SYLLABUS FOR 2014-15

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR M. Sc. ZOOLOGY				
FIRST SEMESTER **July - Dec. 2012**	Paper No. *	Title of Paper	Marks	
			(External)	(Internal) **
	I	Biosystematics and Taxonomy	**80**	**20**
	II	Structure and Function of Invertebrates	**80**	**20**
	III	Population Genetics and Evolution	**80**	**20**
	IV	Tools & Techniques in Biology	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**
SECOND SEMESTER **Jan - June 2013**	Paper No.	Title of Paper	Marks	
			(External)	(Internal)
	I	Molecular Cell Biology	**80**	**20**
	II	General & Comparative Endocrinology	**80**	**20**
	III	Gametic Biology and Embryology	**80**	**20**
	IV	Environmental Physiology and Ecology	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**
THIRD SEMESTER **July - Dec. 2013**	Paper No.	Title of Paper	Marks	
			(External)	(Internal)
	I	Comparative Anatomy of Vertebrates	**80**	**20**
	II	Animal Behaviour	**80**	**20**
	III	Population Ecology	**80**	**20**
	IV	Reproductive Physiology & Immunology	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	LC-II	Lab Course II (Based on paper III & IV)	**80**	**20**
FOURTH SEMESTER **Elective Jan- June 2014**	**Elective A: Fish & Fisheries and Aquaculture**		Marks	
			(External)	(Internal)
	I	Fish & Fisheries (Limnology)	**80**	**20**
	II	Fish & Fisheries (Ichthyology)	**80**	**20**
	III	Fish & Fisheries (Capture Fisheries)	**80**	**20**
	IV	Fish & Fisheries (Aquaculture & Capture Fisheries)	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	Elective B: Insect Biology & Physiology			
	I	Characteristics, Classification and Types	**80**	**20**
	II	Gross Morphology of Insects	**80**	**20**
	III	Insect Physiology	**80**	**20**
	IV	Behavior and Economic Importance	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	LC-II	Lab Course I (Based on paper I & II)	**80**	**20**
	Elective C: Neurophysiology and Molecular Endocrinology			
	I	Biochemistry	**80**	**20**
	II	Neurophysiology	**80**	**20**
	III	Molecular Endocrinology	**80**	**20**

	IV	Biology of Nucleic acid	**80**	**20**
	LC-I	Lab Course I (Based on paper I & II)	**80**	**20**
	LC-II	Lab Course I (Based on paper I & II)	**80**	**20**

*Each theory paper will have 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise.
**The respective teachers on each paper will ensure the internal evaluation by a class test and a seminar/ poster presentation of 10 marks each and submit the foil and counter foil to the HoD by the end the activity.

M. Sc. ZOOLOGY FIRST SEMESTER

PAPER – I: BIOSYSTEMATICS & TAXONOMY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Historical resume of systematics
2. Importance and application of biosystematics in biology
3. Contribution of systematic as a profession

UNIT- II

1. Species concept, subspecies and other categories
2. Origin of species and speciation methods
3. Polytypic species
4. Population taxonomy

UNIT- III

1. Theories of biological classification
    - Essentialism
    - Nominalism
    - Empiricism
    - Cladism
    - Evolutionary classification
2. Cytotaxonomy, Chemotaxonomy, Molecular taxonomy
3. Taxonomic procedures (collection, preservation, identification, procedure of classification and graphical representation)

UNIT- IV

1. Central tendency, sampling and the function of statistics
2. Random sampling and analysis
3. Test of hypothesis and common tests
4. Statistical v/s biological significance (correlation, regression, non parametric tests, probability theory)

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

1. **Biosystematics & Taxonomy**
   Dr.R.C.Tripathi, University Book House JAIPUR.

2. **Theory & Practice of Animal Taxonomy**
   V.C. Kapoor, 5th Edition Oxford & IBH Publishing Co.
3. **Principle of Animal Taxonomy**
   G.G. Simpson, Oxford & IBH Publishing Co.
4. **Elements of axonomy**
   Earnst Mayer
5. **Biodiversity**
   E.O. Vilson, Acadmic Press Washington
6. **The Biology of Biodiversity**
   M. Kato, Springer
7. **Molecular Markers - Natural History & Evolution**
   J.C. Avise

M. Sc. ZOOLOGY FIRST SEMESTER

PAPER-II: STRUCTURE & FUNCTION OF INVERTEBRATES

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Organization of coelome, acoelomate, pseudocoel, schizocoel and Enterocoel
2. Pseudopodial, Flagella and Cilliary movement in protozoa
3. Hydrostatic movement in Coelentereta, Annelida and Echinodermata

UNIT- II

1. Patterns of feeding and digestion in invertebrates
2. Organs of respiration (gills, lungs and trachea), Mechanism of respiration
3. Circulatory system in invertebrates (close and open)
4. Respiratory pigments

UNIT- III

1. Organs of excretion (coelome, coelomoducts, nephridia and malpigian tubules)
2. Mechanism of excretion and osmoregulation
3. Nervous system and trends is neural evolution
4. Larval forms of invertebrates and their phylogenetic significance

UNIT- IV

1. Concept and significance of minor phyla
2. Organization and general characters of
   a. Nemartina
   b. Rotifera
   c. Ectoprocta
   d. Endoprocta

SUGGESTED READING MATERIALS (ALL LATEST EDITION)

1. **Invertebrate Structure and function:-**
   E.J.W. Barrigton English language Book society UK.
2. **Invertebrate Zoology:**
   Robert Barnes IVth Edition Holt Saunders International Edition Japan.
3. **The Cambrige Natural History Vol 1 - 9.**

S F Harmer, A.E. Shipley.
Todays & Tomorrows Book agency, N Delhi India.

4. **A Text book of Zoology Invertebrate:**
   Parker Hasvell, Marshall & Williams.
   AITBS Publishing & Distributers, Delhi
5. **The Invertebrates Vol. 1 - 9**
   Libbic Henrietta Hyman, McGraw Hill Book Company

M. Sc. ZOOLOGY FIRST SEMESTER

PAPER-III: POPULATION GENETICS & EVOLUTION

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Concepts and theories of organic evolution
2. Neo-Darwinism
   (a) Hardy- Weinberg law of genetic equilibrium
   (b) Natural selection, mutation, genetic drift, migration and meiotic drive

UNIT- II

1. Genetic and phenotypic variation
2. Pattern of changes in nucleotide and amino acid sequence
3. Genetic composition and natural selection
4. Genetic variation at molecular level

UNIT- III

1. Isolation and speciation (Models)
2. Gene evolution
3. Major trends in higher categories
4. Micro and macro evolution

UNIT- IV

1. Origin and evolution of economically important microbes and animals
2. Phylogenetic tree construction
3. Phylogeny of Horse
4. Phylogeny of Man

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

1. **Gene & Evolution**
   Jha A.P. John Publication, New Delhi
2. **Evolution & Genetics**
   Merrel D.J. Holt rinchert & Wiston INC.
3. **The Genetics & Origin of Species**
   Dobzhansky, Columbia University Press.

4. **Evolution**
Dobzhansky, Ayala F.J., Stebbins G.L. & Valentine J.M.
Surjeet Publication New Delhi.
5. **Species Evolution - The Role of Chromosomal Change**
King M. Cambridge University Press.Cambridge
6. **A Primer of Population Genetics**
Hartl D.L. Suinaer Associates INC, Massachusetts
7. **Evolutionary Genetics**
Smith J.M. Oxford University Press, NewYork
8. **Evolutionary Biology**
Futuyama D.J. Suinaer Associates INC publishers, Dunderland
9. **Evolution**
Strikberger M.W. Johns & Bartett Publishers, Boston London

M. Sc. ZOOLOGY FIRST SEMESTER

PAPER-IV: TOOLS & TECHNIQUES IN BIOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Biological and Chemical assay studies
2. Principles and uses of the following:
   (a) Balances (b) pH meter (c) Colorimeter
   (d) Spectrophotometer (e) Ultracentrifuge (f) Densitometry
   (g) Spectroflurometer (h) ESR spectrometer (i) NMR spectrometer

UNIT- II

1. Microscopy principles of light transmission and functioning of :
   (a) Light microscope (b) Electron microscope
   (c) Phase contrast microscope (d) Fluorescence microscope
2. Microbiological techniques
3. Molecular separation by chromatography and electrophoresis

UNIT- III

1. Surgical techniques (organ ablation, perfusion, catheters, sterotaxy, parabiosis)
2. Cell separation by flow cytometery, density gradient centrifugation, affinity, adsorption

UNIT- IV

1. Autoradiography
2. Radioisotopes techniques- Radioactive decay, sample preparation for radioactive counting, Radioactive counters biosensors) Magnetic resonance Imaging (MRI),
3. Immunological techniques

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Introduction to Instrumental Analysis**
  - **Robert Braun,** McGraw Hill International Edition
- **A biologist guide to principles and techniques of practical biochemistry**
  - **K Wilson and K. H. Goulding** ELBs Edition
- **Instrumentation**
  - **Upadhyay and Nath,** Meerut Publications
- **Instrumentation and Techniques**
  - **R.C. Bajpayee,** Himalayan Publications

M. Sc. ZOOLOGY FIRST SEMESTER

LAB COUSE-I: (PRACTICAL BASED ON PAPER I & II)

1. Study of Invertebrates through museum specimens
2. Study of permanent slides of Invertebrates
3. Dissections of Invertebrates
4. Permanent slide preparation and its identification

EXAMINATION SCHEME	
Major Dissection	20 marks
Minor Dissection	10 marks
Spotting	20 marks
Slide preparation	15 marks
Viva	15 marks
Sessional (Internal)	20 mark
Total	**100**

M. Sc. ZOOLOGY FIRST SEMESTER
LAB COUSE-II: (PRACTICAL BASED ON PAPER III & IV)

1. Uses of following equipments for different techniques
   (a) pH meter (determination of pH of different soil and water samples)
   (b) Colorimeter (estimation of lambda max, demonstration of Beer's law)
   (c) Chromatography (paper and thin layer)
   (d) Centrifuge (extraction of amino acid, protein and carbohydrates)
   (e) Microscope (study of different parts and types of microscopes)

2. Practical based on population (estimation and genetics)

3. Exercise based on evolution
4. Viva
5. Sessional

EXAMINATION SCHEME	
Tools and Techniques	40 marks
Population Ecology	15 marks
Spots based on Evolution	10 marks
Viva	15 marks
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SECOND SEMESTER

PAPER – I: MOLECULAR CELL BIOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Molecular composition of cell membrane and transport across
2. Function of cell membrane
3. Microfilaments and microtubules- structure and dynamics
4. Cell movement- intracellular, role of kinesin and dyenin, signal transduction mechanism

UNIT- II

1. Cell surface receptor
2. Second messenger system
3. Ca++ dependent cell adhesion
4. Tight junctions, desmosomes, adhesion plaque gap junction and cell interaction

UNIT- III

1. Cell cycle
2. Eukaryotic Chromosome
3. Chromosomal organization of genes
4. Mobile DNA, PCR techniques, Genomic library, Blotting techniques, DNA foot printing

UNIT- IV

1. Protein synthesis
2. Regulation of protein synthesis
3. Auxin and cell expansion
4. Cellulose fibril synthesis and orientation

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **MOLECULAR CELL BIOLOGY**
  Lodish, W.H. Freeman & Co. NewYork
- **Lehninger PRINCIPLES OF BIOCHEMISTRY,**
  Fourth Edition - David L [1]. Nelson, Michael M. Cox
- **MOLECULAR CELL BIOLOGY**
  Lodish M. Baltimore, Scientific American books
- **ESSENTIALS OF CELL & MOLECULAR BIOLOGY**
  Roberties & Roberties, Halt Saunders International Edition.
- **CELL & MOLECULAR CELL BIOLOGY**
  Gerald Karp, Willey & Sons Co.
- **MEDICAL CELL BIOLOGY**
  Flickinger E.J. Brown J.C. Halt Saunders International Edition.
- **CELL BIOLOGY**
  Powar C.B. Himalaya Publishing House

M. Sc. ZOOLOGY SEMESTER - II

PAPER – II: GENERAL AND COMPARATIVE ENDOCRINOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Aims and scopes of endocrinology
2. Neuroendocrine system and neurosecretion
3. Endocrine glands, their structure and function (pituitary, thyroid, parathyroid, adrenal, pancreas, endocrine cells of gut, placenta and gonads)

UNIT- II

1. Classification of hormones
2. Chemical structure and biosynthesis of hormones (peptide, steroid and amino acid derived hormones)
3. Metabolism of hormones (thyroid, steroid and peptide hormone)

UNIT- III

1. Mechanism of hormone action
2. Hormonal regulation of protein, lipid and carbohydrate metabolism
3. Hormones and homeostasis

UNIT- IV

1. Growth, moulting and metamorphosis in insects
2. Hormones and behavior
3. Hormones and reproduction (behavior, menstrual and estrous cycle)
4. Meditation, Yoga and their effect

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- Comparative vertebrate Endocrinology – by **Gorbman & Bern**
- Human Physiology – by **Dr. C. C. Chattergee**
- Comparative Endocrinology – by **Barrington**
- Applied Animal Endocrinology – by **Squires**
- **Endocrinology –** Basic & Clinical principles - by **Melmed & Cohn**

M. Sc. ZOOLOGY SEMESTER - II

PAPER – III: GAMETIC BIOLOGY AND EMBRYOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

1. Heterogamy in eukaryotes
2. Gonadal differentiation in mammals and in invertebrates
3. Spermatogenesis in rodents and in invertebrates
4. Genetic specific gene expression and genome

UNIT- II

1. Oogenesis and Vitellogenesis (follicular growth differentiation, molecular and endocrinal aspects)
2. Fertilization (pre and post fertilization events and biochemistry of fertilization)
3. Mammalian development
4. Multiple ovulation and embryo transfer technologies (MOFT), IVF (in vitro fertilization) collection and cryopreservation of gametes and embryos

UNIT- III

1. Biology of sex determination and sex differentiation
2. Transgenic animals and knock outs (production, applications, stem cells)
3. Assisted reproduction technologies (cloning, ICSI, GIFT)
4. Application of molecular genetics for livestock improvements

UNIT- IV

1. Teratological effects of xenobiotics
2. Immunocontraception
3. Other contraceptive methods

SUGGESTED READINGS MATERIALS

- **Animal Gametes** –
  Vishmanath, Asia Publishing House
- **Foundation Of Embrology** –
  Bradley M.Patten, McGrow Publication
- **Fertilization In Animals** –

Brain Dale, Arlond Heiniman, Gulab Vazerani Publication

- **Development Biology** -
  N.J. Berril, Tata McGraw Hill Publication N. Delhi
- **Embryology Of Vertebrates** -
  Nelson

M. Sc. ZOOLOGY SEMESTER - II

PAPER – IV: ENVIRONMENTAL PHYSIOLOGY AND ECOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Abiotic, biotic and limiting factors
2. Fresh water, marine and terrestrial habitats
3. Community ecology and ecological succession
4. Environmental pollution

UNIT - II

1. Levels of adaptation
2. Mechanism of adaptation
3. Origin of adaptive and non adaptive characters, convergent adaptation
4. Specific adaptation (diving, flight and autotomy)

UNIT - III

1. Aquatic adaptation(fresh water, marine deep sea and estuaries)
2. Terrestrial adaptation (cursorial, fossorial and desert)
3. Aerial adaptation
4. Parasitic adaptation

UNIT - IV

1. Basic concept of environmental stress and strain (stress resistance and tolerance, stress avoidance)
2. Mechanism of thermoregulation
3. Mechanism of thermoregulation
4. Mechanism of osmoregulation
5. Physiological response deficient stress, body exercise

SUGGESTED READING MATERIALS

- **ANIMAL PHYSIOLOGY, MECHANISM AND ADAPTATION -**
  Eckert, R., W,H, Freeman and Co.
- **BIOCHEMICAL ADAPTATION -**
  Hochachka, P.W, and Somero S.N, Princeton, New Jersey
- **ANIMAL PHYSIOLOGY: ADAPTATION AND ENVIRONMENT.-**
  Schiemidt Nielsen, Cambridge
- **GENERAL & COMPARATIVE ANIMAL PHYSIOLOGY**
  Hoar W.S. Princeton Hall of India
- **ENVIRONMENTAL PHYSIOLOGY**

Willmer, P.G. Stone & Johansan I, Blackwell Science Oxford

M. Sc. ZOOLOGY SEMESTER – II
LAB COURSE – I: (PRACTICAL BASED ON PAPER I & II)

1. Study of permanent slides of various endocrine glands
2. Histological slides preparation of various endocrine glands (through microtomy)
3. Dissection of animals to show endocrine glands (insect and vertebrates)
4. Study of various stages of meiosis and mitosis through squash preparation
5. To prepare slides of lampbrush chromosome and polytene chromosome
6. Study of karotype of *Allium seppa* and *Vicia faba*
7. Observation of the presence of absence of barr bodies in nuclei
8. Histochemical preparation of protein, carbohydrate and lipid
9. Isolation of DNA
10. Biochemical estimation of DNA & RNA

EXAMINATION SCHEME	
Exercise based on molecular cell biology	20 marks
Exercise on endocrinology	
a) Dissection and spots	15 + 10 marks
b) Microtomy	20 mark
Viva	15 marks
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – II
LAB COURSE-II: (PRACTICAL BASED ON PAPER III & IV)

1. Study of histological slides of gonads
2. Dissection and display of reproductive organs (vertebrates and invertebrates)
3. Histological preparation of gonads (microtomy)
4. Preparation of permanent mount of gametes
5. Study of embryological slides of frog, reptile and chick
6. Determination of dissolved O_2, chlorine, CO_2, hardness of H_2O, pH, BOD & COD
7. Study of the toxicity of a given chemical
8. Determination of biomass in soil sample
9. Oxygen consumption of aquatic animals under stress

EXAMINATION SCHEME	
Exercise based on gametic biology (dissection/ microtomy/ spot- 1- 5)	15 + 15 + 10 mark
Exercise on Environmental Physiology and ecology	15+10 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER - III

PAPER-I: COMPARATIVE ANATOMY OF VERTEBRATES

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Origin of chordates
2. Geology and ecology during origin of vertebrates
3. Diversity and evolution of vertebrates
4. Classification of amphibian, reptilia, aves and mammals

UNIT - II

1. Comparative account of the structure of skin in vertebrates
2. Hard and soft derivatives of skin
3. General plan of circulation in vertebrates
    (a) structure and evolution of heart
    (b) evolution of aortic arches and portal system
    (c) structure and function of blood

UNIT - III

1. Respiratory surfaces of vertebrates
2. Mechanism of breathing in vertebrates
3. A comparative account of limb and girdles of vertebrates
4. Vertebrates kidney and their duct (archinephros, pro-, meso- and metanephrous, nephron in adults of vertebrates)

UNIT - IV

1. Special somatic receptors (Neuromast organs, membraneous labyrinth, light receptors, olfactory receptor, Jacobson organs)
2. Comparative anatomy of brain in relation to its function
3. Comparative anatomy of spinal cord
4. Nerves- cranial, peripheral and autonomous nervous system

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **Vertebrate life** :– William N. Ferland, F. Harvey pough, Tom J Gode, John B. Heiser
- Collier MacNillem International edition
- **Chordate morphology** :–Malcom Jollie
- Reinhold Publishing Corporation NewYork

- **Chordate –Structure & Function** :- Arnold G. Khage, B.E. Fry Johanson
- Mc Millan Publishing Co. INC. NewYork
- **Comparative Animal Physiology** :- Orosser
- Satish Book Enterprises, Agra
- **The Vertebrate Body** :- Alfred Sherwood Romer
- Vakils, Feffer & Simons Publications Ltd.

M. Sc. ZOOLOGY SEMESTER – III

PAPER-II: ANIMAL BEHAVIOUR

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Introduction, branches, history
2. Classification of behavior patterns
3. Ethogram-analysis of behavior
4. Innate behavior
5. Biological rhythm

UNIT - II

1. Communication (chemical, visual, light, audio, evolution of language in primates and honey bee)
2. Learning and memory (conditioning, habituation, insight learning, neural mechanism of learning)
3. Reproductive behaviour

UNIT - III

1. Structure and function of mammalian brain
2. Neural control of behavior, RAS or RF
3. Genetic component in the development of behavior
4. Environmental components in the development of behavior

UNIT - IV

1. Social behavior (insect, primates, fishes, birds, altruism)
2. Ecological aspects of behavior (feeding, aggression, homing)
3. Bird migration and navigation
4. Fish migration

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **ANIMAL BEHAVIOR – Mc Farland** (English Language Book Society)
- **ANIMAL BEHAVIOR – Arora M.P.** (Himalaya Publishing House, Mumbai)
- **ANIMAL BEHAVIOR - Reena Mathur** (Rastogi Publications, Meerut)

M. Sc. ZOOLOGY SEMESTER – III

PAPER – III: POPULATION ECOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Demography, life table, reproductive rates, reproductive values
2. Population growth, exponential, non overlapping
3. Stochastic and time lag models of population growth
4. Population density
5. Population evolution

UNIT - II

1. Reproductive strategies (r and k selection) ageing
2. Population energetic
3. Competition and niche theory
4. Predation

UNIT - III

1. Mutualism (plant pollinator and animal-animal interaction)
2. Population regulation (extrinsic and intrinsic mechanism)
3. Distribution of organism (analyzing and influencing factors)

UNIT - IV

1. Case studies in population dynamics with reference to wild life or fishes
2. Ecological modeling

(a) construction of models
(b) testing the models

SUGGESTED READING MATERIALS - (ALL LATEST EDITION)

- **ECOLOGY** with special reference to animal & man
    - **S. Charles, Kendeigh** Prentice hall of India Pvt. Ltd. New Delhi
- **ELEMENTS OF TROPICAL ECOLOGY**
    - **Yanney Ewusie** (English language Book Society, Heine mann educational book publication)
- **FUNDAMENTALS OF ECOLOGY**
    - **Odum P.**

M. Sc. ZOOLOGY SEMESTER – III

PAPER – IV: REPRODUCTIVE PHYSIOLOGY AND IMMUNOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Biology of sex (genotype and phenotype sex, sex chromatin and sex ratio)
2. Reproductive behavior and regulation
3. Reproductive organs or invertebrates
4. Viviparity and polyembryony

UNIT - II

1. Pheromones and reproduction, sexual signals
2. Gonadal differentiation in invertebrates and vertebrates
3. Structure of female reproductive system of mammals
4. Follicular growth ovulation, formation of corpus luteum and alteration of ovarian function
5. Reproduction in male mammals (testes, androgens and hormonal control)

UNIT - III

1. Organization and structure of lymphoid organs
2. T-cell origin, maturation, activation and differentiation
3. Mechanism of cell- mediated immune response
4. T cell population, T-B cells interactions

UNIT - IV

1. B cell origin, activation, proliferation
2. Structure of antibodies, classes and sub classes
3. B cell receptors
4. Mechanism of humo Physiology and ecology ral immune response

SUGGESTED READING MATERIALS

- **Immunology**
  - **Kuby,** W.H. Froeman USA
- **Fundamental of Immunology**
  - **W. Paul,**
- **Essential Immunology**
  - **I.M. Roitt,** ELBs Edition
- **Immunology**
  - **Richard M. Hyde, Robert A. Patnode,** A Wiley Medical Publications
- **Reproductive Physiology**
  - **Gayton,**

M. Sc. ZOOLOGY SEMESTER – III

LAB COURSE-I: (PRACTICAL BASED ON PAPER I & II)

1. Study of museum specimens of chordate (from protochordate to mammal).
2. Study of histological slide (from protochordate to mammal).
3. Osteology of Fish, Amphibia, Aves, Reptile and Mammals, skull of dog, cattle, and man.

4. Dissection- cranial nerves of Scoliodon, Toad, Pigeon, Snake & neck nerves of rat
5. Permanent preparation of slides and its identification.
6. Study of insect behavior in response to various environmental stimuli
7. Study of various behaviour patterns in vertebrate

EXAMINATION SCHEME	
Dissection	15 mark
Slide preparation	10 mark
Spot (1-10)	20 mark
Expt. on insect and vertebrate behavior	20 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – III

LAB COURSE-II: (PRACTICAL BASED ON PAPER III & IV)

1. Identification of stages of oogenesis and spermatogenesis
2. Identification of developmental stages of gonads
3. Dissection to show reproductive organs of vertebrates
4. Dissection to show reproductive organs of invertebrates
5. Study based on reproductive organs of invertebrates
6. Identification of gametes
7. Surgical techniques such as castration, thyroidectomy to be done on rats and mice
8. Bioassay of androgens and pituitary gonadotropins
9. In vitro fertilization of eggs of fish and frog
10. Practical based on population ecology
11. Study of lymphoid organs
12. Demonstration of A-B (antigen-antibody interaction)

EXAMINATION SCHEME	
Population Ecology	25 mark
Reproductive Biology and Immunology	30 mark
Spot (1, 2, 5, 6, 11)	10 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE A: FISH AND FISHERIES AND AQUACULTURE

PAPER – I: LIMONOLOGY AND ECTOXICOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Physical characteristics of water
2. Chemical characteristics of water
3. Lotic ecosystem
4. Lentic ecosystem
5. Eutrophication

UNIT - II

1. Phyto and Zooplanktons of water
2. Scope and basic deviation of toxicology
3. Classification of toxicants
4. Toxic agents and mode of action
   (a) pesticide (b) metals (c) solvents (d) radiation (e) carcinogens

UNIT - III

1. Toxicological testing methods
2. Toxicity curves
3. Statistical concepts of toxicity
4. Toxicity of chemical mixture (dose effect response relationship)
5. Xenobiotics (absorption, distribution and excretion)

UNIT - IV

1. Biomagnification
2. Biotransformation
3. Giomonitorin
4. Environmental legislation
5. Chemical safety evaluation

SUGGESTED READING MATERIALS

- **Fundamentals of Limnology**
  - **Arvind Kumar,** APH Publishing, 2005
- **Limnology, Third Edition: Lake and River Ecosystems**
  - **Robert G. Wetzel**, Elsevier Academic Press, 2001
- **Freshwater Ecology, Second Edition: Concepts and Environmental Applications of Limnology (Aquatic Ecology)**
  - **Walter K. Dodds, Matt R Whiles**

ELECTIVE A: FISH & FISHERIES AND AQUACULTURE

PAPER – II: ICHTHYOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. General characteristics and classification of Pisces
2. Characteristics, phylogeny and affinities of Placoderms and Acanthodes
3. Characteristics, phylogeny and affinities of Chondrichthyes
4. Characteristics, phylogeny and affinities of Osteichthyes
5. Dipnoi and Crossopterygii

UNIT - II

1. Early and post embryonic development of an Indian carp
2. Integument (skin and derivatives)
3. Median and paired fins of fishes
4. General anatomy of fish
5. Swim bladder in fishes

UNIT - III

1. Coloration and adaptive significance
2. Osmoregulation and ionic balance
3. Structure and functional divisions of brain
4. Sense organs of fishes
5. Acoustic lateralis system

UNIT - IV

1. Endocrine glands
2. Luminous organs
3. Electric organs
4. Electro receptors
5. Structural modification in hill stream and deep sea fishes

SUGGESTED READING MATERIALS

- **An Introduction to Fishes**
    - **S. S. Khanna,**
- **Fish and Fisheries**
    - **R.P., Parihar**
- **Fisheries and Aquaculture**
    - **R.C. Gupta and P. K. Gupta**
- **Biology of Fishes**
    - **Jhingran**

ELECTIVE A: FISH AND FISHERIES AND AQUACULTURE

PAPER – III: CAPTURE FISHERIES

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Fish as food commodity (composition and nutritional value)
2. Systematic and bionomics of some fresh water fishes
3. Fishing gears and crafts
4. Unconventional fishing methods (electro fishing, light fishing, ecosounder and sonar).

UNIT - II

1. Marine fisheries of India (fishery, yield assessment, gear and crafts and conservation)
2. Estuarine fisheries of India (estuary, types and fishery)
3. Riverine fisheries (river system and fisheries)
4. Cold water fisheries (indigenous and exotic)
5. Fisheries of reservoir and ponds

UNIT - III

1. Ecology of aquatic ecosystem
   (a) Rivers and streams (b) Reservoirs (c) Lakes (d) Brackish water (e) Sea
   (f) Fish farm pond
2. Planktons and their economic use

UNIT - IV

1. Pollution of water bodies
2. Effect of pollutants on fish life
3. Control and abatement of pollution
4. Aquarium and aquarium fishes

SUGGESTED READING MATERIALS

- **Source book for the inland fishery resources of Africa**
  - **J.P. Vanden, Bossche, G.M. Bernacsek**
- **Capture based Aquaculture**
  - **F. Ottolenglin, F. Silvestri**
- **Gloom and doom The future of marine capture fisheries**
  - **S. M. Garcia and Grainger**
- **Technological trends in capture fisheries**
  - **J.W. Walde, Marsen 2001**

ELECTIVE A: FISH AND FISHERIES AND AQUACULTURE

PAPER – IV: AQUACULTURE AND CULTURE FISHERIES

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Aquaculture (aims, objectives, strategies adopted)
2. Physico-chemical and biological characteristics of fish ponds
3. Fish ponds (planning, construction, layout)
4. Maintenance and improvement of the fish farm
5. Control of weed fish and predators

UNIT - II

1. Principal cultivable fisheries
2. Fish seed (collection, identification and transportation)
3. Induced breeding in fishes
4. Composite fish culture

UNIT - III

1. Paddy field fish culture
2. Sewage fed fisheries
3. Larvicidal fishes (characteristics, propagation and introduction in water bodies)
4. Exotic fishes
5. Open water stocking and ranching

UNIT-IV

1. Harvesting the fishes (harvesting, sorting, preservation and processing)
2. Fish production and by-products
3. Transportation and marketing
4. Fish disease and their control
5. Prawn fisheries (capture and culture)
6. Molluscan fisheries of India (capture and culture)

SUGGESTED READING MATERIALS

- **Aquaculture and fisheries**
  - **Wageningen, U.R.**
- **Fish farming Aquaculture Commerical fishing**
  - www.ftai.com
- **Aquaculture fisheries and fish Science**
  - Wiley

ELECTIVE A: FISH AND FISHERIES AND AQUACULTURE

LAB COURSE-I: (BASED ON PAPER I & II)

1. Study of the toxicity of given chemical, EC 50, time dependent value (response)
2. Estimation of EC 50 & LC 50 against mosquito larva or other test organism
3. To analyze intake effect of substance on lungs, gastrointestinal tracts or sub cutaneous tissue
4. Chemical analysis of pond water (DO, free CO_2, pH, BOD, COD, Conductivity, Turbidity and Alkalinity)
5. Study of representative fishes from museum specimens
6. Study of osteology of fish
7. Study of histology through permanent slide of fish
8. Dissection of fish to show anatomy, cranial nerves and accessory respiratory organs
9. Qualitative and quantitative analysis of stomach content of fish

EXAMINATION SCHEME	
Dissection of Fish (Major + Minor)	15 + 10 mark
Spotting (from S. No. 5, 6, 7, 9)	20 mark
Two experiments from S. No. 1, 2, 3, 4	20 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE A: FISH AND FISHERIES AND AQUACULTURE

LAB COURSE-II: (BASED ON PAPER III & IV)

1. Identification of phyto and zooplanktons
2. Study of aquatic weeds and aquatic insects
3. Identification of fish
4. Identification of fish egg, fry and fingerlings
5. To determine the age of fish by reading scale
6. Estimation of number of eggs (fecundity and counting of eggs)
7. Study of histology through permanent slide of fish
8. To determine the state of maturity of fish (Nikolsky, 1963)

EXAMINATION SCHEME

Fish identification	20 mark
Spotting (10)	20 mark
Local fish collection	10 mark
Age determination	15 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE B: INSECT BIOLOGY AND PHYSIOLOGY

PAPER – I: CHARACTERISTICS, CLASSIFICATION AND TYPES

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. General characteristics of insects
2. Classification of different groups of insects with important examples

UNIT - II

1. Study of the morphology and various organ systems of Periplaneta

UNIT - III

1. Study of the morphology and various organ systems of Grasshopper

UNIT - IV

1. Reproductive organs and fertilization in insects
2. Growth and development of insect (pre-embryonic and post-embryonic)

SUGGESTED READING MATERIALS

- **Insect Structure and Function**
  - **R.F. Chapman**
- **General and Applied Entomology**
  - **Little**
- **Insect Physiology**
  - **Wiggilsworth**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE B: INSECT BIOLOGY AND PHYSIOLOGY

PAPER –II: GROSS MORPHOLOGY OF INSECTS

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Appendages of insects (head, thoracic and abdominal)
2. Integument in insect
3. Respiratory structure of insects

UNIT - II

1. Blood, blood vessels and pumping organ in insects
2. Nervous system of insects (primitive and advance)
3. Sense organ of insects

UNIT - III

1. Structure of simple eye in insects
2. Compound eye
3. Mechanism of image formation

UNIT - IV

1. Reproductive system in insects
2. Metamorphosis (types)
3. Endocrinal regulation of metamorphosis

SUGGESTED READING MATERIALS

- **An Introduction to the study of Insects**
  - **Borrer and Delong**
- **Imms Entomology**
  - **Imms**
- **General and Applied Entomology**
  - **Nayer**
- **Entomology Text Book**
  - **Jack De Angelis**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE B: INSECT BIOLOGY AND PHYSIOLOGY

PAPER –III: INSECT PHYSIOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Physiology of nutrition, digestion in insects
2. Intermediary metabolism
3. Physiology of circulation and Haemocyte in insect

UNIT - II

1. Physiology of terrestrial respiration
2. Physiology of aquatic respiration
3. Physiology of respiration in parasitic insect

UNIT - III

1. Regulation of salt and water in insect
2. Muscular system and movement
3. Physiology of sonification in insect

UNIT - IV

1. Mechanism of vision in insect
2. Physiology of chemical communication
3. Neuroendocrinal physiology and its influence
4. Pheromones

SUGGESTED READING MATERIALS

- **Physiology of Insecta** by Barrington
- **General and Applied Entomology** by K.K. Nayer
- **Medical Physiology** by Bijlani

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE B: INSECT BIOLOGY AND PHYSIOLOGY

PAPER – IV: BEHAVIOR AND ECONOMIC IMPORTANCE

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Social behavior in insect
2. Innate and learned behaviour and waggle dance
3. Neuro- physiological basis of behavior

UNIT - II

1. Adaptive value of insect behavior
2. Insect pests of crop
3. Insect pest management

UNIT - III

1. House hold insects, parasitic insects
2. Mites, ticks and their control
3. Life cycle of moth and ants

UNIT - IV

1. Apiculture
2. Sericulture
3. Lac-culture

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE B: INSECT BIOLOGY AND PHYSIOLOGY

LAB COURSE – I (Based on Paper I and II)

1. Study of insect through museum specimens

2. Identification of insects
3. Dissection to show different organs

EXAMINATION SCHEME	
Major Dissection	15 mark
Minor Dissection	05 mark
Spotting	20 mark
Identification of insects	10 mark
Slide preparation of Organ	15 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE B: INSECT BIOLOGY AND PHYSIOLOGY

LAB COURSE – II: (Based on Paper III and IV)

1. Dissection to show endocrinal bodies of insects
2. Identification of insects of economic importance(assign taxonomic position)
3. Spots of insects (museum specimen)
4. Histological preparation through microtomy
5. Slide preparation

EXAMINATION SCHEME	
Dissection (Endocrine glands)	15 mark
Identification of insects	10 mark
Spots (museum specimen), 10 no.	20 mark
Histology through microtomy	10 mark
Slide preparation	10 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE C: NEUROPHYSIOLOGY AND MOLECULAR ENDOCRINOLOGY

PAPER – I: BIOCHEMISTRY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT-I

1. Amino acids; structure, classification and function.
2. Peptide synthesis
3. Protein sequencing
4. Protein; properties, covalent structure, secondary, tertiary and quaternary structure
5. Protein size and composition

UNIT-II

1. Protein folding and dynamics
2. Levinthal paradox; Ramchandran plot
3. Amino acid sequences variation
4. Protein splicing

UNIT- III

1. Biosynthesis and degradation of glucose, palmitic acid, phenylalanine, tryptophan, urea, proline, aspartic acid
2. Redox potential
3. Mitochondrial electron transport chain
4. Oxidative phosphorylation

UNIT-IV

1. Classification and nomenclature of enzyme
2. Kinetics of enzyme catalyzed reactions
3. Regulation of enzyme activity by non genetic mechanism
4. Immobilized enzymes and their applications

Suggested Reading

- **Lehninger Principles of Biochemistry, Fourth Edition**
  David L. Nelson, Michael M. Cox
  Publisher: W. H. Freeman
- **Biochemistry**
  Donald Voet, Hardcover: 1616 pages,
  Publisher: Wiley; 3 edition
- **Principles of Biochemistry With a Human Focus**
  Reginald H. Garrett, Charles M. Grisham
  Publisher: Brooks Cole
- **The Molecular Basis of Cell Cycle and Growth Control**
  Gary S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt,
  Publisher: Wiley-Liss
- **Experiments in Biochemistry: A Hands-On Approach**
  Shawn O. Farrell, Ryan T. Ranallo,
  Publisher: Brooks Cole

ELECTIVE C: NEUROPHYSIOLOGY AND MOLECULAR ENDOCRINOLOGY

PAPER II: NEUROPHYSIOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Physiological role of neurosecretory cells
2. Histological structure of neurons and neuroglial cells
3. Physiological properties of neural fibres
4. Synapsis and synaptical transmission
5. Myoneural junction and neuromuscular transmission
6. Degeneration and regeneration of nerve fibre

UNIT - II

1. Nerve fibre, peripheral nerves, receptors and effector endings, dermatomes and muscle activity
2. The spinal cord and the ascending and descending tracts
3. The cranial and spinal nerves

UNIT - III

1. The fore brain, brain stem, the cerebellum
2. The meninges and cerebrospinal fluid
3. Peripheral nervous system

UNIT - IV

1. Autonomic nervous system; sympathetic and para-sympathetic nervous system with special comparison to hormonal mechanism of transmission through autonomic nervous system
2. Reflex action; verities, characteristics, unconditional reflex, electrophysiology of spinal reflexes
3. Sensation
4. Electro encephalography and its physiological basis.

Suggested Reading

- The Brain: Our Nervous System by Seymour Simon
- Mass Action in the Nervous System by Walter J. Freeman
- Human Anatomy and Physiology with Interactive Physiology 10-System Suite, 8th Edition by Elaine N. Marieb and Katja N. Hoehn (Jan 10, 2010)
- Neuroanantomy by H.G.Snell
- Clinical Neurophysiology-Guide for Authors - Elsevier
- Foundations of Cellular Neurophysiology (Bradford Books): Daniel Johnston,

ELECTIVE C: NEUROPHYSIOLOGY AND MOLECULAR ENDOCRINOLOGY

PAPER-III: MOLECULAR ENDOCRINOLOGY

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

1. Hormone receptor, Identification, quantitation, purification and physiochemical properties.
2. Membrane receptor- structure and signal transduction mechanism
3. G- protein couple receptor, tyrosine kinase linked receptors, ion channel receptors
4. G- protein
5. Nuclear receptors, its structure and function, orphan receptors

UNIT - II

1. Metaboling and development Hormones
2. Hormonal regulation of growth
3. Hormonal regulation of reproduction
4. Hormonal regulation of differentiation(sexually differentiation)
5. Development through differential gene expression

UNIT - III

1. Molecular details of biosynthesis of hormones
2. Steroidogenes- biosynthesis of Aldosterone, Glucocorticoids, Androgens and Estrogens
3. Biosynthesis of Thyroxin
4. Biosynthesis of Adrenalin and noradrenalin, insulin

UNIT - IV

1. Hormone concentration in body fluids
2. Genes and hormones
3. Transcription
4. Post transcription
5. Translation
6. Post translation
7. Secretion of hormones

Suggested Reading

- Molecular and Cellular Endocrinology - Elsevier
- Molecular Endocrinology, 3rd Edition by Franklyn Bolander
- Molecular Endocrinology:Genetic Analysis of Hormones and their Receptors by Gill Rumsby, Dr Sheelagh Farrow
- Molecular endocrinology of the steroid hormones: By D. Schulster;
- Hormones by Anthony W. Norman, Gerald Litwack

ELECTIVE C: NEUROPHYSIOLOGY AND MOLECULAR ENDOCRINOLOGY

PAPER IV: BIOLOGY OF NUCLEIC ACID

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

Nucleic acid

1. Types and structure of nucleic acid
2. Structure of DNA
3. Types of DNA
4. Mitochondrial DNA

UNIT - II

DNA replication

1. Mechanism of prokaryotic DNA replication
2. Mechanism of eukaryotic DNA replication
3. Enzymes and accessory protein required in DNA replication
4. Genetic code

UNIT - III

Transcription of RNA

1. Transcription of prokaryotic RNA
2. Transcription of eukaryotic RNA
3. Regulation of transcription
4. RNA polymerase

UNIT - IV

Translation

1. Ribosome (biogenesis)
2. Types of RNAs
3. Prokaryotic translation
4. eukaryotic translation
5. Regulation of translation

Suggested Reading

- Molecular Biology of the Cell, Fourth Edition: Bruce Alberts
- Molecular Biology by Sean B. Carroll
- Springer: Cell & Molecular Biology - Books & Journals
- Instant Notes in Molecular Biology: P.C. Turner et. al.
- Oxford University Press: Molecular Biology: Nancy Craig
- Molecular Biology of the Cell, Fourth Edition by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts,

ELECTIVE C: NEUROPHYSIOLOGY AND MOLECULAR ENDOCRINOLOGY

LAB COURSE – I: (Based on Paper I and Paper II)

1. Estimation of acid and alkaline phosphatases
2. Estimation of antioxidant enzymes
3. Estimation of α and β amylase
4. Estimation of protein by Biuret and Lowry method
5. Estimation of oil in oilseeds
6. Estimation of carbohydrate by Anthrone reagent
7. Study of slides of nervous system

EXAMINATION SCHEME	
(Exercise based on 1, 2, 3) Enzyme estimation	20 mark
Exercise based on 4	15 mark
(Exercise based on 5 and 6) Estimation of carbohydrate/oil seeds	20 mark
Spotting	10 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**

M. Sc. ZOOLOGY SEMESTER – IV

ELECTIVE C: NEUROPHYSIOLOGY AND MOLECULAR ENDOCRINOLOGY

LAB COURSE – II: (based on paper III and Paper IV)

1. Estimation of RNA
2. Estimation of DNA
3. Chromatography method (separation of steroids)
4. Bioassay of α- keto steroid
5. Study of slides related to endocrine glands
6. Dissection of endocrine glands
7. Estimation of cholesterol
8. Estimation of catecholamine

EXAMINATION SCHEME

Dissection (Endocrine glands)	10 mark
(Exercise based on 1, 2, 7) Estimation of nucleic acid/cholesterol	20 mark
(Exercise based on 3, 4, 8) Steroid separation by chromatography , Hormonal bioassay	25 mark
Spotting	10 mark
Viva	15 mark
Sessional (Internal)	20 Mark
Total	**100**