



**Centurion**  
**UNIVERSITY**

**School of Applied Sciences**

**Centurion University of Technology & Management**

**M.Sc. (ZOOLOGY)**

**(Two years programme)**

**2017**

**M.Sc. Zoology**  
**(Two year programme)**  
**Course Structure-2017**

**Semester-I**

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSZO1101	Animal Diversity	3-1-0	4
2	MSZO1102	Biosystematics and Taxonomy	3-1-0	4
3	MSZO1103	Cell & Molecular biology	3-1-0	4
4	MSZO1104	Biochemistry	3-1-0	4
5	MSZO1105	Zoology Laboratory-I (Practical pertaining to theory)	0-0-6	4
6		Skill I	0-0-3	4
		Total		24

**Semester-II**

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSZO1201	Comparative Anatomy of vertebrates	3-1-0	4
2	MSZO1202	Microbiology	3-1-0	4
3	MSZO1203	Genetics	3-1-0	4
4	MSZO1204	Immunology & Cancer biology	3-1-0	4
5	MSZO1205	Zoology Laboratory-II (Practical pertaining to theory)	0-0-6	4
6		Skill II	0-0-3	4
		Total		24

**Skill Elective Subjects**

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSLS1001	Bio-fertilizer	0-0-3	4
2	MSLS1002	Tools and Techniques in Biosciences	0-0-3	4
3	MSLS1003	Phytochemistry and Pharmacogony	0-0-3	4
4	MSLS1004	Apiculture	0-0-3	4
5	MSLS1005	Medical Diagnostics	0-0-3	4

**Semester-III**

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSZO2301	Physiology & Endocrinology	3-1-0	4
2	MSZO2302	Animal Biotechnology	3-1-0	4
3	MSZO2303	Ecotoxicology	3-1-0	4
4	MSZO2304	Quantitative Biology & wild life	3-1-0	4
5	MSZO2305	Zoology Laboratory-III (Practical pertaining to theory)	0-0-6	4
6	MSRM5101	Introduction to Research	2-0-0	2
7	MSZP2301	Scientific visit	0-0-3	2
		Total		24

**Semester-IV**

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSZO2401	Developmental Biology	3-1-0	4
2	MSZO2402	Instrumentation & Biophysics	3-1-0	4
3	MSZO2403	Environment & Pollution management	3-1-0	4
4	MSZP2401	Project	0-0-6	8
5	MSZS2401	Seminar	0-0-3	4
		Total		24

## First Semester

### MSZO1101 Animal Diversity (Non -chordates & chordates)

Code	Course Title	Course Type	Credits	L-T-P
MSZO1101	Animal Diversity	Theory	4	3-1-0

#### Module-I

(17 Hrs.)

Nutrition in protozoa - Types and mode of feeding, Protozoan parasites in brief (Trypanosome, Plasmodium), Canal system in Sponges, Coral reef formation and significance, Polymorphism in Coelenterates, Excretory structures and functions in Annelids, Helminthic parasites ( Taenia, Ancylostoma), Vision In insects

#### Module-II

(17 Hrs)

Torsion in Gastropoda, Nervous system in Cephalopods, Water vascular system in Echinoderms, Reproduction and development in Echinoderms with evolutionary significance, General characters & interrelationship of Proto-chordates and Siphon mechanism in Tunicates

#### Module-III

(16 Hrs)

General characters of Cyclostomes , Accessory respiratory organs in fishes , Origin of Amphibia, Adaptive radiation in reptiles, Classification of reptiles based on skull pattern, Flight adaptation in Birds General characters of Prototheria and Metatheria, Adaptive radiation in mammals.

#### Text Books

- Kotpal,R.L,2008, Series of Invertebrates, Kalyani Publisher

#### Reference Books:

- Hyman, L.H. The invertebrates, Nol. I.protozoa through Ctenophora, McGraw Hill Co., New York
- Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson anmd Sons Ltd., London.
- Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
- M. Sc. Zoology 2011-2012 Onwards
- Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
- Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
- Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
- Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
- Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V.Mc.Graw Hill Co., New York.
- Read, C.P. Animal Parasitism. Parasitism. Prentice Hall Inc., New Jersey.
- Sedgwick, A.A. Student text book of Zoology. Vol. I, II and III. Central Book Depot, Allahabad.
- Parker, T.J., haswell W.A. Text book of Zoology, Macmillan Co., London.

### MSZO1102 Biosystematics and Taxonomy

Code	Course Title	Course Type	Credits	L-T-P
MSZO1102	Biosystematics and Taxonomy	Theory	4	3-1-0

#### Module-I

(17 Hrs.)

Definition and basic concepts of biosystematics taxonomy and classification. History of Classification Trends in biosystematics: Chemotaxonomy cytotaxonomy and molecular taxonomy, Dimensions of speciation and taxonomic characters. Species concepts species category, different species concepts, subspecies and other infra-specific categories. Theories of biological classification: hierarchy of categories.

#### Module-II

(17 Hrs)

Taxonomic Characters .Different kinds.Origin of reproductive isolation, biological mechanism of genetic incompatibility. Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification. Taxonomic keys, different types of keys, their merits and demerits. Taxonomic categories. Evaluation of biodiversity indices Evaluation of Shannon. Weiner Index, International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Formation of

Scientific names of various Taxa

### Module-III

(16 Hrs)

Evaluation of Dominance Index. Similarity and Dissimilarity Index. Concepts of evolution and theories of organic evolution. Neo Darwinism and population genetics: Hardy-Weinberg law of genetic equilibrium. A detailed account of destabilizing forces: i- Natural selection, ii- Mutation iii- Genetic Drift iv- Migration Meiotic Drive. Trends in Evolution Molecular Evolution Gene evolution, Evolution of gene families. Assessment of molecular variation

#### Text books:

- Murry J.D. Mathematical Biology-Springer, Verlag, Berlin

#### Reference Books:

- M. Koto-The. Biology of biodiversity-Springer
- E.O. Wilson-Biodiversity-Academic Press Washington.
- G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication Company.
- E-Mayer-Elements of Taxonomy
- Bastchelet-F-Introduction to mathematics for life scientists Springer Verlag, Berling.
- Skoal R.R. and F.J.Rohiff Biometry-Freeman, San-Francisco.
- Snecdor, G.W. and W.G. Cochran Statistical Methods of affiliated-East-West Press, New Delhi.
- Murry J.D. Mathematical Biology-Springer, Verlag, Berlin.

### MSZO1103 Cell & Molecular Biology

Code	Course Title	Course Type	Credits	L-T-P
MSZO1103	Cell & Molecular biology	Theory	4	3-1-0

### Module –I

(17 Hrs.)

Cell Theory, Plasma membrane: Composition and dynamics, cell recognition, Social context of cells: Cell junction, cell adhesion and extra-cellular matrix, Plasomodesmata  
Major types of membrane transport, Active transport, Co-transport, Symport, Antiport, Ion channels, Osmosis. Transport across cell membrane: Major types of membrane transport, Active transport, Co-transport, Symport, Antiport, Ion channels, Osmosis  
Cell motility, Cytoskeleton, Cell Signaling: Signalling molecules and signal receptors, second messengers, G protein coupled receptors, activation of gene transcription by G protein coupled receptors. Nucleus: Structure and function of nuclear envelope, nucleolus.

### Module-II

(17 Hrs)

Chromatin organization and its packaging role of nuclear matrix in chromosome organization and function, matrix binding proteins. Lampbrush chromosome, Polytene chromosome, telocentric chromosome, Inter-phase chromatin, Euchromatin and Heterochromatin, karyotype and its significance  
Cell cycle: Molecular models and events. Regulators and checkpoints in cell cycle  
Molecular mechanisms of cell division: Mitosis & Meiosis: Events & mechanism Transport across cell membrane.

### Module– III

(16 Hrs)

DNA synthesis by reverse transcription, DNA Repair: mismatch repair, base excision, nucleotide excision, direct repair, SOS repair, Prokaryotic and eukaryotic translation.  
Prokaryotic transcription: Mechanism of transcription, Principle of gene regulation, The Operon concept, lac- & trp-operon. Processing of tRNA and rRNA, Co- and post-translational modifications of proteins.  
Eukaryotic transcription and regulation: RNA polymerases structure and assembly, Eukaryotic promoters and enhancers, General and specific transcription factors, transcriptional repressors, mechanism of transcription regulation, Transcriptional and post-transcriptional gene silencing.

### Text Books

- Robertis, De and Robertis Cell and molecular biology Lea and Febiger.

### Reference Books:

- J. Darnell, H. Lodish and D. Baltimore molecular cell biology scientific American book. Inc. USA
- B. Alberts
- D. Bray, J. Lewis, M. raff, K. roberts and J.D. Wattson. Molecular biology of the cell.
- Garland Publishing Inc. New York.
- John R. W. animal cell culture A practical approach masters. Irl. Press Albertset. all
- Essentials cell biology garland publishing Inc.
- New York 1998, J.M. Barry molecular biology Philip E. Hartman Gene Action
- Robertis, De and Robertis Cell and molecular biology Lea and Febiger.
- Watson Hopkis Roberts Steitz Weiner, Molecular Biology of the Gene Benjamin, Cummings Publishin Company inc.
- Bruce A; berts Bray ewis Raff Roberts Watson Molecular Biology of the Cell, Garland Publishing inc.
- Watson Gilman Witkowski Zoller Recombinant DNA Scientific American Books. Karp Gerald Cell Biology.
- Lewin B., Genes VII. King Cell Biology. Kaniel L. Hartl, Elizabeth W. Jones. Genetics Principals and Analysis, Jones and Bartlett Publishers.

### MSZO1104 Biochemistry

Code	Course Title	Course Type	Credits	L-T-P
MSZO1104	Biochemistry	Theory	4	3-1-0

### Module-I

(17 Hrs)

Carbohydrates: Classification, configuration and conformation of monosaccharides, sugar derivatives, important disaccharides. Structural and storage polysaccharides, glycosaminoglycan, proteoglycans, glycoproteins and glycolipids.

Carbohydrate metabolism: Glycolysis, TCA cycle, pentose-phosphate pathway. Gluconeogenesis, glycogen metabolism, regulation of carbohydrate metabolism, Oxidative phosphorylation, electron transport and ATP synthesis

Lipids: Classification, storage lipids, structural lipids (glycerophospholipid and sphingolipids), signalling lipids, cofactors, terpenes, and pigments.

### Module- II

(17 Hrs)

Biosynthesis and oxidation of fatty acids, regulation of fatty acid metabolism

Amino acids: Classification and properties, Acid-base properties, The Peptide bond, ionization behavior of peptides, biologically active peptides.

Levels of protein structure, Determination of primary structure of protein. Three dimensional structure of proteins (Secondary, tertiary and quaternary structures, structural patterns: motifs and domains), Protein denaturation and folding, Amino acid catabolism (transamination, oxidative deamination and urea cycle) Protein degradation (proteosomal pathway) and Solid phase synthesis of peptides.

### Module –III

(16 Hrs)

Enzymes: General properties, nomenclature and classification, extraction and assay Michaelis-Menten kinetics and its significance, Brigg's-Halden modification, determination of  $V_{max}$  and  $K_m$ , Mechanism of enzyme action: general acid-base catalysis, covalent catalysis, metal catalysis Mechanism of action of RNase, Lysozyme and Chymotrypsin, Coenzymes and vitamins, Enzyme inhibition: competitive, non-competitive inhibition, determination of  $K_i$ , allosteric regulation, covalent modification.

### MSZO1105 Zoology Laboratory-I

Code	Course Title	Course Type	Credits	L-T-P
MSZO1105	Zoology Laboratory-I	Practice	4	0-0-6

1. Study of Museum Specimen
2. Preparation & mounting of Microscopic Slides
3. Taxonomical practice of various species
4. Estimation of DNA
5. Estimation of RNA
6. Separation of proteins, lipids & nucleic acids from tissues and their quantification
7. Isolation of genomic DNA from animal tissue/blood
8. Agarose gel electrophoresis of DNA
9. SDS PAGE (Demonstration)
10. Microscopy, Microtomy and Histological techniques.
11. Isolation of Mitochondria
12. WBC & RBC counting
13. Estimation of haemoglobin
14. Study of slides of endocrine glands
15. Chromatographic separation of biomolecules (Amino acids /sugars/lipid)

### Second Semester

#### MSZO1201 Comparative Anatomy of Vertebrates

Code	Course Title	Course Type	Credits	L-T-P
MSZO1201	Comparative Anatomy of vertebrates	Theory	4	3-1-0

#### Module-I

(17 Hrs)

Origin of Chordata: Concept of Protochordata Development, structure and functions of integument and its derivatives (glands, scales, feathers and hairs) Respiratory system: Characters of respiratory tissue, external and internal respiration. Comparative account of respiratory organs. Comparative account of Digestive System.

Evolution of heart. Evolution of aortic arches and portal systems. Blood circulation in various vertebrates groups

#### Module-II

(17 Hrs)

Comparative account of jaw suspensorium and vertebral column. Evolution of urinogenital system in vertebrates. Comparative account of organs of olfactory and taste. Comparative anatomy of brain and spinal cord (CNS). Comparative account of peripheral and autonomous nervous system. Comparative account of lateral line system. Comparative account of electroreception, Flight adaptations in vertebrates' Comparative account of lateral line system

#### Module-III

(16Hrs)

Comparative account of electroreception, Flight adaptations in vertebrates. Aquatic adaptations in birds and mammals. Origin, evolution general organization and affinities of Ostracoderms, General organization, specialized, generalized and degenerated characters of Cyclostomes.

Origin, evolution general organization of early Gnathostomes. General account of Elasmobranchi, Holocephali, Dipnoi and Crossopterygii.

#### Text Books

- Young J.Z. life of vertebrates. The oxford University Press, London

#### Reference Books:

- Carter, G.S. Structure and habit in vertebrate evolution – Sedgwick and Jackson, London.
- Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates, Central Book Depot. Allahabad,

- Kent, C.G. Comparative anatomy of vertebrates MalcomJollie, Chordata morphology. East – West Pres Pvt. Ltd., New Delhi. .
- Milton I lildergrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
- Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
- .Sedgwick, A.A. Students Text Book of Zoology, V-I.II.
- Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
- Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia
- Young J.Z. life of vertebrates. The oxford University Press, London
- Parker & Haswell to III Rev. by Marshall willianslatested Macmillan Co. ltd.
- Young J.Z. Life of mammals. The Oxford University Press, London
- Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn.

### MSZO1202 Microbiology

Code	Course Title	Course Type	Credits	L-T-P
MSZO1202	Microbiology	Theory	4	3-1-0

#### Module –I

(18 Hrs)

History and development of microbiology, General features of Bergy's manual for classification of microbes, Whittakar's five kingdom concept, Carl Woese's 3 domain classification, Isolation, culture and maintenance of microorganisms, Microbial growth, continuous culture (chemostat), Factors influencing growth of microbes, Role of microbes in agriculture and industry.

General features of Archaea, Structure, Nutrition and Reproduction of Eubacteria, Genetic recombination in bacteria (Transformation, Conjugation and Transduction), General features and pathogenicity of mycoplasma, Ricktsia and Spirochaetes.

#### Module-II

(16 Hrs)

Cyanobacteria: Cell structure and reproduction. Heterocysts: Structure, development and function  
 Virus: General characteristics and classification of viruses, nature, morphology and chemistry of virus, transmission of virus, virus-vector relationship, replication of Bacteriophage  
 Plant virus- TMV, structure, transmission, pathogenicity and replication Animal viruses - HIV, structure, transmission, pathogenicity and replication Treatment and prevention by anti-virals and vaccine,

#### Module-III

(16 Hrs)

Viroids and Prions, Microbial toxins: types, mode of actions and pathogenicity. Bacterial toxins: Endo and exotoxins, fungal toxins: toxins of Aspergillum, Penicillium, Fusarium and Alternaria Algal toxins: cyanotoxins and dinotoxins.

Chemotherapeutic agents: antibiotics and their mode of action; bacterial drugs (Penicillin, fluoroquinolones, tetracycline and aminoglycosides)

#### Text Books

- Peclzar, 2008, Microbiology

#### Reference Books:

- Microbial Physiology and Metabolism by Caldwell D.R 1995 Brown Publishers.
- Microbial Physiology by Moat A.G. and Foster J. W. 1999.. Wiley.
- Prokaryotic Development by Brun. Y.V. and Shimke, s L.J. 2000. ASM Press.
- Advances in Microbial Physiology. Volumes. Edited by By A.H. Rose. Academic Press, New York.
- Applied Microbial Physiology by Rhodes.
- Biosynthesis by Smith.
- The Bacteria. Volumes by I.C. Gunsalus and Rogery Sta

### MSZO1203 Genetics

Code	Course Title	Course Type	Credits	L-T-P
MSZO1203	Genetics	Theory	4	3-1-0

#### Module-I

(17 Hrs)

Mendel's experiments and laws of inheritance, gene interaction with epistasis or modified mendelian dihybrid ratios: masking gene action, supplementary gene action, duplicate gene action, complementary gene action.

Multiple allele in human (ABO blood group); eye colour in *Drosophila*, self incompatibility in plants; Polygenic inheritance, pleiotrophy, Maternal effects and cytoplasmic inheritance, mitochondrial & chloroplast genome

Sex chromosomes, Chromosomal sex determination: XX-XY, XX-XO and ZZ-ZW systems, Compound sex chromosome, Meiotic behaviour of chromosomes: Primary & Secondary non-disjunction, Genic balance theory of sex determination, Sex determination in humans and *Drosophila* with special reference to SRY and sex lethal genes.

#### Module-II

(17 Hrs)

Sex linkage: Sex linked genes in man, sex chromosome disorders in man, Sex influenced dominance by sex-linked gene expression.

Sex determination in plants with special reference to *Melandrium*, Linkage groups: Complete and incomplete linkage, Crossing over: Relationship between genetic and cytological crossing over, Relationship between crossing over and chiasma formation, molecular mechanism of crossing over

Detection of linkage & Linkage maps: Test cross, test for linkage on the basis of F<sub>2</sub> generation, LOD score, gene mapping, three point test cross in *Drosophila*, construction of linkage maps, identification of particular linkage groups with specific chromosome, physical distance and map distance, Interference and coincidence,

#### Module-III

(16Hrs)

Mitotic Recombination, Recombination within gene.

Structural and numerical alterations in chromosomes: Spontaneous and induced mutations, physical and chemical mutagens, chromosomal aberrations, meiotic behavior of deletion, duplication, inversion and translocation.

Euploids and aneuploids-classification, origin, induction, role of polyploidy in evolution and practical significance in crop improvement.

#### Text books:

Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India

#### Reference Books:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.
- Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A. Goldstein, D. B. and Patel, N. H. (2007).
- Evolution. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.



### MSZO1204 Immunology and Cancer Biology

Code	Course Title	Course Type	Credits	L-T-P
MSZO1204	Immunology & Cancer biology	Theory	4	3-1-0

#### Module-1

(18 Hrs)

Phylogeny of Immune system, Innate and acquired Immunity, Haematopoiesis and differentiation, Cells of the Immune system- B lymphocytes, T-lymphocytes, Macrophages, Dendritic cells, Natural Killer cells, Eosinophils, Neutrophils and mast cells.

Organization and Structure of Lymphoid Organs, MALT, CALT, NALT, BALT, Nature and Biology of antigens and super antigens, Structure and function of antibody molecule, Antigen – Antibody interaction (Antibody affinity, Radial and Double immune diffusion, Radioimmunoassay, ELISA- Indirect, Direct, Sandwich, ELISPOT, Competitive, Western blotting)

#### Module-II

(17Hrs)

Major histocompatibility complex and MHC restriction, Antigen Processing and Presentation, Generation of humoral and cell mediated immune response, BCR and TCR, generation of diversity, Complement system(Classical, Alternate and lectin pathway), Cytokines- Types and their role in immune regulation, Activation and regulation of B and T lymphocytes, Cell-mediated cytotoxicity and Antibody dependent cell mediated cytotoxicity, Hypersensitivity, Autoimmunity and Transplantation.

#### Module-III

(15Hrs)

Biology of cancer cell, Genetic basis of cancer-I: Proto-oncogenes, Viral and cellular oncogenes, Genetic basis of cancer-II: Tumor suppressor genes from humans: structure, function and mechanism of action of pRB and p53 tumor suppressor proteins, Role of carcinogens and DNA repair in cancer

#### Text Books:

- Kuby's Immunology, 5th edition, By R. A. Goldsby et al.

#### Reference Books:

- Kuby's Immunology, 5th edition, By R. A. Goldsby et al.
- Clinical Immunology By Brostoff, Seaddin, Male and Roitt
- Fundamentals of immunology By William Paul.
- Immunology by Janeway
- Principles of Immunology by N.V. Shastri, Himalaya Publishing House
- Cellular and Molecular Immunology- Abul Abbas and Andrew Lichtman
- Immunology-Weir

### MSZO1205 Zoology Laboratory-II

Code	Course Title	Course Type	Credits	L-T-P
MSZO1205	Zoology Laboratory-II	Practice	4	0-0-6

1. Study of Museum Specimen
2. Study of anatomical slides
3. Detection of genetically disorder.
4. Estimation of gram +ve &-ve bacteria
5. Method & techniques of Bacterial culture
6. Study of immunological method
7. Study of different Parasiticforms.
8. Identification of parasitic forms
9. Antigen-Antibody Interaction (Haemoagglutinationassay)
10. Identification of histological slides of lymphoid tissue
11. Immunization Protocol Demonstration of Thioglycolate induced peritonitis (cell infiltration and Inflammatory exudates)
12. Sessional work (Internal evaluate)

### Skill elective subjects

#### **MSLS1001 Bio fertilizer**

Code	Course Title	Course Type	Credits	L-T-P
MSLS1001	Bio-fertilizer	Practice	4	0-0-3

#### **Experiments:**

1. Isolation of rhizobium or aztobacter from plant root nodules.
2. Identification of soil cyanobacteria from different soil samples.
3. Culture of cyanobacteria-
  - A. Growth media
  - B. Media preparation & strater culture
  - C. Sterilization of medium in autoclave
  - D. Prepare slants & plates
  - E. Inoculation & growth of cyanobacteria
4. Cyanobacteria inoculation to plants
5. Coating the seeds with cyanobacteria extract & observing its growth basically in monocots
6. Field application of cyanobacteria
7. To list five plants which can be used as green manure.
8. To study different types of mycorrhizal association.
9. Isolation of vam
10. Methods of bio compost
11. Methods of vermicomposting
12. Field application of vermicompost

#### **MSLS1002 Tools & Techniques in Biosciences**

Code	Course Title	Course Type	Credits	L-T-P
MSLS1002	Tools and Techniques in Biosciences	Practice	4	0-0-3

#### **Experiments:**

1. General principle & application of colorimeter, spectrophotometer,
2. General principle & application ultracentrifuge, flame photometer beers & lambart law
3. Microbial techniques: media preparation, sterilization, inoculation & growth monitoring.
4. Microbial assay
5. Microbial identification
6. Separation techniques such as chromatography
7. Principle types & applicants. Electrophoresis,
8. Principles types & application page, sds-page.
9. Histological techniques: principle of tissue fixation, microtomy, staining, mounting.
10. Molecular biology techniques: southern hybridization, western hybridization, Northern hybridization (any one of these)
11. Dna sequencing, polymerase chain reaction (pcr)
12. Principles types agarose gel & gel electrophoresis

#### **MSLS1003 Phytochemistry & Pharmcognosy**

Code	Course Title	Course Type	Credits	L-T-P
MSLS1003	Phytochemistry and Pharmacogonsy	Practice	4	0-0-3

#### **Experiments:**

1. Preparation of plant profile of some locally available medicinal plants, suchas tulsi,neem,&turmericetc
2. Herbarium preparation
3. Extraction of phytochemicals such as alkaloid,terepenoids,& sapogennin
4. Separation by tlc&hplc.
5. Characterization byuv spectrophotometer

### MSLS1004 Apiculture

Code	Course Title	Course Type	Credits	L-T-P
MSLS1004	Apiculture	Practice	4	0-0-3

#### Experiments:

1. Study of characteristics of honey bee (queen, worker & drawn bee).
2. Study of selection of bee species.
3. Study of social organization of bee colony.
4. Study & observation of techniques of bee keeping.
5. Demonstration of bee keeping equipment.
6. Observation of pollination & work of bee.
7. Study of artificial bee rearing.
8. Study of methods of extraction of honey.
9. Scientific visit to apiculture industry/institute
10. Submission of a small project as per course.

#### Text books:

- Singh S., Beekeeping in India, Indian Council of Agricultural Research, New Delhi

#### Reference books:

- Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
- Bisht D. S., Apiculture, ICAR Publication.

### MSLS1005 Medical Diagnostics

Code	Course Title	Course Type	Credits	L-T-P
MSLS1005	Medical Diagnostics	Practice	4	0-0-3

#### Experiments:

1. Preparation of blood smear.
2. Study of d.l.c (differential leucocyte count) using Leishman's stain.
3. Platelet count using haemocytometer.
4. Determination of ABO blood group
5. Estimation of haemoglobin using Sahli's haemoglobinometer
6. Preparation of haemin and haemochromogen crystals
7. Recording of blood pressure using a sphygmomanometer.
8. Estimation of blood glucose using glucometer/kit
9. Estimation of sugar in urine.
10. Estimation of protein using kit.
11. Estimation of lipid using kit.
12. Study & preparation of E.S.R
13. Preparation of TLC for amino acid/other molecules
14. Basic methods to diagnosis AIDS, tuberculosis & hepatitis.
15. Study of various medical imaging techniques
16. Estimation of hcg in urine.

#### Text books:

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers

#### Reference books:

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkarp, B. and Godkard, P. Text Book of Medical Laboratory Technology, II Edition, Bhalani Publishing House
- Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- Robbins and Cotran, Pathologic Basis of Disease, VIII Edition, Saunders

**Third Semester**  
**MSZO2301 Physiology & Endocrinology**

Code	Course Title	Course Type	Credits	L-T-P
MSZO2301	Physiology & Endocrinology	Theory	4	3-1-0

**Module-I**

**(17Hrs)**

Composition of blood, RBC anatomy, RBC Breakdown cycle, blood groups and mechanism of platelet plug formation and blood coagulation.

The heart: cardiac cycle & its regulation, pulmonary ventilation, respiratory surface & gas exchange, regulation of respiration, transport of gases, acid base balance.

Excretory system: Urine formation, glomerular filtration, tubular function, renal Mechanism of concentrating & diluting urine General organization of central nervous system, Type of neuronal cells, Structure and function of neuron and glia,

**Module-II**

**(16Hrs)**

Types of ion channels, Action potential, Electrical and Synaptic transmission, Neurotransmitters & Neuropeptides, Neuromuscular Junction, Blood brain barrier.

Ultra structure of muscles, Regulatory, Structural and Contractile proteins, mechanism of contraction in Skeletal, Smooth and Cardiac muscle.

Chemical messengers, Hormones & their feedback systems, Mechanism of hormone action (fixed membrane- and mobile receptor mechanisms), hormonal signalling

**Module-III**

**(17Hrs)**

Pineal, Thymus & gastrointestinal hormones, Anatomy, chemistry and biological action of adeno-hypophysial & neurohypophysial hormones, Thyroid gland: Anatomy, biosynthesis & function of thyroid hormones, Parathyroid gland: Anatomy & function of parathyroid hormone.

Endocrine pancreas: Anatomy, Biosynthesis, chemistry & functions of pancreatic hormones, Adrenal gland: Anatomy, biosynthesis, functions of cortical & medullary Hormones, Gonads: Anatomy and biological actions of gonadal hormones.

**Text Books**

- Guyton's Physiology

**Reference Books**

- Guyton's Physiology
- Human physiology- Tortora
- Endocrinology - Hadley
- Endocrinology - Turner & Bagnora
- Bentley, P. J. Comparative vertebrate endocrinology
- Bern, H. A. Text book of comparative endocrinology
- Colour Atlas of Physiology- Thieme
- Harper's Illustrated Biochemistry(26<sup>th</sup> Edition)

**MSZO2302 Animal Biotechnology & Application**

Code	Course Title	Course Type	Credits	L-T-P
MSZO2302	Animal Biotechnology	Theory	4	3-1-0

**Module-I**

**(17 Hrs)**

Animal cell and tissue culture technology: Cell culture laboratory design and equipment, Media and reagents, Different types of cell culture, application, scale up Biotechnology in improvement of livestock: Fish breeding, Androgenesis and Gynogenesis in fish, Polyploidy in fish, Gene manipulation in aquaculture.

Reproductive biotechnology: Cryopreservation and Cryoprotection and gamete banking, Assisted reproductive technology, In vitro fertilization and embryo transfer, ICSI, Sperm sexing

**Module-II****(17Hrs)**

Gene and Somatic cloning techniques: Transgenic technology, Animals as bioreactor Knockout model systems & their utility.

Animal Production technology & Food security: Polyculture of fish for high yield, Edible oyster and Pearl oyster production. Vermi-culture and Vermicomposting for alternative sustainable agriculture. Soil fauna in soil formation & fertility, Organic farming, Fish culture in flow through system and recirculation technology.

**Module-III****(16Hrs)**

Environmental Bio-technology: Bioprocess technology, Bioassay and Biosensors in Eco toxicological screening, Biomarkers in Eco toxicological screening

Medical Biotechnology: Disease diagnostic markers, Gene therapy, Mechanism of gene therapy (antisense, virus mediated, immunotherapy, stem cell therapy), Drug delivery and targeting, Forensic Biotechnology.

**Text books:**

- Culture of animal cells by R.I. Freshney

**Reference Books:**

- Culture of animal cells by R.I. Freshney
- Tissue Culture – Methods and Applications by Paul F. Kruse Jr. and M. K. Patterson Jr.
- Cell Culture Lab Fax by Butler and Dawson.
- Cell and Tissue culture: Laboratory procedures by Doyle and Griffiths
- Basic Cell Culture by J.M. Davis

**MSZO2303 Ecotoxicology**

Code	Course Title	Course Type	Credits	L-T-P
MSZO2303	Ecotoxicology	Theory	4	3-1-0

**Module-I****(18Hrs)**

General principles of Environmental Biology with emphasis on ecosystems Abiotic and biotic factors of ecosystems. Communities of the environment, their structure & significance. Energy flow in environment: Ecological energetic. Productivity, Production and analysis. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation. Remote sensing –basic concepts and applications of remote sensing techniques in environmental conservation. Environmental indicators and their role in environmental balance.

**Module-II****(16Hrs)**

Kinds of environmental pollution and their control methods, radioactive compounds and their impact on the environment, Vehicular exhaust pollution causes and remedies, Noise pollution

Toxicology- Basic concepts, Principles and various types of toxicological agents. Toxicity testing principles, hazards, risks and their control methods.

**Module-III****(16Hrs.)**

Food toxicants and their control methods, Public Health Hazards due to environmental disasters, Pesticides, types, nature and their effects on environment, Important heavy metals and their role in environment, Agrochemical use and misuse, alternatives, Occupational Health Hazards and their Control.

**Text Books**

- Clark : Elements of ecology

**Reference Books:**

- Clark : Elements of ecology
- Odum : Fundamentals of Ecology
- South Woods : Ecological methods

### MSZO2304 Quantitative Biology, Biodiversity and Wildlife

Code	Course Title	Course Type	Credits	L-T-P
MSZO2304	Quantitative Biology & wild life	Theory	4	3-1-0

#### Module- I

(17Hrs)

Quantitative biology: Distribution of the data in biology- mean, mode and median, Measures of dispersion : range, mean deviation, IQD , standard deviation and coefficient of variation, Chi square test, Normal distribution, Experimental designing and sample theory, Probability distribution, properties and probability theory, Completely randomized design and randomized block design, Analysis of variance, Co-relation- types of correlation, Karlpearson, coefficient correlation, Regression, Probability distribution, properties and probability theory

#### Module II

(17Hrs)

Completely randomized design and randomized block design, Analysis of variance, Co-relation- types of correlation, Karlpearson, coefficient correlation, Regression  
Biodiversity: concept and principal of biodiversity, causes for the loss of biodiversity, Biodiversity conservation methods, Medicinal uses of forest plant

#### Module III

(16Hrs)

Wildlife of India, types of wildlife, Values of wildlife, positive and negative, Wildlife protection Act  
Conservation of wildlife in India, Endangered and threatened species, Wildlife and conservation, National Parks and Sanctuaries, Project Tiger, Project Gir Lion and Crocodile breeding project, Wildlife in M.P. with references to Reptiles Birds and mammals, Biospheres reserves

#### Text Books:

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling
- Jorgenserr, S.E. Fundamental of Ecological modling E. sevier New York

#### Reference Books:

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling
- Jorgenserr, S.E. Fundamental of Ecological modling E. sevier New York
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
- Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
- Snedecor, G.W. and W.G. cochran, stactical methods, Affilited East, West Press New Delhi (Indian ed.)
- Muray , J.D. Methamatical Biology, Springer Verlag Berlin
- Pelon, E.C. The interpretation of ecological data: A promer on classification and ordivation.lewis . Biostatics
- B.K. Mahajan Methods in Biostatics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georgs&WiliansStartical method
- R.K. Tondon Biodiversity Texonomy& Ecology
- M.P. Arora An Introduction to prevantology
- P.C. Kotwal Biodiversity and conservation
- lewis . Biostatics
- B.K. Mahajan Methods in Biostatics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georgs&WiliansStartical method
- R.K. Tondon Biodiversity Texonomy& Ecology
- M.P. Arora An Introduction to prevantology
- P.C. Kotwal Biodiversity and conservation

### MSZO2305 Zoology Laboratory-III

Code	Course Title	Course Type	Credits	L-T-P
MSZO2305	Zoology Laboratory-III	Practice	4	0-0-6

1. Study of T.S,V.S,L.S of different mammalian organ
2. Detection of protein ,carbohydrate, lipid
3. Tissue culture
4. Gel Electrophoresis, Blotting
5. DATA interpreting
6. Estimation of toxic in Water Sample
7. Various tools & techniques
8. Estimation of DNA
9. Estimation of RNA
10. Separation of proteins, lipids & nucleic acids from tissues and their quantification
11. Isolation of genomic DNA from animal tissue/blood
12. Agarose gel electrophoresis of DNA
13. SDS PAGE (Demonstration)
14. Microscopy, Microtomy and Histological techniques.
15. Isolation of Mitochondria9. WBC & RBC counting
16. Estimation of haemoglobin
17. Study of slides of endocrine glands
18. Chromatographic separation of biomolecules (Amino acids /sugars/lipid)

### MSZP2301 Scientific Visit

Code	Course Title	Course Type	Credits	L-T-P
MSZP2301	Scientific visit		2	0-0-3

### MSRM5101Introduction to Research

Code	Course Title	Course Type	Credits	L-T-P
MSRM5101	Introduction to Research	Theory	2	2-0-0

### Fourth Semester

### MSZO2401 Developmental Biology

Code	Course Title	Course Type	Credits	L-T-P
MSZO2401	Developmental Biology	Theory	4	3-1-0

#### Module I

(17 Hrs)

Principles of Developmental Biology : Potency, commitment, specification, induction, competence, Gametogenesis : Primordial germ cells, Spermatogenesis, Oogenesis, Fertilization: Ultrastructure of sperm and ovum, biochemical aspects of fertilization, Cell-cell interaction and cell signalling during morphogenesis in early embryo: gastrulation, neurulation and primordial organ rudiments, origin and fate of neural crest cells

#### Module II

(17 Hrs)

Post-embryonic development: Growth, cell proliferation, growth hormone, Spatial and temporal gene expression during development, Apoptosis and its role in development

Ageing: Mitochondrial control of ageing, insulin pathway control of ageing and possible relation to oxygen radicals, "Ageless" animals and environmental control of ageing, senescence & cell death, Application of developmental biology in medicine and animal husbandry: In vitro fertilization and embryo transfer, embryo sexing

**Module III****(16 Hrs)**

Embryonic stem cells, stem cell niche, their role in development, Genetic errors of human development: Nature of human syndromes- Pleiotropy, genetic heterogeneity, phenotypic variability, mechanism of dominance, Gene expression and human disease: Inborn errors of nuclear RNA processing, inborn errors of translation, Teratogenesis: Environmental assaults on human development, teratogenic agents like alcohol, retinoic acid etc

**Text Books:**

- Introduction to embryology by Balinsky

**Reference Books:**

- Developmental biology by Gilbert
- Introduction to embryology by Balinsky
- Fertilization FT Longo
- Culture of animal cells by R.I. Freshney
- Tissue Culture – Methods and Applications by Paul F. Kruse Jr. and M. K. Patterson Jr.
- Cell Culture Lab Fax by Butler and Dawson.
- Cell and Tissue culture: Laboratory procedures by Doyle and Griffiths
- Basic Cell Culture by J.M. Davis

**MSZO2402 Instrumentation & Biophysics**

Code	Course Title	Course Type	Credits	L-T-P
MSZO2402	Instrumentation & Biophysics	Theory	4	3-1-0

**Module I****(17 Hrs)**

Principle of operation and Instrumentation of Light, Fluorescence and Electron Microscopes Ultraviolet-visible absorption spectroscopy: Principle, Instrumentation and application, Fluorescence spectrophotometry: Principle, Instrumentation and application Radioisotope techniques: Nature of radioactivity, isotopes in biochemistry, measurement of radioactivity (carbon dating, Geiger-Muller counting and liquid scintillation counting). Principles of electrochemical techniques: Electrochemical cells and reactions, potentiometry and voltametry, the pH electrode

Centrifugation techniques: Basic principles of sedimentation, Types of centrifuges, Types of rotors, Methods in preparatory ultracentrifugation (differential and density gradient centrifugation).

**Module II****(17Hrs)**

Chromatographic techniques: Principles of chromatography (Adsorption and Partition chromatography), planar chromatography (Paper and Thin-layer chromatography), Column chromatography (Gas chromatography, Gel exclusion/permeation chromatography, Ion exchange chromatography, Affinity chromatography, HPLC).

Electrophoretic techniques: General principles, support media, electrophoresis of proteins (SDS-PAGE, native gels, gradient gels, isoelectric focusing gels and two dimensional gels), electrophoresis of nucleic acids (Agarose, pulse-field and sequencing gels).

Blotting techniques (Southern, northern and western blotting)

**Module III****(16 Hrs)**

**Biophysics:** pH meter and measurement of Ph, Paper chromatography of amino acids, mixtures, identification of unknown amino acids and sugars, Gel filtration chromatography (Separation of starch from glucose), Thin layer chromatography of amino acids and sugar, Serum electrophoresis, Determination of absorption coefficient and concentration of unknown solutions by calibration curve using a coloured solution, Absorption spectrum of a coloured solution (KMnO<sub>4</sub>), Drawings using camera lucida

**Text Books**

- John T (2002) Practical statistics for environmental and biological scientists john wiley and sons



**Reference Books:**

- John T (2002) Practical statistics for environmental and biological scientists john wiley and sons
- Ackerman, E. (1962).Biophysical Science. Prentice Hall Inc.
- Alonso, A and Arrondo, J.L.R (2006) - Advanced techniques in Biophysics, Springer
- Alok Srivastava and Ipsita Roy-(2009)-Bio-Nano- Geo Sciences- The future challenge-Ane Books Ltd.
- Baker, E.J and Silverton, R.E. (1978) – Introduction to medical laboratory technology, ELBS

**MSZO2403 Environment and Pollution Management**

Code	Course Title	Course Type	Credits	L-T-P
MSZO2403	Environment & Pollution management	Theory	4	3-1-0

**Module I (17 Hrs.)**

Basic Environmental biotechnology: Scopes and issues, basic environmental problems-pollution, land degradation, deforestation, biodiversity loss and eutrophication, biotechnology for safer environment, biotechnology for resource management and biomass production, biotechnology for generation of biogas and bio fuels, biotechnology for environmental friendly processes.

Soil: Classification, formation, survey and land capability, soil structure and profile, soil reaction and buffering, soil organisms-microbes, algae and invertebrates, rhizospheric activity and plant growth.

**Module-II (17 Hrs.)**

Soil organic matter, litter dynamics in soil, soil nutrient balance and nutrient cycle, soil erosion and its control. Management and remediation of soil pollution: Pollutants in soil, sources and effects of soil pollutants, physical, chemical and biological decontamination methods, management and decontamination of saline, acidic, alkaline and mine waste soil, management of water logged, sandy and peat soil, degradation of organic pollutants in soil environment, ex situ and in situ bioremediation of contaminated soil: biopile, bioventing, biosparging and bio slurping.

**Module III (16 Hrs.)**

Pollutants in air: Major air pollutants; oxides of nitrogen, sulphur and carbon-sources, effects and environmental reactions, particulate air pollutants; methods of air pollution control, particle settling chamber, inertial separator, cyclone filters, electrostatic precipitators, gaseous pollutant control-scrubber, absorbers, thermal decomposers, biological filters.

**Text Books:**

- Dash, M.C. 2004. Ecology, chemistry and management of environmental pollution.
- Dash, M.C. and S P Dash, 2009. Fundamentals of ecology

**Reference Books:**

- Dash, M.C. 2004. Ecology, chemistry and management of environmental pollution.
- Dash, M.C. and S P Dash, 2009. Fundamentals of ecology
- Toxicology- Wallace Hayes
- Toxicology-V.C Kapoor
- Advanced toxicology- Adhikari
- Soil biology- Burges and Ran, 1967
- Dindal, D.L. 1990.Soil biology guide
- Mahapatra, P. Textbook of Biotechnology

**MSZP2401 Project**

Code	Course Title	Course Type	Credits	L-T-P
MSZP2401	Project	Project	8	0-0-6

**MSZS2401 Seminar**

Code	Course Title	Course Type	Credits	L-T-P
MSZS2401	Seminar	Seminar	4	0-0-3