiology in Annelids and Arthropods, Pergamon Press, New York and Oxford.
10. Johanson, O.A., Butt, F.H. , Embryology of Insects and Myriapods, McGraw Hill, New York and London.
11. Kerkut, G.A. and Gilbert, L.I., 1985: Comprehensive Insect Physiology, Biochemistry and Pharmacology, Vol. I-XIII pergamon Press, Oxford and NewYork.
12. Rockstein M. (ed.) 1974: The physiology of Insects, edn.2, Vol. I-V, Academic Press, New York.
13. Turner, R.B. (ed.) 1977: Analytical Biochemistry of Insects, Elsevier Scientific Publishing Co., Amsterdam.
14. Novak, V.JA. 1975: Insect Hormones, edn. 4, Chapman and Hall, London.
15. Gilmour, D., 1965: The Metabolism of Insects, Oliver & Boyd, Edinburgh and London.

**Semester – III**  
**MZC317**

**GENOME AND GENOMICS**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. Prokaryotic genome  
Chemical composition of genome  
Organisation of genome into nucleoid
2. Extra chromosomal DNA  
Bacterial plasmids and episomes  
Transposable genetic element of bacteria.
3. Organisation of eukaryotic genome:  
C-Value paradox  
Reassociation kinetics  
Sequence complexity
4. Packaging of eukaryotic genome into chromosomes:  
Chemical nature of eukaryotic chromatin  
Packaging into nucleosome, solenoid and supersolenoid.

**SECTION-B**

5. Organisation of viral genomes:  
Genetic analysis of bacterial viruses.  
Genetic analysis of retrovirus.

6. Genomes sequestered in organelles:  
Mitochondrial genome  
Chloroplast genome  
Recombination and rearrangement of organelle DNA
7. Molecular analysis of genomes:  
Techniques : chromosome walking, DNA sequencing, PCR  
Simple sequence repeats (SSR's) Variable number of tandem repeats (VNTR's)  
Molecular markers and their applications.
8. Genomics and proteomics:  
Introduction to genomics and proteomics  
Functional genomics  
Pharmacogenomics.

### **SUGGESTED READINGS**

1. Watson, Hopsteing, Roberts, Steitz and Weiner. Molecular Biology of gene. The Benjamin/Cummings Pub. Co. Ltd., California.
2. Gardner, Simmons, Snustad. Principles of Genetics. Wiley & Sons Inc., New York.
3. Zubay Genetic. The Benjamin/Cumming Pub. Co.
4. Benjamin Lewin. Genes, IV/V/VI/Vii. Oxford University Press.
5. Sandhya Mitra. Genetics, Tata McGraw Hill, Pub. Co. Ltd.
6. Walker &Gingold. Molecular Biology and Biotechnology. Royal Society of Chemistry, Cambridge.
7. Friefeider. Microbial Genetics.
8. Davis, R. W. Advanced Bacterial Genetics.

**Semester – III**  
**MZC318**

**Membrane and the Cytoplasm: Structure and Function.**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Membrane structure:  
The lipid bilayer  
Membrane proteins  
Human erythrocyte membrane
2. Membrane transport:  
Diffusion and facilitated diffusion  
Na<sup>+</sup> K<sup>+</sup> transport system, calcium and proton pumps  
Co-transport by symporter and antiporters
3. Membrane potentials:  
Ultrastructure of neuron  
Conduction of nerve impulse  
Synaptic transmission
4. Cell signaling:  
4.1 Cell surface receptors  
4.2 Second messenger systems  
4.3 Neurotransmitters

**SECTION-B**

5. Cytoskeleton:  
Microtubules  
Intermediate filaments  
Microfilaments

6. Cell adhesion and communication:  
Tight and gap junction  
Connexins and desmosomes  
Adhesive proteins
7. Lysosomes:  
Enzymes of lysosomes  
Heterophagy  
Autophagy.
8. Intracellular protein trafficking:  
Protein synthesis on free and bound ribosomes  
Targeting of proteins to ER  
Membrane protein segregation and Golgi sorting

#### **SUGGESTED READINGS**

1. Alberts, B., Bray D. Lewis J, Raff M., Roberts K, Watson J., (1993) : Molecular Biology of the cells, Garland Publication Inc. New York.
2. Karp, G. Cell and molecular Biology, Concepts and experiments. 2<sup>nd</sup> Ed. John Wiley & Sons. Inc. New York.
3. Aleber B., Bray D., Johnson A., Lewis J., Raff, M. Roberts, K., Walter, P. (1997): Essential cell Biology: An introduction to the molecular biology of the cell Garland publishing Inc. New York.
4. Prescott, D. M. (1988) Cells: Principles of molecular structure, Jones and Bartlett Publication, Boston.
5. Thorpe, N.O. (1984): Cell Biology, John Wiley and sons, New York.
6. Darnell, J., Lodish, H. Baltimore, B. Molecular cell Biology, Scientific American Book Inc. USA
7. Sadava, D.E. (1993) Cell biology, organelle structure and function. Jones and Bartlett Publication, Inc.
8. Nelson, D.L., Cox, M.M. (2000) Lehninger Principles of Biochemistry, Third edition, MacMillan worth Publishers, New York.
9. Elliott, W.H. Elliott, D.C. (2001): Biochemistry and molecular Biology, 2<sup>nd</sup> edition. Oxford University Press Inc., New York.

**Semester – III**  
**MZP319**

**REPRODUCTIVE PHYSIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION –A**

1. Histology of the adult mammalian testis:
2. Structure and function of the Leydig cells
3. Endocrine function of the sertoli cells
4. Spermatogenesis and its hormonal control
5. Abnormal spermatogenesis and male fertility.
6. Function of the male accessory reproductive organs-epididymis, seminal vesicles, prostate gland
7. Structure of spermatozoa
8. Biochemistry of semen
9. Capacitation of spermatozoa.

**SECTION – B**

10. Structure of adult mammalian ovary
11. Folliculogenesis and ovogenesis
12. Hormonal factors in ovulation
13. Corpus luteum and its function
14. Reproductive cycles and their hormonal regulation
15. Functions of placenta
16. Regulation of parturition
17. Structure, development, differentiation, and hormonal regulation of mammary glands
18. Factors regulating the initiation and maintenance of lactation.

### **SUGGESTED READINGS**

1. Austin, C.R. and Short, R.V. (1984): Hormonal control of Reproduction, Cambridge University Press. Cambridge. UK.
2. Finn, C.A. (1982): Oxford Reviews of Reproductive Biology, Vol. 4., Clarendon Press, Oxford.
3. Hogarth. P.J. (1978): Biology of Reproduction, Blackie and Glasgow, London.
4. Knobil, E. and Neil, J.D. (1988): The Physiology of Reproduction. Vol. I and II Eds. – L.L. Ewing G.S. Greenwald, C.L. Markert and D.W. Pfaff, Pawen Press.
5. Michael, H.R: Lynn, J.R., Gordon I.K., 1995 Histology: A Text and Atlas, 3rd edition; Williams and Wilkins Publications, USA.
6. Wilson, J.D, Foster D.W, 1992, Williams, Text Book of Endocrinology, 8th edition, W.B. Saunders Company, U.K.
7. Ganong, W.F., 2005, Review of Medical Physiology. 22nd edition, McGraw Hill Publications, New York.

**Semester – III**  
**MZP320**  
**ENVIRONMENTAL PHYSIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION A**

1. Basic concepts of environmental stress
2. Thermal stress:
  - 2.1 Rate effects
  - 2.2 Acclimation and acclimatization
  - 2.3 Endothermy in invertebrates
  - 2.4 Nature of chilling and freezing injuries, mechanisms of cold tolerance and resistance
  - 2.5 Molecular mechanisms of thermal acclimation in poikilotherms- homeokinetic and homeoviscous adaptations
3. Water, osmotic and ionic stress:
  - 3.1 Preservation of intracellular solvent capacity and associated metabolic adaptations
  - 3.2 Ionic regulation in Micro-organisms
  - 3.3 Regulation of intracellular osmolarity; role of glutamate dehydrogenase; coupling of water transport to active transport of solutes
  - 3.4 Sodium pump and Na, +K, + AT Pase in relation to salinity adaptation: in freshwater and sea water fishes
  - 3.5 Ion transport in avian salt gland and its neuroendocrine regulation.

**SECTION – B**

4. Pressure stress:
  - 4.1 Rate effects
  - 4.2 Enzymatic adaptations to hyperbaric stress with special reference to deep sea fish
  - 4.3 Adaptations to depth problems; concept of buoyancy in marine organisms
  - 4.4 Physiology of aviation and space:

4.4.1 Effects of centrifugal and linear acceleratory force on the body

4.4.2 Weight lessness in space

5. Oxygen deficient stress:

5.1 Oxygen debt in vertebrate muscle and its anoxia adaptations

5.2 Anoxia adaptation in anaerobic vertebrates

5.3 Biochemical adaptations to high altitude in man

5.4 Respiratory Adaptations in parasitic habitats

5.5 Hypoxic & hyperoxic adaptations in organisms inhabiting shore lines and estuaries

### **SUGGESTED READINGS**

1. Environmental physiology of Animals, Pat wilmer, Graham Stone & Ion Johnstone. Blackwell Science Ltd. 2000.
2. Strategies of Biochemical Adaptations, Hochaachka, P.W. and Somero, G.N. 1973.
3. Comparative physiology of Animals; An Environmental Approach Hill R.W. Harper of Co, Publishers. New York. 1976.
4. Adaptation to Environment. Essays on physiology of Marine Animals: Newell, R.C. Butter worths London, 1976.
5. General and comparative physiology. Hoar W.S. Prentice Hall of India Private, Ltd. New Delhi. 1982.
6. Biochemical Adaptation to Environmental change. Sillie, RMS. Acad. Press 1976.
7. Environmental Physiology, Philips, J.G. Blackwell Sci. 1975.
8. Biochemical Adaptation, Conte, F. Univ. of Chicago Press. 1973.
9. Animal Physiology, Eckert, R.W.H. Freeman and Co. New York. 1988.
10. Text Book of Medical Physiology, Guyton, A.C and Hall J.E Saunders Publication, 2006.

**Semester – III**  
**MZPR321**  
**VECTOR BIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Arthropods as vectors:  
Classification of arthropod vectors  
Modifications in the mouth parts of insect vectors  
Ticks and their role in disease transmission
2. Mites as vectors:
3. Important vectors from the following orders.  
Hemiptera  
Anoplura  
Siphonoptera

**SECTION – B**

4. Life histories of vectors belonging to following families and their disease relationships  
Psychodidae  
Simulidae  
Glossinidae  
Tabanidae
5. Myiasis
6. Life histories of mosquitoes and their role in transmission of following diseases.  
6.1 Malaria  
6.2 Filariasis  
6.3 Yellow fever  
6.4 Dengue  
6.5 Encephalites.

### **SUGGESTED READINGS**

1. Herms, W.B., 1962: Medical Entomology, the Macmillan Co. New York.
2. Kettle, D.S., 1984: Medical and Veterinary Entomology, John Wiley and Sons, New York.
3. Herms W.B., James and M.T., 1961: Medical Entomology, Macmillan Co., New York.
4. Harwood, R.f. and James, M.T., 1979: Entomology in Human and Animal Health. Collier Macmillian Pub., London
5. Goddard, J. 1993: Physician's guide to arthropods of medical importance, CRC Press, Florida.

**Semester – III**  
**MZPR322**

**HUMAN-PARASITOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Protozoa:

General organization and outline classification of parasitic protozoa

Epidemiology, morphology, life cycle, pathogenicity, and control of *Entamoeba histolytica*, *Balantidium coli*, *Giardia lamblia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Toxoplasma* and *Cryptosporidium*.

2. Trematoda:

General organization and outline classification of digenetic trematodes, variation in Life cycle in Digenea, Ultrastructure of body wall of digenetic trematodes

Epidemiology, morphology, life cycle, pathogenicity, and control of *Fasciola hepatica*, *Fasciola buski* and *Paragonimus westermani* and *Schistosomes*.

**SECTION –B**

3. Cestoda:

General Organisation and outline classification of cestoda, various larval forms and ultrastructure of the body wall of cestodes

Epidemiology, morphology, Life cycle, pathogenecity and control of *Diphyllobothrium latum*, *Taenia solium*, *T. saginata*, *Echinococcus granulosus*, *Hymenolepis diminuta*, *H.nana*, *Dipylidium caninum* including sparganosis, cysticercosis and hydatid disease.

4. Nematoda:

General organization, classification and life cycle patterns

Epidemiology, morphology, life cycle, pathogenicity and control of *Trichuris trichiura*, *Trichinella spiralis*, *Ascaris lumbricoides*, *Enterobius vermicularis*, *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercoralis*, *Wuchereria bancrofti*, *Onchocerca volvulus* and *Dracunculus medinensis*.

### SUGGESTED READINGS

1. Burton J. Bogitsh and Thomas C. Cheng: Human Parasitology Academic Press.
2. Belding D.L., Text Book of Parasitology III edition, Appleton Century Croft, New York.
3. Richard R. Kudo: Protozoology, Check Thomas Publication.
4. Levine N.D., Nematode Parasites of domestic animals.
5. Chatterjee, K.D. 1995 : Parasitology Chatterjee Medical Publisher
6. Marquardt, W.C. Demaree, R.S. and Gruieve, B. 2000, Parasitology and Vector Biology, Harcourt A.P.

## **MZ323**

### **Semester III**

#### **Practical Paper V: Pertaining to theory papers MZ311, MZ312, MZ313 & MZ314**

##### **MZ311**

1. To study the behavior of rat by using the "Skinner's Boxes"
2. Habituation/Sensitization in mosquito larvae.
3. To study the Grooming behavior of Cockroach.
4. To study the predation behavior of Rats.
5. Simulating the dilution, confusion and odd prey effects.
6. To study the rolling behavior of pill bugs.
7. To assess the importance of a visual stimulus (background colour/brightness) on an individual's decision to position itself relative to it.
8. To assess the importance of an olfactory stimulus (background food/odorant) on an individual's decision to position itself relative to it.

##### **MZ312**

1. To prepare permanent slides of some endocrine glands by microtomy: Thyroid, Pancreas, Thymus, Spleen, Adrenal gland, Testis & Ovary.
2. To study the Process of spermatogenesis, process of oogenesis, Corpus luteum, Structure of sperm, Parathyroid gland, Sickle cell anemia, Mammary gland & Calcified and decalcified bone.
3. To demonstrate the abnormalities of growth hormone: Dwarfism, Gigantism and Acromegaly etc.
4. To demonstrate the abnormalities related to Thyroid Gland: Hyperthyroidism Exophthalmos, Goiter and Grave's disease; Hypothyroidism Myxedema, Cretinism.
5. To demonstrate the abnormalities of Adrenal Gland: Cushing Syndrome.

##### **MZ313**

1. To identify, classify and study morphological characteristics of Chondrichthyes fishes.
2. To identify, classify and study morphological characteristics of Osteichthyes fishes
3. To prepare permanent slides of Placoid scales.
4. To prepare permanent slides of Ctenoid scales.
5. To prepare permanent slides of Cycloid scales.
6. To prepare permanent slides of Ganoid scales.
7. To prepare permanent slides of ampulla of lorenzini.

##### **MZ314**

1. To study the principle, working and applications of Compound microscope.
2. To study the principle, working and applications of Stereo zoom microscope.
3. To study the principle, working and applications of Phase contrast microscope.
4. To study the principle, working and applications of Fluorescent microscope.
5. To study the principle, working and applications of Spectrophotometer.
6. To prepare the chromatograph for different inks/oils by paper chromatography.

## MZ324

### Specialization Entomology

#### Practical Paper VI: Pertaining to theory papers Specialization MZE315 & MZE316

##### MZE315

1. Morphology of head region (Sutures, Structure, Tentorium etc.)
2. Morphology of thorax
3. Wing and its modifications
4. Morphology of abdomen & genitalic structures
5. To study digestive system of Ak grasshopper.

##### MZE316

1. To study Nervous system of Ak grass hopper.
2. To study internal reproductive system of an insect.
3. To study excretory system of different insects.
4. To study respiratory system of different insects.
5. To study circulatory system of different insects.
6. To prepare assignment s on
  - a. Nerve conduction in insects.
  - b. Muscle contraction

### Specialization Cytogenetics

#### Practical Paper VI: Pertaining to theory papers Specialization MZC317 & MZC318

##### MZC317

1. To prepare karyotype of grasshopper chromosomes.
2. To prepare the karyotype of bug chromosomes.
3. Comparative study of sex determining mechanisms in insect chromosome.
4. To perform C banding and study distribution of Cheterochromatin in acrocentric chromosomes.
5. To perform C banding and study distribution of Cheterochromatin in holocentric chromosomes.
6. To perform silver nitrate staining and study the NOR regions in the acrocentric chromosomes.
7. To perform silver nitrate staining and study the NOR region in holocentric chromosomes.
8. Study of sequence specificity (AT and GC) of heterochromatin under the fluorescent microscope.

##### MZC318

1. To make the chromosome preparations from the bone marrow of Rat and study the chromosome complement from somatic metaphase plates.
2. To make the chromosome preparations from the bone marrow of *Hemidactylus* and study the chromosome complement from somatic metaphase plates.
3. To make the chromosome preparations from testes of Rat and study the different stages of meiosis.
4. To study the somatic metaphase chromosomes from permanent slides of Rabbit.
5. To study the chromosome complement in different stages of meiosis from permanent slides of Varanus.

### Specialization Physiology

#### Practical Paper VI: Pertaining to theory papers Specialization MZP319 & MZP320

### **MZP319**

1. To estimate CO<sub>2</sub> production in human body.
2. To determine the effect of impurities on ice.
3. To determine gustatory receptors.
4. To determine acuity of taste sensation.
5. To determine the zone of tolerance and zone of resistance for mosquito larva.
6. To study the effects of temperature on respiratory rate of a fish.
7. To study the role of glycerine in bringing down freezing point of water.
8. To observe the selective permeability of plasma membrane.

### **MZP320**

1. Anatomy of male reproductive system of rat.
2. Anatomy of female reproductive system of rat.
3. Histology of male reproductive system of rat using microtomy: Testis, Epididymis, Ductus deferens and accessory reproductive glands of male rat; Seminal vesicles, Prostate gland, Cowper's gland
4. Histology of female reproductive system of rat: Ovary, Oogenesis, Structure of Ovum and Corpus luteum
5. Study of Permanent slides: Spermatogenesis, Mammary gland and Placenta.

## **Specialization Parasitology**

### **Practical Paper VI: Pertaining to theory Specialization MZPR321 & MZPR322**

#### **MZPR321**

1. Permanent preparation of GI protozoan parasites of the given animal.
2. Collection, fixation and temporary mounting of GI nematode parasites of the given animal.
3. Collection, fixation and permanent mounting of GI cestode parasites of sheep and goat.
4. Dissect and study the detailed morphology of eggs, male and female of *Ascaris suum*.
5. Detailed study of morphology of eggs, male and female of *Trichuris globulosa*.
6. Make a stained preparation of *Fasciola* sp. and study the detailed morphology.
7. Make a stained preparation of *Moniezia* sp. and study the detailed morphology.
8. Examination of freshwater snails for the presence of larval forms of *Fasciola hepatica* and make permanent preparation.
9. Study of permanent slides – *Plasmodium berghei*, *Leishmania* sp., *Balantidium coli*, *Nyctotherus* sp., *Opalina*, *Entamoeba histolytica* – Trophozoite, *Taenia* Scolex, proglottids, cysticercus, hexacanth, Hydatid cyst, *Dipylidium scolex*, *Paramphistomum*, *Fasciola* – egg, radia, cercaria, *Taenia* T. S., *Fasciola* – T.S., *Ascaris* T. S., *Ancylostoma duodenale* male & female, *Enterobius vermicularis* – Male & female, *Dracunculus medinensis* female.

#### **MZPR322**

1. Preparation of permanent mounts of mouth parts of major vector species.
2. Study of permanent slides related to vectors (Whole mounts and various structures).
3. Preparation of permanent slides of antennae, wings, legs and other. morphological structures of insects having medical importance.
4. Study of immature stages of various species of mosquitoes (eggs, larvae and pupae)
5. Collection and preservation of ticks and mites of medical and veterinary importance.

**Semester – IV  
MZ411**

**INTEGRATIVE ORGANISMAL BIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. The central role of the organism in biology
2. Plasticity, complexity and evolution of interacting traits across levels of organization
3. The role of ecological epigenetics in integrative biology
4. The ecological and evolutionary importance of variation in life history reaction norms

**SECTION –B**

5. Evolutionary systems biology: shifting focus to the context-dependency of genetic effects
6. Evolutionary trade-offs and biological diversity: an integrative approach
7. Impact of climatic variations on species distributional ranges, linking physiological and evolutionary perspectives
8. Chemical ecology and biomolecular evolution

**SUGGESTED READINGS**

1. Martin, L.B., Ghalambor, C.K. and Woods, H.A. 2015. Integrative Organismal Biology. Wiley-Blackwell
2. Glenn-Peter Sætre and Mark Ravinet 2019. Evolutionary Genetics, Concepts, Analysis, and Practice. Oxford University Press
3. Andrew P. Hendry 2017 Eco-evolutionary Dynamics. Princeton University Press

**Semester – IV**  
**MZ412**

**WILD LIFE AND ITS MANAGEMENT**

Maximum Marks: 60

Theory: 44

Internal Assessment: 16

Minimum Pass Marks: 35%

Total Teaching Hrs: 30

Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Introduction to wild life.
2. Wild life management Principles:
  - Food
  - Cover
  - Predators
  - Diseases.
3. Important wild animals of India (mammals and birds)
4. Factors important in wild life management:
  - Water
  - Soil
  - Exotic animals

**SECTION-B**

5. Wild life protection Act:
  - Hunting of wild animals.
  - Sanctuaries and National parks
  - Central Zoo Authority
  - Trade in wild animals
6. Conservation biology
  - Conflict between man and wild life.
  - Wild life conservation projects of India
  - Modern practices in wild life conservation.

### **SUGGESTED READINGS**

1. Teage R.D., 1967: A manual of wild life conservation. Natraj Publishers, Dehradun
2. Giles R.H., 1980: Wild life management techniques. Wildlife Society, Washington.
3. Dasmann, R.F., 1982: wildlife Biology, Wiley Easton Publishers.
4. Sharia, V.B., 1985: Wildlife in India Natraj Publihsers, Dehradun.
5. Teage R.D., 1989: A manual of Wildlife conservation.

**Semester – IV**  
**MZ413**  
**Zoogeography and Evolution**

Maximum Marks: 60

Theory: 44

Internal Assessment: 16

Minimum Pass Marks: 35%

Total Teaching Hrs: 30

Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

- 1 Zoogeography:
  - 1.1 Zoogeographical realms
  - 1.2 Origin of major group of animals
  - 1.3 Principles, types and theories of distribution of animals
- 2 Island theory and conservation:
  - 2.1 Habitats as Islands
  - 2.2 Island biogeography theory
  - 2.3 Speciation and Island conditions

**SECTION-B**

- 3 Population and Environment:
  - 3.1 Complexity of interactions between population and environment
  - 3.2 Reaction of organism to environmental complexity
  - 3.3 Sub-specific and trans-specific aspects of evolution
- 4 Origin of variation:
  - 4.1 Rates of mutations and rates of evolution
  - 4.2 Evolution of genome
  - 4.3 Diversification of natural selection

**SUGGESTED READINGS**

1. Whittaker, R.J.1998. Island Biogeography: Ecology, Evolution and conservation Oxford University Press, New York.
2. Seevers, Charles Systematics, Evolution and Zoogeography Chicago Natural History Museum, Chicago.

3. MacArthur, Robert H. and Wilson, Edward O. 1967 The theory of Island Biogeography Princeton University Press, Princeton & Oxford.
4. Futuyma, D.J. 2005. Evolution. Sinauer Associates Inc., USA .
5. Dobzhansky, T, Ayala, F.J., Stebbins, G. Ledyard and Valentine, James W. 1975. Evolution. Surjeet Publications, Delhi, India.

**Semester – IV**  
**MZ414**  
**LIMNOLOGY**  
**Elective Paper-II**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. Classification and nature of fresh water ecosystems:  
Standing water – lakes, ponds, wetlands.  
Flowing waters- rivers, streams and riparian habitats.
2. Characteristics of fresh water ecosystems:  
Physical characteristics – current, suspended solid, light, temperature, run-off.  
Chemical characteristics – dissolved gases and dissolved solids.
3. Ecological classification of fresh water organisms:
  - 3.1 Zonation of lentic habitat
  - 3.2 Zonation of lotic habitat.
4. Biological communities of Fresh water:
  - 4.1 Biota of lentic habitat
  - 4.2 Biota of lotic habitat
  - 4.3 Adaptations to lentic and lotic habitats.

**SECTION – B**

5. Community structure:  
Trophic structure  
Food chains and food webs.
6. Animal communities and biotic interactions:  
Population dynamics

Competition and predation in freshwater communities.  
Movement, migration and colonization.

7. Eutrophication of water:  
Eutrophic ecosystems  
Characteristics and restoration of eutrophic ecosystems
8. Pollution of water:  
Types of water pollutants  
Effects of pollutants  
Pollution indicators.

#### **SUGGESTED READINGS**

1. Fundamentals of Environmental Biology By S. Arora. Kalyani Publishers, New Delhi
2. Biology of Fresh Water by P.S. Maitland Chapman and Hall, New York
3. Handbook of Limnology and Water Pollution by S.M. Das. South Asian Publisher New Delhi
4. Fresh Water Ecology: Principles & Application by M. Jafferries Q. D. Mills CBS Publishers, New Delhi.

**Semester – IV**  
**MZ415**  
**BIOTECHNOLOGY AND ENVIRONMENT**  
**Elective Paper-II**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

**INTRODUCTION & POLLUTION CONTROL**

- 1.1 Definition, Historical background, scope & importance of biotechnology.
- 1.2 Biosorption - use of bacteria, fungi and algae in biosorption.
- 1.3 Biodegradation of Pesticides

**RECYCLING AND RECLAMATION**

- 2.1 Conventional waste water treatment strategies using biosystem. Activated sludge process, Trickling filter, Rotating Biological contactor (RBC) and Fluidized Beds.
- 2.2 Role of Biotechnology in:
  - 2.2.1. Energy production from Biomass

**SECTION-B**

**BIOTECHNOLOGY AND LAND RESTORATION**

- 3.1 Biotechnology for restoration of degraded land
  - 3.1.1. Reforestation through micropropagation.
  - 3.1.2. Use of microbes in improving soil fertility.
- 3.2 Use of microbes as biofungicide and bioherbicides.

**NOVEL METHODS FOR POLLUTION CONTROL**

- 4.1 Biotechniques for Air pollution Abatement & odour control Bioscrubbers, Biobeds, Biotrickling filters
- 4.2 Vermitechnology
- 4.3 Biodegradable plastics - Bioplast

## **SUGGESTED READINGS**

1. Abbasi, S.A. & Ramasami, E. (1999). Biotechnological Methods of Pollution Control. Universities Press (India) Ltd., Hyderabad.
2. Chatterji, A.K. (2002). Introduction to Environmental Biotechnology. Prentice Hall of India. Pvt. Ltd. N. Delhi.
3. Gupta, P.K. (1994). Elements of Biotechnology. Rastogi & Co. Meerut
4. Higgins et.al. (1984). Biotechnology - Fundamentals & Principles. Blackwell Publishers, London.
5. Jogdand, S.N. (1995). Environmental Biotechnology. Himalayan Publishing House, New Delhi.
6. Mukherjee, R.N. (1992). Down stream processing in Biotechnology. Tata McGraw Hill Publishers Co. New Delhi.
7. Purohit, S.S. & Mathur, S.K. (1996). Biotechnology Fundamentals & Applications. Agro botanical Publication, New Delhi.
8. Sohal, H.S. & Srivastava, A.K. (1994). Environment & Biotechnology. Ashish Pub. House, New Delhi.

**Semester – IV**  
**MZE416**

**INSECT PEST CONTROL AND TOXICOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. Basic Principles of insect pest control:
  - Quarantine
  - Mechanical control
  - Physical methods of control.
  - Synthetic organic insecticides (Organochlorines)
  - Natural organic insecticides
  - Inorganic insecticides
2. Biological control:
  - Procedures
  - Parasites.
  - Predators
  - Micro organisms
3. Introduction to IPM.

**SECTION-B**

4. Appliances for insecticide application
5. Resistance to Insecticides
6. Introduction to transgenic crops.
7. Scope of toxicology:
  - Mode of action of various insecticides
  - Brief idea about antidotes
  - Route and sites of toxicity

### SUGGESTED READINGS

1. Matsumura, F, 1967: Toxicology of Insecticides, Plenum Press, New York & London.
2. Kilgore, W.W. & Douthett, R.L.: Pest Control, Academic Press, London & New York.
3. Abdul Aziz S.A. Kadir & Henry S. Barlow. 1992: Pest Management & The Environment in 2000, C.A. B. International U.K.
4. David Dent, 1991: Insect Pest Management C.A.B. International U.K.
5. Srivastava, K.P., 2002: A Text Book of Applied Entomology, Kalyani Publishers, New Delhi.
6. Paul DeBach, 1970 : Biological control of Insect Pests & Weeds, Chapman & Hall Ltd., London
7. Singh, H.R.: 1989 Introduction to Animal Ecology & Environmental Biology, Shoban Lal Nagin Chand & Co., Delhi & Jalandhar.
8. Pruthi, H.S. 1969: Text Book on Agricultural Entomology, ICAR, New Delhi.
9. Stefferud, Alfred: Insects: The Year Book of Agriculture, Oxford & IBH Publishing Co., Oxford Bldg., 1969.
10. Singh H., 1984 : Household and Kitchen Garden Pests : Principles & Practices, Kalyani Publishers, New Delhi & Ludhiana
11. Nayar, K.K., Ananthakrishnan, T.N. & David, B.V., 1976 : General & Applied Entomology, Tata McGraw-Hill Publishing Co., Ltd.

**Semester – IV**  
**MZE417**  
**AGRICULTURAL AND MEDICAL ENTOMOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Insect pests: emergence of pests and pest resurgence.
2. Life history, mode of damage and control of insect pests of cotton, wheat, sugarcane, rice, pulses, oil seeds, vegetables.
3. Stored grain pests, their biology and control.
4. Biology and control of locust.
5. Household pests.

**SECTION-B**

6. Arthropods as vectors of human diseases.
7. Systematics, biology and control of major insect vectors belonging to Diptera.
8. Mode of transmission, control of vectors and epidemiology of Malaria, Filariasis, Dengue and Plague.

### SUGGESTED READINGS

1. Atwal, A.S, 1986: Agricultural Pests of India & South East Asia, Kalyani Publishers, New Delhi.
2. Metcalf, C.L. & Flint, W.P. (revised by Metcalf, R.L.), 1962; Destructive and Useful Insects – Their Habits and Control, McGraw Hill, New York.
3. Lefroy, H.M, 1971: Indian Insect Pests, Today and Tomorrows Printers and Publishing, New Delhi.
4. Pruthi, H.S, 1969: Text Book on Agricultural Entomology, ICAR, New Delhi.
5. Kettle, D.S. 1984: Medical and Veterinary Entomology, John Wiley & Sons, New York.
6. Harwood, R.F & James, M.T. 1979: Entomology in Human and animal Health, Collier Macmillan Pub, London.
7. Hill, D.S, 1975: Agricultural Insect Pests of the Tropics and Their Control, Cambridge University Press, Cambridge.
8. Pradhan, S, 1969: Insect Pests of Crops. National Book, New Delhi.
9. Nair, M.R., G.K., 1975: Insects and Mites of Crops in India ICAR, New Delhi.
10. Ananthakrishnan, T.N, 1987: Insects and Host Specificity, Macmillan Co. of India Ltd.
11. Herms, W.B. & James, M.T., 1961: Medical Entomology, Macmillan Co., New York.
12. Roy, D.N. : Entomology ( Medical and Veterinary) Calcutta, India.

**Semester – IV**  
**MZC418**  
**HUMAN AND MEDICAL GENETICS**

Maximum Marks: 60  
 Theory: 44  
 Internal Assessment: 16  
 Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
 Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. Organization of human genome:
  - 1.1 Techniques in human chromosome analysis
  - 1.2 Human karyotype and nomenclature
    - 1.2.1. Morphological characteristics of human somatic chromosomes
    - 1.2.2 Morphological variability of human chromosomes: satellite variability, acrocentric chromosomes and secondary constriction
2. Sex determination and sex linked diseases:
  - 2.1 X chromosomes and X linked diseases
  - 2.2 Y chromosomes and Y linked diseases
  - 2.3 Dosage compensation.
3. Longitudinal differentiation of chromosomes:
  - 3.1 C,G, Q and R banding
  - 3.2 Chromosome painting
4. Chromosome mapping:
  - 4.1 Somatic cell hybridization and in situ hybridization
  - 4.2 Restriction maps and construction
  - 4.3 Physical map of human genome.

**SECTION – B**

- 5 Numerical abnormalities of human chromosomes:
  - 5.1 Non disjunction and aneuploidy
  - 5.2 Patau syndrome, Edward syndrome, Down syndrome, Turner syndrome and Klinefelter syndrome
  - 5.3 Mosaics and chimeras
- 6 Structural abnormalities of human chromosomes:
  - 6.1 Deletions and robertsonian translocations

- 6.2 Cri-du-Chat syndrome, Pader-Willi syndrome, Williams syndrome and Wolf-Hirschhorn syndrome
- 6.3 Genomic imprinting.

- 7 Genetic screening and prenatal diagnosis:
  - 7.1 Prenatal, neonatal and adult screening
  - 7.2 Pedigree analysis and genetic counselling
  - 7.3 Pre-implantation diagnosis and genetic imprinting
  - 7.4 ELSI.
- 8 Gene therapy:
  - 8.1 Criteria for effective gene therapy
  - 8.2 Therapy of recessive and dominant disorders
  - 8.3 Current gene therapy and its future.

### **SUGGESTED READINGS**

1. Gardner, Simmon and Snustad: Principles of Genetics, Wiley & Sons Inc., New York.
2. Strickberger: Genetics. MacMillan, New York.
3. Lewin, Genes IV to VII. Oxford University Pub.
4. Nagle: Heredity and Human Affairs Mosby, Toronto.
5. Novitski: Human Genetics, Mac Millan, New York.
6. Harsh Mohan, Jay Pee: Text Book of Pathology. Brothers Medical Pub. Ltd. (2000).
7. Robins: Text-book of Pathology.
8. John Hamerton: Human Cytogenetics, Vol I & Vol. II.
9. Hsu. T.C., Chromosomes longitudinal differentiation of Annual Review, Gene I.
10. Seth P. and Seth S: New perspectives.
11. The human genome Nature (2001).
12. Genomic maps science (2002)

**Semester – IV**  
**MZC419**  
**Cell Division, Differentiation and Cellular Interaction**

Maximum Marks: 60  
 Theory: 44  
 Internal Assessment: 16  
 Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
 Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION-A**

1. Cell division in eukaryotes:  
 Cell cycle  
 Measurement of cell cycle period  
 Spindle organization  
 Chromosome movements  
 Synchronization of cell division  
 Regulation of cell division
2. Differentiation:  
 Genetic determinants of development  
 Genetic Control of cell lineages  
 Genetic basis of pattern formation  
 Homeo-box, significance in differentiation.  
 Cellular senescence

**SECTION-B**

3. Cancer :  
 Macroscopic and Microscopic features of tumors  
 Mechanism of invasion and metastasis  
 Etiology and pathogenesis of neoplasia
4. Molecular Genetics of cancer:  
 Oncogenes  
 Tumor suppressor genes  
 Mutator genes  
 Tumor markers
5. Cell and environment  
 Effects of radiations on cells  
 Effects of chemicals on cells  
 Mutagens  
 Drugs  
 Apoptosis- mechanism and Significance

### SUGGESTED READINGS

1.     Alberts, Bray, Lewis, Raff, Roberts and Watson, 1983: Molecular Biology of cells, Garland Pub. Inc., New York.
2.     Zubay, 1987: Genetics. The Benjamin/cumming Publishing Company
3.     Watson, Hopkin, Roberts, Steitz, Weiner, 1987: Molecular Biology of Gene. Benzamin Cumming, Pub. Co.
4.     Harsh Mohan, Jay Pee, Text book of pathology, Brothers Medical Publishers Ltd. 2000
5.     Benjamin Lewin, Genes IV/V/VI/VII. Oxford University Press.
6.     Saunders. 1982. Developmental Biology. Macmillan Publishing Co., New York.
7.     Diwan and Dhakad, 1998: Molecular Cell Biology. Anmol Pub. Pvt. Ltd., New Delhi
8.     Sandhya Mitra, 1994: Genetics, Tata McGraw Hill. Pub. Co. Ltd.

**Semester – IV**  
**MZP420**

**CELL PHYSIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. Applications of the laws of thermodynamics to the cell :
  - 1.1 The First law of thermodynamics : The law of conservation of energy
  - 1.2 Entropy and second law of thermodynamics
  - 1.3 The Law of conservation of matter and life
  - 1.4 Cellular enzymes:
    - 1.4.1 Hydrolytic enzymes.
    - 1.4.2 Enzymes involved in cellular oxidation – reduction.
  - 1.5 Release of energy in cells:
    - 1.5.1 Pathway of oxidation reduction reactions of the cell
    - 1.5.2 Determination of redox potentials in living cells.
- 2.1 Heat and cold resistance of active cells.
- 2.2 Thermal resistance of dormant cells
- 2.3 Cellular and molecular effects of ultra violet radiations and the phenomenon of photoreactivation.
- 2.4 Cellular and molecular effects of ionizing radiation and mechanism of radio protection.
- 2.5 Bioluminescence:
  - 2.5.1 Fluorescence and phosphorescence
  - 2.5.2 Chemical basis of bioluminescence in fire fly and luminous bacteria
  - 2.5.3 The physical nature of bioluminescence

**SECTION – B**

3. The functional significance of cell membranes:
  - 3.1 The chemical composition of cell membrane.
  - 3.2 The models of membranous structure
  - 3.3 Cell to cell contact and communications.
  - 3.4 Biological transport processes:
    - 3.4.1 Osmotic flow
    - 3.4.2 Facilitated diffusion
    - 3.4.3 Active transport
    - 3.4.4 Bulk transport (endocytosis, phagocytosis, pinocytosis, exocytosis etc.)

- 3.5 Membrane bioelectrics:
  - 3.5.1 Action potentials in excitable plant cells
  - 3.5.2 Sensory fiber action potentials
  - 3.5.3 Synaptic transmission of action potentials.
- 4. The biochemistry of contraction with special reference to the physiology of skeletal muscle fiber :
  - 4.1 Ultra structure and the structural proteins of muscle cells
  - 4.2 The sliding filament theory of muscle contraction and the source of energy for contraction.
  - 4.3 Excitation of muscle contraction and the mechanism of coupling between the electrical and chemical events.
  - 4.4 Work and heat relations in muscle contraction.
  - 4.5 Physiological types of muscles (skeletal, cardiac and smooth) and their functional specialization.
  - 4.6 Mechanism of contraction in non-muscular cells.

#### SUGGESTED READINGS

1. Giese, A.C. (Third Edition), 1979: Cell Physiology W.B. Saunders Company, Toppan Company Ltd. Tokyo.
2. Karp. G., 1979: Cell Biology. McGraw Hill.
3. Davson, H. 1964 A Text Book of General Physiology *Little Brown & Co.*, Boston.
4. Alberts, B., Brey, D., Lewis, J. Raff. M. Roberts, K. and Waston, J.D., 1973: Molecular Biology of the cell Garland Publication Inc.
5. W.S. Hoar, 1983: comparative Animal Physiology 3<sup>rd</sup> ed. Prentice Hall Inc. Indian Print by Jay Print Pack Pvt. Ltd., New Delhi.
6. Martin, D.W., Meyes, P.A. and Rodwell, V.W., Harper's Review of Biochemistry, Lange Medical Publications, Maruzen Asia (Pvt.) Ltd.
7. Prosser, C.L. Ed., 1973 : Comparative Animal Physiology W.B. Saunders Co. (Indian Print by Asia Playing Cards Co., Agre in 1984).
8. Guyton, A.G. 2006. Text Book of Medical Physiology, 11<sup>th</sup> Edition Saunders Publication.
9. Guthe, F. 1968. The Physiology of Cells. The MacMillan Co.

**Semester – IV**  
**MZP421**

**MAMMALIAN PHYSIOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION – A**

1. Physiology of digestion
  - The basic pattern and innervations of the gut wall.
  - Digestion and absorption of carbohydrates, proteins and lipids.
  - Role of liver and pancreas in digestion
  - Neural regulation of gastrointestinal movements.
2. General disorders of the gastrointestinal tract.
  - Vomiting.
  - Gastritis
  - Peptic ulcer
  - Gastrointestinal obstruction.
3. Physiology of respiration.
  - Air conducting passages and respiratory surfaces.
  - Mechanism of breathing.
  - Volume and capacities of lungs.
  - Alveolar ventilation and dead space.
  - Transport of O<sub>2</sub> and CO<sub>2</sub> in the blood.
  - Chemical control of respiration.
9. Pulmonary abnormalities.
  - Emphysema
  - Pneumonia
  - Atelectasis
  - Asthma
  - Hypoxia

**SECTION –B**

10. Physiology of excretion
  - The functional anatomy of mammalian kidney and its renal unit.
  - The role of ultra filtration, re-absorption and secretion as transport mechanisms involved in the formation of urine.
  - Control of urinary concentration of sugar, urea, sodium, potassium and PH.

Functions of aldosterone. Antidiuretic hormone and rennin angiotensin system in renal physiology.  
Regulation of acid-base balance.

11. Physiology of blood circulation
  - Pacemaker system and the specialized conducting fibres
  - Cardiac action potentials.
  - Cardiac cycle.
  - Cardiac output.
  - Blood pressure and its regulation
  - Lymphatic system.

#### SUGGESTED READINGS

1. Guyton, A.C., 2006: Text Book of Medical Physiology, 11<sup>th</sup> Edition, Saunders Publication, U.K.
2. Ganong, W.F., 2005: Review of Medical Physiology, 22nd Edition. McGraw Hill Publication, New York.
3. Ruch, T.C.; Patton, M.D. 1965: Physiology and Biophysics, 19 edition, Saunders Publication, UK.
4. Keel C.A.; Neli, E. and Joels, N. 1982: Samson Wright's Applied Physiology Oxford University Press, Oxford.
5. West, J.B. 1985: Best and Taylor's Physiological basis of Medical Practice (11<sup>th</sup> Ed.), William and Wikins, U.S.A.
6. Gordon, 1977: Animal Physiology 3rd Ed. Mc Millan Publishing Co., Inc. New York.
7. Neil, A.C., Jane, B.R; Lisa, A.U., Michael, L.C., Steven, A.W; Peter, V.M., Robert, B.J. 2008, Biology. Pearson International 8th edition U.S.A.
8. Daniel, D.C. 2005, Human Biology, 5th Edition, Jones and Bartlett Publications, U.K.
9. Stuart, I.F., 1996, Human Physiology, 5th edition, W.C.B. Publishers, U.S.A.

**Semester – IV**  
**MZPR422**

**IMMUNOLOGY**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION –A**

1. The complement system : Functions of complement components of complement system, activation and regulation of the complement system, complement deficiencies
2. Major Histocompatibility Complex: General organization and inheritance of MHC, Regulation of MHC expression, MHC and immune responsiveness, MHC and disease susceptibility.
3. Immune response to infectious diseases, viral infections, bacterial infections, protozoan diseases and diseases caused by parasitic worms (Helminths).
4. Auto immunity: Organ specific autoimmune diseases, systemic autoimmune diseases, mechanisms for induction of autoimmunity.

**SECTION –B**

5. Hypersensitive reactions: Classification IgE mediated (Type-I) hypersensitivity, antibody –mediated cytotoxic (Type-II) hypersensitivity, Immune complex mediated (Type-III) hypersensitivity, TDTH mediated (Type –IV) hypersensitivity.
5. Vaccines: active and passive immunization, whole organism vaccines, Purified macro-molecules as vaccines, recombinant vaccines, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines.
7. Cancer and immune system: origin, malignant transformation of cells, oncogenes and cancer induction, tumors of the immune system, tumorevasion of the immune system, cancer immunotherapy.
8. AID's and other immunodeficiencies.

### SUGGESTED READINGS

1. Ovan M. Roitt, 1988: Essential Immunology ELBS.
2. Robert M. Coleman, Mary F. Lanbard and Raymond E.S. Card, 1992: Fundamental Immunology Wm. C. Brown Publishers.
3. Roitt, I.M., Brostoff. J. and Male, D.K., 1985: Immunology Churchill Livingstone.
4. Tragger, W., 1986: Living Together- The Biology of Animal Parasitism, Plenum Press.
5. Ruben, L.N. and Gershwin, M.E., 1982: Immune Regulation.
6. Cooper, E.L., 1976: Comparative Immunology, Prentice Hall.
7. Series of Recent Advance in Parasitology A.P.
8. Burnet, F.M. Immunology W.H. Freeman and Company.
9. Cheng, T.C., The Biology of Animal Parasities, W.B. Saunders Co.
10. Hayward, A.R. Immunodeficiency.
11. Godsby, R.A. et al, 2000: Kuby Immunology W.H. Freeman & Co.
12. Benjamini, et al. 2000: Immunology – A short course, Wiley Liss.
13. Abbas, A.K. et al, 2000: Cellular and Molecular Immunology W.B. Saunders.

**Semester – IV**  
**MZPR423**

**HOST-PARASITE RELATIONSHIPS**

Maximum Marks: 60  
Theory: 44  
Internal Assessment: 16  
Minimum Pass Marks: 35%

Total Teaching Hrs: 30  
Time Allowed: 3 hrs

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6½ marks each. Section C will consist of 9 short-answer type questions will cover the entire syllabus uniformly and each will carry 2 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions from each section A & B of the question paper and the entire section C.

**SECTION –A**

1. Establishment of infection:  
Active and passive entry, site selection within the host, entry into specific organs and cells.
2. Host-parasite interface:  
In extracellular and intracellular parasites.
3. Parasite induced modifications of the host:  
Effect on behaviour, growth, parasitic castration.
4. Modifications of the host cell by  
Microsporidians, Piroplasms & *Plasmodium*.
5. Uptake of Nutrients:  
5.1 Role of external surface, tegument and alimentary canal of parasites.  
5.2 Digestion.
6. Metabolism:  
Energy sources and respiration with special reference to *Entamoeba*, *Giardia*, *Trypanosoma*, Trichomonads and helminths including *Ascaris*.

**SECTION –B**

7. Immunoparasitology:
  - 7.1 Immune reactions to Trypanosomes, malaria, leishmaniasis, American trypanosomiasis and schistosomiasis.
  - 7.2 Acquired immunity to intestinal nematodes.
8. Main clinical and pathological signs of parasitic infections in domestic animals:
 

Parasitic diseases of the alimentary system, oral cavity and oesophagus, gastrointestinal tract; liver and abdominal cavity.

Parasitic diseases of the respiratory system : nasal cavity and sinuses, larynx, trachea and lower respiratory tract.

Parasitic diseases of the urinogenital system.

Parasitic diseases of the nervous system.

Parasitic diseases of the cardiovascular and hematopoietic system.

### SUGGESTED READINGS

1. Trager, W. 1986. Living Together. The Biology of animal Parasitism Plenum Press, New York.
2. Bryant, C. and Beyhn, C. Biochemical Adaplation in Parasites Chapivan & Hall Lendar
3. Bush, A.O. Fernande J.C., Esch G.W. & Seed R. Parasitism. The diversity and ecology of Animal parasitic Cambridge University Press.
4. Chappel, L.H. Physiology of Parasities. Black i.e. Glasgew & Lenden.
5. Melhorn, H. 1988. Parasitology in Focus, Springe-verlag.
6. Smyth, J.D. 1996 Animal Prasitology, Cambridge University Press.

## MZ424

### Semester IV

#### **Practical Paper VII: Pertaining to theory papers MZ411, MZ412, MZ413, MZ414 & MZ415**

##### **MZ411**

1. Knowledge about cuticular hydrocarbons and their extraction.
2. Study about Mutualism: Effects of Ants on Aphids, Their Predators, and Host Plants.
3. Linking of phenotypic plasticity with adaptation in insect societies.
4. Avoidance of predator odors, a case study with squirrels.
5. Report on invasive ant species and their life history traits

##### **MZ412**

1. To deliver a seminar on a topic related to wild life conservation.
2. To submit an assignment on a topic concerning wild life in India.
3. To prepare a report on the latest events concerning wild animals at the national and international level.
4. To observe the behavior of one wild animal and to write a report on it.
5. To visit a wild life National Park and to submit a report on it.

##### **MZ413**

1. To study the habitat, distribution, habits and important characters of various animals: *Naja naja*, Pigeon, *Hystrix* (Porcupine), *Hyla*, *Salamander*, *Apteryx* (kiwi), Flying Squirrel, *Ornithorhynchus*, *Protopterus*, *Peripatus*, *Balanoglossus*, *Archaeopteryx*.
2. To study the vestigial organs in animals.
3. To study the zoogeographic realms of the world.
4. Map studies:
  - a. India – Climatic Regions
  - b. India Rainfall and wind
  - c. India – Distributions of Animals
  - d. Distribution of endangered animal species in Himalayan region
5. Map studies: Biodiversity Hotspots location in (a) World (b) India
6. Map Studies: Protected Areas of India such as National parks, Wildlife Sanctuaries, Biosphere Reserves.
7. To study the Leg modifications in case of insects.

##### **MZ414**

1. To estimate the CO<sub>2</sub> concentration in given water sample.
2. To estimate the concentration of Dissolved Oxygen in given water sample.
3. To estimate the total alkalinity of given water sample.
4. To estimate chloride in given water sample.
5. To estimate total hardness in given water sample.
6. Analysis of phytoplankton and zooplankton in given water sample.

##### **MZ415**

1. Study of the Microbial Techniques
2. Study of growth response of bacteria on petroleum fuel (diesel)
3. Isolation and Characterization of Bacteria from Crude petroleum oil contaminated soil.

4. Interaction of Plant seeds with diesel for potential use in the remediation of diesel fuel contaminated soils.
5. Detection of alkylbenzenesulfonate – degrading microorganisms
6. Field Trip: Waste water treatment plant, distilleries etc.
7. Enrichment for Uric Acid utilizing bacteria
8. To produce Biodiesels in the lab.
9. Solar energy : production and uses
10. Vermicomposting: to culture earthworm in soil.

#### **MZ425**

### **Specialization Entomology**

#### **Practical Paper VIII: Pertaining to theory papers of specialization MZE416 & MZE417**

##### **MZE416**

1. To study different kinds of hand operated sprayers: Syringe, Bucket Pump Sprayer, Knap Sack Sprayer, Rocket Sprayer, Foot of Paddle Pump Sprayer, Wheel Barrow Sprayer and Hand Atomizer (Flit Pump)
2. To study spray lances and cut off devices.
3. To study the effect of concentration of insecticides on given Insect.
4. To make a comparative study and determine the strongest fumigant.
5. To study the testing of attractancy of a substance on Insects.

##### **MZE417**

1. Study of major crop pests: their identification and writing a note on their economic importance.
2. Study of the biology of some stored grain pests by rearing them in the laboratory.
3. Identification of major insect vectors and writing note on their medical importance
4. Study of permanent slides of vectors.
5. Preparation of permanent mounts of mouth parts of major vector species.
6. Preparation of permanent slides of antennae, wings, legs and other morphological structures of insects having medical importance.

### **Specialization Cytogenetics**

#### **Practical Paper IV: Pertaining to theory of specialization MZC418 & MZC419**

##### **MZC418**

1. To study the distribution of constitutive heterochromatin in the somatic metaphase plates of Rat bone marrow.
2. To study the distribution of constitutive heterochromatin in somatic metaphase plates of *Hemidactylus* bone marrow.
3. To study the distribution of constitutive heterochromatin in the different stages of meiosis of Rat testes.
4. To study nucleolar Organizer regions (NOR) in the somatic metaphase plates of Rat bone marrow.
5. To study Nucleolar Organizer regions (NOR) in the somatic metaphase plates of *Hemidactylus* bone marrow.
6. Study of normal human chromosome complement and karyotyping
7. Study of chromosome abnormalities in complements of human syndromes and their karyotyping.

**MZC419**

1. Histochemical preparation of slides to demonstrate localization of glycogen in the given tissue.
2. Histochemical preparation of slides to demonstrate localization of lipids in the given tissue.
3. Histochemical preparation of slides to demonstrate localization of proteins in the given tissue.
4. Histochemical preparation of slides to demonstrate localization of nucleic acids in the given tissue.
5. Demonstration of laminar air flow and its applications.
6. Demonstration of instruments used in extraction and amplification of DNA and their applications.

**Specialization Physiology****Practical Paper VIII: Pertaining to theory of specialization MZP420 & MZP421****MZP420**

1. To demonstrate osmotic haemolysis in RBC's.
2. To demonstrate the activity of amylase.
3. To demonstrate the activity of enzyme catalase.
4. To demonstrate the dehydrogenase activity in milk.
5. To demonstrate the absorption chromatography for the separation of leaf pigments using a piece of chalk.
6. Demonstration of absorption curves of  $\text{KMnO}_4$ .
7. Spectrophotometric demonstration of Beer Lambert's Law.

**MZP421**

1. To plot the calibration curve for standard solution of glycogen.
2. To determine the amount of ascorbic acid in the given sample.
3. Extraction and quantitative analysis of glycogen in liver.
4. To plot the calibration curve for standard solution of proteins.
5. Demonstration of thin layer chromatography of neutral lipids.
6. Determination of total leukocyte count of given sample of blood.
7. Enumeration of red blood corpuscles in the given sample of blood.

**Specialization Parasitology****Practical Paper IV: Pertaining to theory papers of specialization MZPR422 & MZPR423****MZPR422**

1. Preparation of Immunoglobulin IgG from Sheep/goat serum.
2. Immuno-precipitation of immunoglobulin from sheep/goat serum.
3. To demonstrate the process of Hemagglutination assay.
4. To study the techniques of immunohistochemistry.
5. To demonstrate ELISA (Enzyme linked Immunoabsorbent Assay) technique.
6. To separate lymphocytes from peripheral blood.
7. To prepare cell suspension from lymphoid organ.

**MZPR423**

1. Enumeration of eggs/oocysts/larvae of gastrointestinal protozoan and helminth parasites of sheep and goat by Salt Floatation method, Zinc Sulphate method and Formaldehyde Ether Sedimentation method.
2. Prepare and stain (H + E) histological sections of nematode (*Trichuris*) and cestode (*Moniezia*) parasites to demonstrate the host-parasite interface.
3. Study of detailed morphology and classification of nematode, cestode and trematode parasites of sheep and goat : *Trichuris globulosa*, *Trichuris ovis*, *Haemonchus contortus*, *Oesophagostomum* sp., *Moniezia* sp., *Stilesia* sp., *Avitellina* sp., *Paramphistomum* sp. and *Cotylophoron* sp.
4. Study of histopathology of large intestine caused by the nodular worm. *Oesophagostomum columbianum*.

## **OPEN ELECTIVE SUBJECT ECONOMIC ZOOLOGY**

Maximum Marks: 50  
Theory: 38  
Internal Assessment: 12

Total Teaching Hrs: 30  
Time Allowed: 3 hrs  
Minimum Pass Marks: 35%

### **INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections: A, B & C. Section A & B will have four questions in each section from the respective sections of the syllabus and will carry 6 marks each. Section C will consist of 7 short-answer type questions that will cover the entire syllabus uniformly and each will carry two marks.

### **INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from the section A & B of the question paper and the entire section C.

#### **SECTION – A**

1. Aquaculture : definition, objectives, its role in impending food crisis
2. Poultry farming: table and egg-laying varieties of chicken, economic importance of poultry products.
3. Dairy farming: milk production, status of dairy industry in India, importance of milk and other dairy products.

#### **SECTION –B**

4. Apiculture: brief introduction, honeybees, bee keeping, bee products and their utility, current status in India.
5. Sericulture: brief history, silk production moths, mulberry and non-mulberry sericulture, current status in India.
6. Lac culture: brief introduction, life cycle of lac insects, propagation, cultivation and current status in India.

#### **SUGGESTED READINGS**

1. Pillay, T.V.R. and Kutty, M.N. 2005. Aquaculture: Principles and Practices (2<sup>nd</sup> Edition) . Blackwell Publishing Ltd. Oxford U.K
2. Rice, E.J and Botosford, H.E. 1949. Practical Poultry Management John Wiley, Hansen Inc. New York
3. Sahai, R. and Vijh, R. K. 2000. Domestic Animal Diversity (Conservation and sustainable development). SI Publication, 231 MIG Housing Board, Karnal
4. Winter A.R. and Funk E.M. 1956 Poultry Science and Practice, J.E Lippinocott and Co. Chicago, Philadelphia, New York.
5. Srivastava, K.P, Text Book of Applied Entomology Volume-II.