SYLLABUS FOR
M.SC. ZOOLOGY
( SEMESTER PATTERN )
( For Candidates admitted in the Colleges affiliated to Periyar University from 2017-2018 onwards )
REGULATIONS

AIM & SCOPE

1. To Educate Knowledge across different area of Zoology.
2. There is also scope for self employment.
3. Practical's include in a syllabus will improve all skills of students in microscopy observation, Drawing and laboratory technique.

1. **ELIGIBILITY:**
   A candidate who have passed the three year B.Sc., Examination with Zoology will be eligible for admission to this course.

2. **DURATION OF THE COURSE:**
   The course for the Degree of Master of Science shall consist of two years divided into four semesters, over a total of 2500 marks. Each semester consist of 90 working days.

3. **PASSING MINIMUM:**
   The candidate shall be declared to have, passed the Examination if he/she secured not less than 50 marks.

4. A candidate shall eligible for appearing examination provided he/she secure percentage of attendance as specified by the university.

5. Examination would be held for completion of curriculum at the end of the each semester practical examination would be held end of the each year.

6. A candidate should obtain at least 50% in each of the theory are practical course to qualified in each semester.
## Course of Study and Scheme of Examination

### I Semester

<table>
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<tr>
<th>Course</th>
<th>Course Code</th>
<th>Subject Title</th>
<th>Hrs/W</th>
<th>Credits</th>
<th>Exam Hrs</th>
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<td>Animal Taxonomy, Phylogeny and Biology of Invertebrates and Chordates</td>
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### M.Sc. ZOOLOGY

#### COURSE COMPONENT

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M.Sc. ZOOLOGY
SEMESTER - I
CORE I – ANIMAL TAXONOMY, PHYLOGENY AND BIOLOGY OF INVERTEBRATES AND CHORDATES

UNIT I


UNIT II


UNIT III


UNIT IV

Respiration: Gills and Trachea in Arthropods.

Circulation: Circulation in Arthropods.

Excretion: Different types of excretory organs in Invertebrates – their structure and functions.

Nervous System: Annelids.

Reproduction: Reproductive system of Arthropods – Invertebrate Larval forms and their significance.
UNIT V

Comparative study: Structure and Function of the following system in vertebrates.

Digestive System: Alimentary Canal and Associated Glands in Amphibia and Mammals.

Respiratory System: Fishes and Birds.

Circulatory System: Arterial and Venous system of Reptiles and Birds.

Excretory system: Reptiles and Mammals.

Nervous System: Brain of Amphibia and Mammals.

Reproductive System: Reptiles and Mammals.

TEXT BOOKS:


REFERENCES:


M.Sc. ZOOLOGY
SEMESTER - I
CORE II – CELL AND MOLECULAR BIOLOGY

UNIT I
Membrane Structure and Function: Structure of model membrane, lipid bilayer and membrane protein – diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

UNIT II
Structural organization and function of intracellular organelles: Mitochondria, Ribosome, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes, Nucleus.

UNIT III
Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle.

UNIT IV
Organization of Genome: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Structure, types of DNA and RNA, DNA replication and repair RNA Synthesis and processing; protein synthesis and processing: Control of gene expression at transcription and translation level in prokaryotes and eukaryotes.

UNIT V
Cell signaling: G-Protein coupled receptors, Signal transduction pathways, Regulation of signaling pathways.
Cellular communication: Principle, Cell adhesion, Gap junctions, extracellular matrix and integrins.
Cancer: Oncogenes, tumour suppressor genes, cancer and the cell cycle, Virus – induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis. Immune response to cancer.
M.Sc. ZOOLOGY

TEXT BOOKS:


REFERENCE BOOKS:


UNIT I

Molecular Gene concept: Fine structure of genes. Linkage and crossing over, Sex linkage, sex limited and sex influenced characters. Extra chromosomal inheritance of mitochondrial genes.

Gene mapping methods: Linkage maps, mapping with molecular markers.

UNIT II

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction.

Human genetics: Pedigree analysis, karyotypes, Genetic disorders: Chromosomal Syndromes, Gene based disorders, mitochondrial gene disorders.

UNIT III

Quantitative genetics: Polygenic inheritance.

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

UNIT IV


UNIT V

Genetic Engineering : Restriction enzymes and other enzyme tools used in rDNA technology, Recombinant DNA techniques. Application of rDNA technology

TEXT BOOKS:

REFERENCES:
M.Sc. ZOOLOGY
SEMESTER - I
CORE IV - MICROBIOLOGY AND IMMUNOLOGY

UNIT I


UNIT II

UNIT III

UNIT IV

UNIT V
Major Histo-compatibility Complex (HLA) and its Products in Man. Transplantation Immunology, Tumour Immunology – Immune Deficiency Diseases – AIDS – Autoimmune Diseases – Examples – Concept and Mechanisms – Types of Hypersensitivity.
M.Sc. ZOOLOGY

TEXT BOOKS:

REFERENCES:
M.Sc. ZOOLOGY
SEMESTER - I
CORE - PRACTICAL – I

ANIMAL TAXONOMY, PHYLOGENY AND BIOLOGY OF INVERTEBRATES AND CHORDATES, CELL AND MOLECULAR BIOLOGY, MOLECULAR GENETICS AND MICROBIOLOGY AND IMMUNOLOGY

I. Animal Taxonomy, Phylogeny and Biology of Invertebrates and Chordates

**Invertebrates**
1. Identification and study of selected Protozoan and Helminthes of medical importance
2. Identification and study of Trochophore larva, Nauplius larva, Zoea larva and Bipinnaria larva.
3. Dissection of nervous system of Prawn.

**Chordates**
Demonstration – Dissections: Arterial System & Cranial nerves – Shark, Frog, Calotes & Rat using video clippings (Demo Only). A student can make use of material available in any search web site for online dissection using Apple quick time software.

II. Cell and Molecular Biology
1. Micrometry – Simple measurements of cells (any prepared slides) by micrometry
2. Study of Mitosis in the cells of Onion root tip.
3. Observing the Giant Chromosomes in the salivary glands of larva of Chironomus sp.

III. Molecular Genetics
2. Localization of Barr body in the buccal smear (Squamous epithelial cells of man)

IV. Microbiology and Immunology
1. Study of clinical and veterinary protozoans.
2. Study of bacterial diseases of man with reference to gastro – intestinal, respiratory, nervous, genital systems with any two examples for each.
3. Tour report of the visit to Food Preservation/Food Fermentation industries and Dairy.
5. Identification of Lymphoid organs of Rat/Mouse.
M.Sc. ZOOLOGY

SEMESTER - I

ELECTIVE – I – NUTRITION AND DIETETICS

UNIT I

Introduction – Food as a sources of Nutrition - Food intake and its regulations - Food is more than nutrients - population and food production. Food and Future.

UNIT II


UNIT III


UNIT IV


UNIT V

Therapeutic diets – Modifications and objectives based on causative factors – Diseases of the heart and circulatory systems – Atherosclerosis, coronary heart disease, congestive heart failure, hypertension, different – sodium restricted diets.

REFERENCE


M.Sc. ZOOLOGY
SEMESTER - II
CORE – V – BIOSTATISTICS, COMPUTER APPLICATION AND RESEARCH METHODOLOGY

BIOSTATISTICS

UNIT I


UNIT II


Computer Application

UNIT III


UNIT IV

Computer Software : Programming, Languages (BASIC, COBOL, FORTRAN and C only – Basic concept). Data processing and Database Management – Internet – E-Mail – Computer applications in Science and Technology.

Research Methodology

UNIT V

M.Sc. ZOOLOGY

**TEXT BOOK :**

1. Basotia G.R. and Sharma. K.K., Research Methodology,
3. Chaudhary, C.H. Research Methodology- RBSA Publication,
UNIT I

Structure of atoms, molecules and chemical bonds. Stabilizing interactions: Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction.

Classification, Composition, structure and function of biomolecules: carbohydrates, lipids, amino acids, proteins, nucleic acids and vitamins.

UNIT II

Principles of biophysical chemistry: pH, buffer, reaction kinetics, thermodynamics, colligative properties.

Metabolism of Carbohydrates: Glycolysis, TCA Cycle, Electron transport cycle, HMP Shunt, Glycogenesis, Glycogenolysis and Gluconeogenesis.

UNIT III


UNIT IV


UNIT V

M.Sc. ZOOLOGY

TEXT BOOK:


REFERENCES:


M.Sc. ZOOLOGY
SEMESTER - II
CORE – VII – ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

UNIT I
Habitat Ecology and Niche: Lake, Marine – Rocky, Muddy and Sandy shore, Estuary, Terrestrial, Grassland, Forest and Desert ecosystem. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

UNIT II
Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

UNIT III
Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Ecological succession: Types; mechanisms; changes involved in succession; concept of climax. Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

UNIT IV
Applied Ecology: Environmental pollution - Air, Water, Land, Thermal, Radiation and Noise; global environmental change; Biodiversity - status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.
Conservation Biology: Indian case studies on Conservation / management strategy (Project Tiger, Biosphere reserves)
Remote sensing and GIS: Methods and Applications in environmental management

UNIT V
Toxicology: Environmental Toxicants and their accumulation, biotransformation and biomagnification in ecosystem, Evaluation of Toxic residues, Toxicity – Factors affecting toxicity, Bioassay - concept of LC 50 and LD 50. Xenobiotics, Teratogens, Safety evaluation of toxicants.
M.Sc. ZOOLOGY

TEXT BOOK:


REFERENCES:


M.Sc. ZOOLOGY  
SEMESTER - II  
CORE PRACTICAL – II  
BIOSTATISTICS AND COMPUTER APPLICATIONS, BIOCHEMISTRY, BIOPHYSICS,  
ENVIRONMENTAL BIOLOGY AND TOXICOLOGY  

Subject Code:  17PZOP02  

I. Biostatistics  

Problems related to  

1. Mean  
2. Standard Deviation  
3. Students 't’ test  
4. Chi – square test  

II. Computer applications  

Demonstration: computers accessories and their usages.  

1. CPU  
2. Monitor  
3. Key board  
4. Mouse  

MS Word: Typing, Editing and formatting a document (Demonstration only).  

MS Excel: Drawing Bar diagram, Histogram, Line diagram and Pie – Chart (Demonstration only).  

III. Biochemistry  

1. Qualitative detection of proteins, carbohydrates and lipids in tissue samples  
2. Quantitative estimation of total proteins, carbohydrates (glycogen) in tissue samples (Demo only).  
4. Demonstration of amino acids in body fluid of Cockroach or grasshopper using paper chromatography.
M.Sc. ZOOLOGY

IV. BioPhysics

Phase – contrast microscope, Spectrophotometer, pH meter, Agrose – gel electrophoresis.

V. Environmental Biology & Toxicology

1. Identification of Zoo planktons (fresh water/marine)(Any five).


4. Report on ecological collection representing different habitats – Sandy, Muddy and Rocky shores (Study tour/ Field trip may be arranged, report should be submitted).


VI. Record submission
UNIT I
Types of parasites, types of hosts, inter relationship between host and parasite. Responses and hosts to parasitic infection, mode of transmission of parasite, host specificity and parasitic adaptation.

UNIT II

UNIT III
Vectors - definition, types of vector. Arthropod vector of medical and veterinary importance – sand flies, mosquitoes, horse flies and Rat flea, ticks, mites and vector control.

UNIT – IV
Study of parasites from Protozoa & Cestoda
1. Trypanosoma of humans.
2. Intestinal flagellates Giardia.

UNIT V

REFERENCE BOOKS:
UNIT I
Introduction – Importance of Inland fisheries principles and aim of fish culture 
Qualities of culturable fishes. Types of fish culture – mono culture – composite culture 
– paddy cum fish culture.

UNIT II
Fresh water Prawn culture – Preparation of farm – Reproduction – Seed collection and 
methods of prawn fishing.

UNIT III
Construction and maintenance of fish farm – types of fish ponds – management of fish 
culture – breeding – types of breeding – Natural and Induced.

UNIT IV
Harvesting – methods of fishing – electric fishing. Transportation and marketing – 
structure of a fish market. Marketing system – Co-operative system – National Co- 
operative Development Corporation capital market.(NCDC).

UNIT V
Processing and Preservation – Fish spoilage – processing – Fish – Rigor mortis – 
spoilage. Principle and process of preservation – Methods of preservation. By 
products of fishing industries.
TEXT BOOK:

REFERENCE BOOKS:
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TEXT BOOK:
Reference
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
M.Sc. ZOOLOGY

TEXT BOOKS:
1. Veer Bala Rastogi, Developmental Biology, Kedarnath Ramnath publishers, Meerut.

REFERENCE BOOKS:
M.Sc. ZOOLOGY
SEMESTER - III

CORE IX – BASIC CONCEPTS OF BIOTECHNOLOGY

Subject Code: 17PZO09

UNIT I
Tools and techniques of Genetic Engineering: Basic Principles of Genetic Engineering; Restriction enzymes, Linkers/Adaptors; Cloning Vectors – Salient Features and Types – Plasmids, Phages, Cosmids, Transposons, Shuttle and Expression Vectors; Techniques – Strategies of rDNA Technology, Gene Library, Insertion of a Foreign DNA into a Vector, Transfer of rDNA into a Bacterial Cell, Selection & Screening of Recombinants, Blotting Techniques.

UNIT II

UNIT III
Animal biotechnology: Cultivation of Animal Cells in a Bioreactor; Somatic Cell Fusion, Applications of Cell Culture – tPA Blood Factor VIII and Erythropoietin; Organ Culture; Transgenic Animals – Transgenic Goat.

UNIT IV
Enzyme Biotechnology: Microbial Production of Enzymes, Immobilisation of Enzymes and its applications.
Agricultural Biotechnology: Agrobacterium as a natural genetic engineer; Single Cell Protein, Nitrogen fixation – nitrogen fixing organisms, mechanism and genetics of fixation; Bio-pesticides; Biofertilizers.

UNIT V

TEXT BOOK

REFERENCES:
UNIT I
Cardiovascular System: Structure of myogenic heart, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure – neural and chemical regulation.

UNIT II
Digestive systems (Human): Digestion, absorption, energy balance, BMR.
Excretory system (Human): Anatomy of excretory system, Physiology of urine formation, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance, Dialysis.

UNIT III
Nervous system (Human): Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
Sense organs (Human): Vision, hearing and tactile response.
Thermoregulation: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

UNIT IV
Muscles: Structure and mechanism of Skeletal Muscle Contraction – physiochemical changes taking place during muscle contraction.

UNIT V
TEXT BOOK


REFERENCE BOOKS:


M.Sc. ZOOLOGY
SEMESTER - III
CORE – XI – OPTIONAL SUBJECT – I
GENERAL AND APPLIED ENTOMOLOGY

UNIT I Classification
Classification of Insects up to order: Basis of classification – Classification of important pests up to order level (any five), Key characteristics with South Indian Examples.
External anatomy of a typical Insect – Exoskeleton, Head, Thorax and Abdomen. Mouth parts of Insects.

UNIT II Physiology of Insects
Digestive system, Excretory system, Respiratory system, Circulatory system, Nervous system, Sense organs, Reproductive system, Endocrine system and Pheromones.

UNIT III
Medical Entomology
Vectors: Mosquito and House fly - Vectors borne diseases and their control.

Agricultural Entomology
Insect Pest of Crops and their control measures: Paddy, Groundnut, Coconut, Cotton, Sugarcane, Brinjal, Lady’s finger, Pests of Stored grains. Pest Control: Prophylactic, Mechanical, Chemical and Biological Control measures.

UNIT IV Chemical Control & IPM
Insecticidal formulations, Classification of the insecticide, Mode of action of insecticides, Drawback of chemical control.
Biological control, autocidal control, Integrated Pest Management (IPM), Nano – insecticide control

UNIT V Methods of Pest Management
Non conventional methods: Plant products – Chemosterilants – Anti feedants – Pheromones – Insect repellants – Attractants.

TEXT BOOKS
4. D.B Tembhare, Modern Entomology, Himalaya Publishing House
M.Sc. ZOOLOGY
SEMESTER - III
CORE PRACTICAL - III
DEVELOPMENTAL BIOLOGY, BIOTECHNOLOGY, ANIMAL
PHYSIOLOGY AND
GENERAL AND APPLIED ENTOMOLOGY (OPTIONAL SUBJECT-I)

I. Developmental Biology
   2. Preparation of sperm suspension and observation of Spermatozoa in Bulls Semen. Study of rate of motility of sperm in Bulls Semen (Demonstration Only).
   5. Study of different types of placentas.

II. Biotechnology
   Spotters: Single Cell Protein, Bio – reactor, Plasmid pBR322 and PCR.

III. Animal physiology
   1. Qualitative study of digestive enzymes in Cockroach.
   2. Determination of rate of salt loss and salt gain in Fish / Crab using different experimental media.
   3. Determination of RQ in an aquatic animal in relation to light (Fish/ Crab).
   4. Qualitative analysis of excretory products.
   5. Principles and application of sphygmomanometer and kymograph.
   6. Kymographic recordings of simple muscle twitch, summation, treppe and tetanus.

IV. Entomology
   1. Preparation of key for the identification of Insects
   2. Collection, preservation and mounting of important pests of paddy, sugar cane, cotton, ladies finger, ground nut and stored products to understand the life history of insects in relation to the life history of plants
   3. Mouth parts of insects (Mosquito, Honey bee and House fly).
   4. Field study to understand the various methods of pest management: Pesticide formulation, Pesticide application, Safety measures, Hazardous and first aid.
   5. Insect box submission.

V. Record submission.
M.Sc. ZOOLOGY

SEMESTER - III

ELECTIVE – III – ENDOCRINOLOGY

UNIT I Introduction to Endocrinology

UNIT II Pituitary and Parathyroid Gland

UNIT III Pancreas and Adrenal Gland

UNIT IV Insects and Crustacean Endocrinology

UNIT V Reproductive Endocrinology
Structure of Mammalian Testis and Ovary – Hormones of Testis and Ovary and Menstrual Cycle – Hormones of Pregnancy – Parturition – Hormonal Control of Lactation.

REFERENCE BOOKS:
UNIT I Theories of Evolution


UNIT II Variations


UNIT III Speciation


UNIT IV Molecular Evolution


UNIT V

Evolution of Man, Origin of Man, Special features of primates, Compelling causes of evolution of Man, Evolutionary trends, Cultural evolution, Civilization, human races, future of man.

TEXTBOOKS
1. Arumugam, Evolution, Saras Publication

REFERENCE BOOKS
UNIT I Instrumentation

The Laboratory: Accidents – Universal work precautions (UWP) for laboratory personnel.


UNIT II  Haematological Techniques


UNIT III

Haematocrit – packed cell volume, MCH, MCHC, MCV, Erythrocyte sedimentation rate, platelet count. Haemorrhagic disorders, clotting time, bleeding time.

UNIT IV  Clinical Analysis

Knowledge and skill in the study and analysis of Urine – Physical parameter – Colour, Odour, pH, Density. Chemical parameters – Sugar, Albumin, Ketone bodies and their clinical significances Pregnancy tests.

UNIT V Clinical Studies

Analysis of faeces, semen, cerebrospinal fluid for clinical investigation. Techniques – RIA, ELISA, WESTERN BLOT and WIDAL TEST.

TEXT BOOK:


M.Sc. ZOOLOGY
SEMESTER - IV
CORE XIV - OPTIONAL SUBJECT – II – SERICULTURE

UNIT I General Aspects of Silkworms

Types of Silkworms – Mulberry, tasar, muga, eri – Morphology and life cycle of silkworms – Races of mulberry silkworms – Voltinism.

UNIT II Mulberry Cultivation


UNIT III Silkworm Rearing


UNIT IV Grainage Techniques


UNIT V Silk Reeling


TEXT BOOKS

M.Sc. ZOOLOGY

SEMESTER - IV

CORE – PRACTICAL – IV

(OPTIONAL SUBJECT - II)

EVOLUTION, MEDICAL LABORATORY TECHNIQUES, SERICULTURE AND MICRO TECHNIQUE

I. Evolution

Study of Fossils (Ammonoids, Nautiloids & Echinoderm fossils).

II. Medical Laboratory Techniques

1. Genetic and Immunological basis of human blood grouping (A, B, AB, O and Rh).
2. Estimation of Haemoglobin (Hb) and Erythrocyte Sedimentation Rate (ESR).
4. Qualitative analysis of urine for proteins, glucose, acetone and ketone bodies.

III. Optional subject – II – Sericulture

1. Identification of common mulberry varieties and their features.
2. Identification of pests and diseases of mulberry.
3. Suitable mulberry leaves for young age silkworm rearing.
4. Identification of various types of silkworms and silk moths and their external morphology.
8. Visit of silk farms and silk reeling weaving units in nearby areas and submission of tour report

IV. Micro technique

1. Spreading of serial sections.
2. Preparation of permanent mount of serial sections.
3. Comment on the Staining procedure for prepared slides.
4. Spotters: Microtome

V. Submission of Record.
M.Sc. ZOOLOGY
SEMESTER - IV
ELECTIVE – IV – ECONOMIC ZOOLOGY

UNIT I Vermiculture
Introduction to Vermiculture. Types of earthworm, Biology of Eisenia foetida. Rearing of earthworms, Equipments, devices used in vermiculture, Vermicompost Technology – Methods and products, Vermiwash Collection, Composition & use.

UNIT II Apiculture

UNIT III Prawn culture

UNIT IV Fish culture

UNIT V Poultry Management

REFERENCE BOOKS
## EXAMINATION
### THEORY

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### CLASSIFICATION OF INTERNAL ASSESSMENT STRUCTURE MARKS

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Passing minimum (IA) – 50% - 12 Marks
Passing minimum (UE) – 50% - 38 Marks
**Total Passing minimum** - 50 Marks

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## PRACTICAL

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### CLASSIFICATION OF INTERNAL ASSESSMENT STRUCTURE MARKS

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Passing minimum (IA) – 50% - 20 Marks
Passing minimum (UE) – 50% - 30 Marks
**Total Passing minimum** - 50 Marks
QUESTION PAPER PATTERN

(For the candidates admitted from 2017 - 2018 onwards)

M.Sc, DEGREE EXAMINATION

BRANCH II - STATISTICS

First Semester

Core IV - SAMPLING THEORY

Time : Three hours

Maximum: 75 marks

PART A - (5 x 5 = 25 marks)

Answer ALL questions.

All questions carry equal marks.

PART B - (5 x 10 = 50 marks)

Answer ALL questions.

All questions carry equal marks.
MODEL QUESTION PAPER

M.Sc, DEGREE EXAMINATION
BRANCH II - STATISTICS
First Semester
Core IV - SAMPLING THEORY

Time: Three hours  Maximum: 75 marks

PART A - (5 x 5 = 25 marks)
Answer ALL questions.
All questions carry equal marks.

1. (a) Mention the important steps involved in drafting a questionnaire. (Or)
(b) What is meant by non-response? Write down its types.

2. (a) In SRSWOR, show that the sample mean square is an unbiased estimate of the population mean square (Or)
(b) Explain circular systematic sampling.

3. (a) Explain separate and combined regression estimators. (Or)
(b) Define multivariate ratio estimator.

4. (a) Explain Lahiri’s method of selecting sample under PPSWR scheme. (Or)
(b) Derive Horwitz-Thompson estimator for population total.

5. (a) Describe the sub sampling procedure. (Or)
(b) In double sampling for stratification, show that the sample mean is an unbiased estimate of the population mean

PART B - (5 x 10 = 50 marks)
Answer ALL questions.
All questions carry equal marks.

6. (a) Explain the principal steps involved in sample survey? (Or)
(b) Derive Warner’s model in randomized response technique.

7. (a) If f.p.c is ignored, then show that
\[ V_{prop} < V_{rand} < V_{opt} \] (Or)
(b) Compare systematic sampling with stratified and simple random sampling when the population consists of linear trend.

8. (a) Define ratio estimator. Derive the variance of the ratio estimator and also obtain its relative bias. (Or)
(b) Obtain an unbiased estimate of population mean and its variance in cluster sampling.

9. (a) Define Desraj’s ordered estimator. Also derive the expression for the variance of the estimate of the population total. (Or)
(b) In the case of pps sampling with replacement, obtain an unbiased estimator of the population total and variance of the estimator.

10. (a) Suggest an estimator for population mean in two stage sampling and obtain its variance. (Or)
(b) Discuss double sampling for stratification and derive the standard error of estimate.