VIKRAMA SIMHAPURI UNIVERSITY::NELLORE
DEPARTMENT OF ZOOLOGY

Syllabus for M.Sc Zoology (2 Year Course) for V.S. University Constituent College(s) and Affiliated Colleges under the jurisdiction of Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020 – '21

PREAMBLE

Zoology is a major subject of Basic Sciences which deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. The advancements in biological Sciences demands, a zoology student to be a master of many areas in the subject. This Postgraduate degree program has been designed by the Board of Studies in Zoology of Vikrama Simhapuri University with a tangible understanding of what is needed from zoologists and what zoologists need to pursue as a skilled career. It emulates closely the benchmark statement for biosciences and the guidelines laid down by the University Grants Commission, New Delhi. This Newly designed Curriculum is an appropriate blend of the classical aspects in Zoology which has been the "backbone" knowledge required for all zoologists and the recent and specialized areas. The flexibility in the Curriculum allows the students to choose their areas of interest leading to enhanced employability. Students will be provided sufficient number of hours for their skill development through the lab courses and the project component. The lab courses have differing flavours and priorities to make a good zoologist. This degree offers specialization in areas like Genetics, Animal Physiology and Animal Behaviour along with a range of core courses like Biochemistry, Molecular Biology, Comparative Animal Physiology, Developmental Biology etc. Various cross cutting issues relating to Environmental biology have been aptly included to develop the students" sense towards human wellbeing. The field trip/surveys and study tours are included to gives the student an enticing taste of what life is especially outside the walls of the classroom. On successful completion of the programme, the students are expected to understand the key life processes of human and other animal groups, the functioning of molecules, cells, tissues, organs and systems. Also, the students will gain increased confidence to use initiative and judgement to make decisions in complex and changeable situations and reflect critically and analytically on personal experience and make informed decisions about further study, training and employment opportunities. The Master of Science (M.Sc.) in Zoology is a Postgraduate program under the Faculty of Science and Technology of Vikrama Simhapuri University. The curriculum designed encompasses subjects like Physiology, Behaviour, Genetics, Cell Biology, Developmental Biology, Endocrinology, Biochemistry, Molecular Biology, Wildlife Conservation Biology, Environmental Biology, Genetic Engineering, Aquaculture etc. Both classical and applied subjects of Zoology have been rightly blended to offer holistic understanding of the subject.

The Choice Based Credit System (CBCS) will be implemented through this curriculum. This curriculum would certainly felicitate students to develop a strong base of the fundamentals and specialize in the desired area of their fondness and abilities. The students pursuing this program would get a privilege to select optional subjects of their choice. A total of 240 hours for theory lectures and 120 hours for laboratory work have been prescribed in each semester including a dissertation to inculcate the research culture amongst students. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem-solving skills.

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PROGRAM OBJECTIVES

1. Impart the students with higher level knowledge and understanding of contemporary trends in different aspects of Zoology.
2. Equip the students to evaluate and apply the Knowledge of Zoology and allied subjects to the understanding of complex life processes and phenomenon .
3. Design processes /strategies that meet the specified needs with appropriate consideration for the public health safety , cultural societal and environmental considerations.
4. Conduct investigations of complex problems , use research based Knowledge and research methods including design of experiments, analysis and inter pretation of data and synthesis of the information to provide valid conclusions in real situations.
5. Provide guidance to students to plan and undertake independent research in a chosen discipline.
6. Train the students on team work lifelong learning and continuous professional development.

PROGRAMME OUTCOMES

After successful completion of two year Post graduate Degree programme in Zoology ,the students would be able to

PO1	Knowledge Based: Gain the knowledge of Zoology through theory and practical
PO2	Problem Analysis:Acquire Knowledge about the concepts and Students would sufficiently be skilled and empowered to solve the problems in the area of Zoology and its allied areas..
PO3	:Investigation :Critically analyze the qualitative and quatitative data on contemporary issues in different fields of Zoology
PO4	Use of Tools: Learn about the application of Different statistical tools and techniques so as to arrive at suitable decision for the laboratory Experiments
PO5	Individual team work Have knowledge about the good laboratory practices and safety.
PO6	Communication Skills :Inculcate communication skills and learn interview participation techniques for acquiring proper placement.
PO7	Impacts of course as society and Environment:Understand the emerging trends in the different branches of Zoology especially Metabolism,Molecular Biology,Cell Biology,Microbiology and Immunology and their impact on society and demonstratethe knowledge required for sustainable development of Industry and service sector. **Social Responsibility:**Apply reasoning provided by the continual knowledge to assess societal legal and cultural issues and consequent responsibility relevant to Biophysical and Biochemical Techniques, Immunological Techniques, Zoological tools ,agriculture based and health related sectors. The broad skills and the deeper knowledge in the field would make the students highly successful and excellent researcher in advanced areas of biological sciences

PROGRAMME SPECIFIC OBJECTIVES

PSO1	Acquire knowledge in basic Zoological sciences and concepts in cell Biology immunological Techniques and different advanced techniques in Biology .
PSO2	Understand the value of Microbiology, Animal Biotechnology and Biodiversity and wild life conservation and also acquire skille in becoming zoologists.
PSO3	Acquire Knowledge in the field of Bioinformatics , Biostatistics and obtain skills in Microbiology and Animal Biotechnology.

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PROGRAMME STRUCTURE WITH COURSE TITLES:

S. No.	Course code	Course/Subject	No. of credits	Internal Marks	External Marks	Total
Semester – I						
1	20RMSCZOO101	Invertebrata & Chordata	4	30	70	100
2	20RMSCZOO102	Cell Biology & Immunology	4	30	70	100
3	20RMSCZOO103	Animal Physiology & Endocrinology	4	30	70	100
4	20RMSCZOO104	Biophysical and Biochemical Techniques	4	30	70	100
5	20RMSCZOO105	Practical -I:ZOO-101&102	4	---	100	100
6	20RMSCZOO106	Practical -II:ZOO-103&104	4	---	100	100
Semester – II						
1	20RMSCZOO201	Genetics and Evolution	4	30	70	100
2	20RMSCZOO202	MolecularBiology	4	30	70	100
3	20RMSCZOO203	Chemistry of bimolecules	4	30	70	100
4	20RMSCZOO204	Developmental Biology	4	30	70	100
5	20RMSCZOO205	Practical -III:ZOO-201&202	4	---	100	100

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6	20RMSCZOO206	Practical -IV:ZOO-203&204	4	---	100	100
Semester -III						
1	20RMSCZOO301	Environmental Biology & Biodiversity Conservation	4	30	70	100
2	20RMSCZOO302	Enzymology &Metabolism	4	30	70	100
3	20RMSCZOO303	Animal Biotechnology &Micro Biology	4	30	70	100
4	20RMSCZOO304	(A)Aquaculture	4	30	70	100
5	20RMSCZOO305	(B)Animal Husbandry and Dairy Technology	4	30	70	100
6	20RMSCZOO306	Practical -V:ZOO-301&302	4	---	100	100
7	20RMSCZOO307	Practical -VI:ZOO-303&304	4	---	100	100
SEMESTER – IV						
1	20RMSCZOO401	Neurobiology and Animal Behaviour	4	30	70	100
2	20RMSCZOO402	Applied Toxicology	4	30	70	100
3	20RMSCZOO403	Biostatistics and Bioinformatics	4	30	70	100
4	20RMSCZOO404	(A)Genetic Engineering	4	30	70	100
5	20RMSCZOO405	(B)Wild life Conservation Biology	4	30	70	100
6	20RMSCZOO406	Practical -VII:ZOO-401&402	4	----	100	100
7	20RMSCZOO407	Practical -VIII:ZOO-403&404	4	----	100	100

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PROGRAMME	**M.Sc Zoology**	**SEMESTER**	**I**
COURSE CODE & TITLE	**20RMSCZOO101: INVERTEBRATA AND CHORDATA**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1. To comprehend the systematic position, functional morphology, mode of life, affinities and diversity of invertebrates. 2. To Understand the ICZN Procedures, Coelom, Fate of Blastopore, Different patterns of Feeding, Torsion In Mollusca and Water Vascular system in Echinoderms 3. To understand the comparative study of different systems in Annelida, Arthropoda and in Mollusca 4. To comprehend the systematic position, functional morphology, mode of life, affinities and diversity of chordates. 5. To understand about the geological time scale and different significant events in it 6. To understand about the skin and its derivatives with various exoskeletal parts and their importance 7. To understand about the various systems and their comparative study in different taxonomic groups		

UNIT	CONTENT	NO. OF HOURS
I	**Taxonomy and Organizational Coelom, Nutrition and Digestion** Species concept, International code of Zoological nomenclature, Taxonomical procedures, New trends in taxonomy. Acoelomata, Pseudocoelomata, Coelomata, Proterostornia and Dueterostornia. Patterns of feeding and digestion in lower metazoan. Feeding in polychaeta, Mollusca, Echinodermata. Tortion in Mollusca, Water vascular system in Echinoderms	15
II	**Respiration, Circulation, Nervous system and Larval forms** Respiration: Structure of Gill, Lung and Trachea and Mechanism of respiration. Circulation: Circulation system in Annelids, Arthropods and Mollusca. Nervous System: Nervous system of Annelida, Arthropoda and Mollusca. Larval forms of Crustaceans and Echinodermata and its phylogenetic significance.	15
III	Evolutionary time scale, Eras, Periods & Epoch major events in evolutionary time Scale.Vertebrate integument and derivatives, Skin structure and function, Glands, Scales, Horns, Claws, Nails, Hoofs, Feathers, Hair.Comparative anatomy of Heart, Aortic arches and portal system.Comparative account of Excretory system.	15
IV	Comparative Anatomy of Respiratory organs,Comparative Anatomy of Brain and Spinal cord,Organs of Vision: Structure and Functional Significance,Organs of Hearing and tactile responses	15

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<table>
<tr><td>REFERENCES</td><td colspan="3">1. Barrington, EJ. W. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd., London.
2. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
3. Hyman, L.H. The Invertebrates. Vol. 1-8. Mc Graw Hill Co., New York and London.
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11. Carter, GS. Structure and Habit Invertebrate Evolution Sedwick and Jackson, London.
12. Eecles, J. C. The Understanding of the Brain. Mc Graw Hill Co., New York and London.
13. Kingsley, J.S.Outlines of Comparative Anatomy of Vertebrates. Central Book Depot, Allahabad</td></tr>
<tr><td rowspan="5">COURSE OUTCOME</td><td colspan="2">On the successful completion of course students will be able to</td><td>Knowledge</td></tr>
<tr><td>CO1</td><td>Demonstrate knowledge of Species Concept,Zoological Nomenclature, feeding and digestion in different phyla</td><td>K2</td></tr>
<tr><td>CO2</td><td>Understand the Respiration,circulation,nervous system in Different Invertebrates ,crustacean and echinoderm larval forms</td><td>K2</td></tr>
<tr><td>CO3</td><td>Understand the Evolutionary time scale, vertebrate integument, Heart, and Excretion</td><td>K2</td></tr>
<tr><td>CO4</td><td>Gain the knowledge of comparative anatomy of Respiration, Central Nervous system, organs of vision and hearing</td><td>K3</td></tr>
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COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	3	2	3	2	2	1	3	2	1
CO2	3	3	2	3	2	2	1	2	1	2
CO3	3	2	3	2	3	2	1	2	3	2
CO4	2	3	2	3	2	2	1	3	2	1

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PROGRAMME	**M.Sc Zoology**	**SEMESTER**	**I**
COURSE CODE & TITLE	**20RMSCZOO102:CELL BIOLOGY AND IMMUNOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1. This course will provide knowledge about the complex organization in the eukaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types. 2. It will also make them understand the relationship between the physiological processes at the cellular and organismic levels. 3. Students are taught the basics of immunology so as to develop understanding of the subject, such as how the immune system does works. 4. The course also emphasizes the research and development opportunities for therapeutic intervention arising from recent advances in immunology. 5. The immunological aspects of disease will also be discussed using case-based studies.		

UNIT	CONTENT	NO. OF HOURS
I	**CELL BIOLOGY** : The Cytoskeleton: The Cytoskeletal elements, Microtubules, shaping of the cell and mechanical support, Microfilaments, intermediate filaments, cytoskeletal architecture. (Red blood cells, platelfibroblasts, epithelial cells, endothelial cells) Regulation of Cell cycle, Cyclins, Cyclin dependent kinases. Mitochondria and Cell energetics, Enzyme distribution in mitochondria Bioenergetics: Molecular organization, biogenesis and functions of mitochondria, Oxidative Phosphorylation, the chemical - conformational Hypothesis. The development and causes of cancer, tumor viruses, oncogenes, Cancer suppressor genes, prevention and treatment. Regulation of programmed cell death, caspases and apoptosis, cell death receptors and caspase activation, signaling cell survival.	15
II	**CELL SIGNALING**: Models of cell-cell signaling (steroid receptors, nitric oxide and carbon monoxide) Functions of cell surface receptors (G-protein coupled receptors, Tyrosine kinases, cytokine receptors, receptors linked to other enzymatic activities). Pathways of intracellular signal transduction (cAMP pathways, cyclic GMP, phospholipids and Ca^{2+}). Signalling in development and differentiation (Ras, MAP kinase pathway in Drosophila, notch signalling)	15

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IV	Hypersensitivity – Classification, mediators, mechanism, consequences of hypersensitive reaction. Auto immunity- Concept of tolerance of autoimmune disorders, basis for therapy and autoimmune disorders. Transplantation – Transplantation antigens, mechanisms graft rejection, graft versuses host reaction, immune suppressors. Tumor immunity –Tumors of immune system, immune responses against tumors. Immunodeficiency – Primary, secondary and combined immune deficiency, AIDS. Vaccines – Concept of immunization, routes of vaccination. Types of Vaccines – Whole organism (attenuated and inactivated) and component vaccines.	15
PRACTICALS	**CELL BIOLOGY AND IMMUNOLOGY** 1. Use of Compound and dissection microscope and capturing images. 2. Observation of various stages of Mitotic and meiotic divisions using Onion root tips by squash preparation method. 3. Observation of Giant chromosomes in the salivary glands of Chironomus larvae. 4. Gram staining technique for visualization of prokaryotic cells. 5. Blood Smear Preparation and observation. 6. Mounting of Buccal epithelium. 7. Permanent slides: a) Columnar Epithelium; b) Ciliated Epithelium; c) Glandular Epithelium; d) Cartilage T.S.; e) Bone T.S.; f) Cardiac muscle; g) Striated Muscle; h) Non striated muscle; i) Neuron; j) Male germ cell; k) Female germ cell **IMMUNOLOGY:** 1. Total count of RBC and WBC using Haemocytometer 2. Estimation of haemoglobin using Sahli's haemoglobinometer. 3. Preparation of haemin and haemochromogen crystals. 4. Blood smear preparation – Differential count of WBC 5. Immunoelectrophoresis 6. Estimation of antigen concentration by using rocket electrophoresis technique. 7. Antigen & antibody reaction - Human Blood Grouping & Rh typing by haemagglutination test. 8. Dot immune binding assay to detect antibodies in the serum. 9. To perform ELISA/dot ELISA (using kit)/sandwich ELISA test 10. Determination of Coagulation time & Bleeding time	

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11. Immunology. Male, D., J. Brostoff, D.B. Roth and I. Roitt. 2006. Elsevier, Canada.
12. Immune modulating Agents. Kresina, T.F. 1998. Marcel Dekker, New York.

COURSE OUTCOME

On the successful completion of course students will be able to		Knowledge
CO1	Understand the importance of cytoskeleton cellular Resspiration in mitochondria, causes of cancer and regulation of programmed cell death	K2
CO2	Demonstrate Knowledge of cell signaling	K3 & K2
CO3	Gain the Knowledge of phylogeny of Immune system and Lymphoid organs.	K3 & K2
CO4	Understand the importance of Hyper sensitivity ,Transplantation Tumor immunity and vaccines	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	2	1	3	2
CO2	2	3	3	1	2	2	1	2	1	2
CO3	3	2	3	2	2	2	1	2	2	1
CO4	2	3	3	2	1	2	2	1	2	1

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PROGRAMME	**M.Sc Zoology**	**SEMESTER**	I
COURSE CODE & TITLE	**20RMSCZOO103: ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1. This paper is aimed to introducing the students for comparative Animal Physiology &Endocrinology 2. It is aimed to make the students understand about various aspects like Comparative physiology of Digestion, Respiration, Metabolism and circulation of body fluids, Osmoregulation, thermoregulation, biological rhythms, bioluminescence, chromatophores and their role in colour production, Muscles and their contractile mechanisms. 3. It is also aimed to make the students acquainted with the knowledge of neuro-endocrine system, endocrine glands and their secretions ,mechanism of endocrine hormonal action and chemical structure and functions of Hormones 4. It is also to make the students to know about hormonal control of various systems like Reproduction, Moulting, Metamorphosis, Digestion and Mineral metabolism		

UNIT	CONTENT	NO. OF HOURS
I	**ANIMAL PHYSIOLOGY** 1 .1 Aim and Scope of Physiolog ,Physiological Functions and Principles. 1 .2 Feeding Mechanisms and Regulation. Comparative Physiology of Digestion. 1. 3 Respiration and Metabolism. Circulation of body fluids. 1.4 Patterns of nitrogen excretion among different animal groups. Osmo regulation in different animal groups.	15
II	**ANIMAL PHYSIOLOGY** 1. Thermoregulation, Homeothermic animals, poikilothermic animals. Hibernation and aestivation. 2. Biological rhythms & Bioluminesence - Mechanism of light production, Control of bioluminescence, Functions of luminescence. 3. Chromatophores and Regulation of their function - Color production, Chromatophore pigmen Mechanism of action of Chromatophores, Movement of pigment, Control of Chromatophores, Factors influence in Chromatophore System. 4. Contractile elements, cell, and tissues among different phylogenetic groups. Muscle structure and function.	15

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III	**ENDOCRINOLOGY** 1. Introduction to Endocrinology–Function and classification of hormone. Characteristic features of Hormones. 2. Organization and function of neuro endocrine system. Classification and Chemical nature of Hormones. Biosynthesis and Secretion of hormones. Corticosteroid hormones-Peptide hormones- Catecholamines. Hormones of Insects. 3. Anatomy, Secretions and Functions of Endocrine organs Pituitary, Thyroid, Adrenal and Pancreas, Gonads and their hormones. 4. Mechanism of hormone action. Hormone Receptors, Receptor structure and Signal transduction mechanism- G-protein family. Structure and function of Nuclear Receptors, Organ Receptors. Termination of hormone action.	15
IV	**ENDOCRINOLOGY** 1. Hormonal regulation in Digestive System: Gastrin, Secretin, Insulin, Glucagon. 2. Reproductive Endocrinology: Structure of mammalian testis and ovaries. Hormonal regulation of Reproductive system: Hormones in female sexual cycle, Hormones of Pregnancy and parturition, Hormonal control of spermatogenesis. 3. Neuro endocrine system in Insects and Crustaceans. Control of Moulting, Metamorphosis and Reproduction. 4. Hormonal regulation of Mineral metabolism - Ca2, PO4, glucose, water, Temperature	15

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COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Perception of Physiological functions and Principles,Feeding,Mechanism,Respiration ,Circulation and excretion in different animal groups	K2
	CO2	Understand the Thermoregulation, Biological Rhythms, Chromatophores and Contractile elements in different phylogenetic groups	K3 & K2
	CO3	Gain the knowledge on structural anatomy of Neuro Endocrine system and Mechanism of Hormone action	K3 & K2
	CO4	Acquire the knowledge of Hormonal regulation ,Reproductive Endocrinology, Insect Endocine system and hormonal Regulation of Mineral Metabolism	K4

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	2	3	2
CO2	2	3	3	1	2	2	1	1	2	1
CO3	3	2	3	2	2	2	1	2	2	3
CO4	2	3	2	3	2	2	1	1	3	2

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PROGRAMME	**M.Sc. Zoology**	**SEMESTER**	I
COURSE CODE & TITLE	**20RMSCZOO104: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1. To provide general overview of different biochemical experimental approaches to understand the structure and functions of cell and its components. 2. It is aimed to provide a detailed insights into different advanced techniques like Electrophoresis, Chromatography, blotting techniques, Spectroscopy, Radioisotope techniques in the study of Life sciences Course specific Objectives 3. Aquiring the Knowledge of Different techniques used in Biology 4. To understand the concepts in of Biophysical and chemical Techniques like Electrophoresis,Spectroscopy and tools and Techniques in histology.		

UNIT	CONTENT	NO. OF HOURS
I	Molarity and Normality. Measurement of pH, Biochemical buffers. Cell disruption methods – French press, Sonication, Freeze-thaw techniques, Enzymatic method, use of Liquid Nitrogen in Cell disruption. Centrifugation - Basic principles of sedimentation, types of centrifuges and rotors. Preparative Ultracentrifugation – Differential centrifugation, density-Gradient, Analytical Ultra Centrifugation and its Applications.	15
II	Separation methods - General Principles and definitions. **Methods based on Polarity**- Chromatography & Types: Thin layer Chromatography, Gas- liquid Chromatography and Reverse-phase Liquid Chromatography. **Methods based on size**- Principle of Gel filtration, Methodology and Applications. Dialysis, Ultra filtration, Lyophilization. **Methods based on affinity** - Principle of Affinity Chromatography, methodology and applicationsHigh-Performance Liquid Chromatography and Ion - Exchange Chromatography - Principle, Instrumentation, Practical procedure and Applications.	15
III	Electrophoresis – General principles and definitions PAGE, 2D electrophoresis, identification of novel proteins in 2D gels, Capillary electrophoresis. Agarose gel Electrophoresis: Preparation, Separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications, Recovery of DNA from Agarose gels. Pulse - field gel electrophoresis (PFGE) - Principle, methodology and applications in separation of large DNA fragment. Blotting techniques - Western, Southern and Northern.	15

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IV	Spectroscopy - Principles, laws of light absorption. Instrumentation and applications of UV- Visible spectrophotometer, Fluorescence Spectroscopy, NMR, ESR. Mass Spectroscopy. Radioisotope techniques – Types of isotopes, radioactive decay. Detection and Measurement of Radioactivity. GM counter Autoradiography. Preparation of labeled compounds – Pulse chase studies and Tracer techniques, Isotopes used in biology, safety methods in handling Radioisotopes. Tools and Techniques in histology: Principles, design and functioning of microtomes, Sample preparation, fixatives and types. Processing of tissues: dehydration, embedding, block making, staining, dyes and dye binding reactive groups, mordants and mordanting, temporary and permanent preparations.	15
PRACTICALS	**BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES** 1) Separation of coloured pigments by using Paper Chromatography. 2) Separation of plant pigments using Thin Layer Chromatograpy. 3) Salivary proteins separation by using SDS-PAGE technique. 4) Separation of DNA fragments by using Agarose Gel Electrophoresis. 5) Zebrafish gonadal tissue Fixation using Bouin's fluid. 6) Block preparation of tissue. 7) Phosphate buffer preparation by using pH Meter. 8) Proteins precipitation by using Ammonium sulphate. 9) Quantification of DNA by using UV-Vis Spectrophotometer. 10) Separation of cell organelles by using high speed Centrifuge	

REFERENCES

1. Separation methods in biochemistry by S. J. Morris and P. Morris (Pitman).
2. The tools of Biochemistry by Terrance G. Cooper (Wiley)
3. Biochemical research technique (A practical introduction by Ed. John M Wriggles worth. 4) Analytical biochemistry by David J. Holmes and Hazel peck.
4. A Biologist' s guide to principles and techniques of practical biochemistry, 2nd edition Ed. by B L. Williams and K. Wilson (Edward Arnold).
5. Biophysical chemistry D. Freifelder, W. H. Freeman.
6. Principles of Physical Biochemistry by E. Vanholdem W. C. Johnson, P. S. Ho, (Prentice Hall), 1998.
7. Biophysics – Edited by W. Hoppe, W. Lehman Hi. Maskal and H. Ziegler (Springer - Verlag, Berlin) 1983.
8. Practical biochemistry: Principles & Techniques - Edited by Wilson & Walker Cambridge Univ. Press New York) 1986.
9. Biological Spectroscopy by Iain D. Campbell and Raymond A. Dwek, the Benjamin / Cumming Pub. Co., California, London.
10. Biophysical Chemistry by C. R. Cantor and P. R. Schimmel, W. H. Freeman & Co.,
11. Introduction to Biophysical Methods for Protein and Nucleic Acid Research, Ed. J. A Glasel and M.P. Deutscher, (Academics Press), 1995.

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Understand the importance of Cell Disruption methods,Centrifugation,and their applications	K2

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	CO2	Demonstrate the knowledge of separation methods based on polarity ,size and affinity	K2
	CO3	Gain the Knowledge of Electrophoresis, and Blotting Techniques	K3
	CO4	Understand the importance of Spectroscopy, Radioisotope, and histology Techniques	K3

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	2	1	3	2	2
CO2	2	3	2	1	3	2	2	1	3	1
CO3	2	3	2	1	2	3	2	3	3	2
CO4	2	3	2	3	2	1	3	2	1	2

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PROGRAMME	**M.Sc. Zoology**	**SEMESTER**	I
COURSE CODE & TITLE	**20RHVPE101: HUMAN VALUES AND PROFESSIONAL ETHICS**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1. The aim of this course is to familiarize students with the concepts of human values, self introspection and self esteem to avoid harm to others. 2. It helps the students to appreciate the responsibilities of family and the role of woman in family and society. 3. The course will focus on significance of human rights in the development of society and the violation of human rights.		

UNIT	CONTENT	NO. OF HOURS
I	**Value Education** Definition Relevance to present day — Concept of human values — Set introspection — Self esteem. Family values — Components, Structure and responsibilities of family — Neutralization of anger Adjustability Threats of family life Status of women in family and society — Caring for needy and elderly — Time allotment for sharing ideas and concerns. (Theory only)	12
II	**Medical Ethics:** Views of Charaka, Sushruta and Hippocrates on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Eluthanasia, Ethical obligation to animals, Ethical issues in relation to health care professionals and patients. Social justice in healthcare, human cloning, problem of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge. (Theory only)	12
III	**BUSINESS ETHICS** Ethical standards of business Immoral and illegal practices and their solutions. Characteristics of ethical problems in management, Ethical theories, causes of unethical behavior, Ethical abuses and work ethics. (Theory only)	12
IV	**ENVIRONMENTAL ETHICS:** Ethical theory, man and nature — Ecological crisis, Pest control. Pollution and waste, Climate change, Energy and pollution, Justice and environmental health. (Theory only)	12
V	**SOCIAL ETHICS** Organ trade, Human trafficking, Human rights violation and social disparities. Feminist ethics, Surrogacy pregnancy. Ethics of media Impact of Newspapers, Television, Movies and Internet (Theory only).	12

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REFERENCES

1. Johns S Mackenjie: A Manual of ethics
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response
4. Books, New Delhi.
5. "Ethics in Management" by S.A. Shelekar, Himalaya Publishing House.
6. Harold H. Titus: Ethics for Today
7. Maitra, S.K: Hindu Ethics
8. William Lilly: Introduction to Ethics
9. Sinha: A Manual of Ethics
10. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.

COURSE OUTCOME

On the successful completion of course students will be able to		**Knowledge**
CO1	Demonstrate knowledge of human values and family values	K2
CO2	Understand the moral responsibility of medical practitioners	K2
CO3	Demonstrate the characteristics of ethical problems in business	K3
CO4	Gain the knowledge of remediation for environmental pollution	K3
CO5	Understand the Human rights violation and social disparities	K3

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	2	3	2
CO2	2	3	3	1	2	2	1	1	2	1
CO3	3	2	3	2	2	2	1	3	2	3
CO4	2	3	2	3	2	2	1	2	3	2
CO5	2	2	3	1	3	-	1	2	1	3

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PROGRAMME	**M.Sc Zoology**	**SEMESTER**	**II**
COURSE CODE & TITLE	**20RMSCZOO201: GENETICS AND EVOLUTION**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1. The course provides an insight into the life processes at the subcellular and molecular levels. 2. Other important aspects include DNA and molecular genetics including gene cloning. 3. The origin of life and the related evolutionary processes. 4. The evolutionary theories and the process of species formation will be elaborated in view of the natural selection process.		

UNIT	CONTENT	NO. OF HOURS
I	**GENETICS:** Concept of Gene: Allelles, Multiple alleles (Characters, symbolism, ABO blood grouping, Bombay Phenotype and Rh factor), Pseudo alleles: Interaction of genes (Lethal genes, Complementary genes, duplicate genes). Genome organization in prokaryotes and Eukaryotes, Microbial genetics (Methods of genetic transfers – Transformation, Conjugation, Transduction and Sexduction), Human Genome – Heirarchy and Classification. Gene mapping methods: Linkage – complete and Incomplete linkage; Linkage maps, Recombination, mapping with molecular markers, somatic cell hybrids. Crossing over: Types (Somatic or mitotic crossing over and Germinal or meiotic crossing over), Theories about the mechanism of crossing over, tetrad analysis, and cytological detection of crossing over.	15
II	**GENETICS** **Mutations**: Types (Spontaneous and Induced), Causes and Detection, Mutant types (Lethal, Conditional, biochemical, Loss of function, Germinal versus somatic mutants), Molecular basis of Mutations. Chromosomal aberrations (Deletion, Duplication, Inversion and Translocation, Ploidy and their genetic implications); Autosomal abnormalities (Down's Syndrome, Trisomy – 13, -18); Sex Anomalies (Turner'ssyndrome, Klinefelter's Syndrome, Hermaphroditism). **Human genetics**: Pedigree analysis – gathering family history, pedigree symbols, construction of pedigrees. Human traits – (sex linked inheritance, sex limited and sex influenced traits) MIM number. Genetic disorders – Monogenetic disease, triplet repeat based disorders, Inborn metabolic errors & disorders of haemopoietic systems. Eugenics (Positive Eugenics – Artificial insemination and sperm banks; Negative Eugenics – consanguinity, genetic counselling); Euphenics (Intake of missing enzyme, cure for inherited anemia, Increasing role of genetics to medicine).	15

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III	**A BRIEF ACCOUNT ON THEORIES OF ORGANIC EVOLUTION** Evolutionary Time scale. Chemical origin of life.Darwinism, Neo Darwinism, Lamarkism. Isolation – definition, types – Role of isolation mechanisms.Models of speciation (Allopatric, Sympatric and Parapatric)	15
IV	**POPULATION GENETICS AND MOLECULAR EVOLUTION** A detailed account on destabilizing forces (i) Natural Selection (ii) Mutation (iii) Genetic Drift(iv) Hardy Weinberg law. Phylogenetic gradualism & punctuated equilibrium, Gene evolution and phylogeny. Micro, Macro evolution and Mega evolution.Gene Evolution and Phylogeny; Evolution of Man, origin of Man, special features of primates.	15
PRACTICALS	**GENETICS** 1. Spotters: Normal Human Karyotype, Down's syndrome, Klinefelter's and Turner's syndrome. 2. Calculate allelic frequency by Hardy-weinberg law. 3. Preparation of Polytene chromosome from Chironomous larvae. 4. Methodology for constructing Human Pedigree. 5. Preparation of metaphase chromosomal spreads of one vertebrate. 6. Enzyme polymorphism in natural population. 7. Concept of genetic disorder databases and demonstration of use of OMIM. 8. Genetic monitoring (using immunogenetic marker) in laboratory animals. 9. Open field Activity test and Elevated plus maze test for anxiety levels in laboratory mice. **EVOLUTION** 1. Study of fossil evidence from plaster cast models and pictures. 2. Study of homology and analogy from suitable specimens/ pictures. 3. Demonstration of changing allele frequencies with and without selection. 4. Construction of cladogram based on morphological characteristics. 5. Construction of phylogenetic tree with bioinformatics tools (Clustal W and Phylip). 6. Interpretation of phylogenetic trees. 7. Study of Fossils (Ammonoids, Nautiloids & Echinoderm fossils).	

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REFERENCES

1. Genetics - MonrveW. Strickberger. 3rd Ed., May, 2000.
2. Genetics- K. B. A llluwallia-1985.
3. Principles of Genetics - EJ. Gardner. MJ. Simmons & D.P. Snustad.
4. Molecular Biology of genes - Watson, J. D., N. H. Hopkins, J. W. Roberts, J. A. Steitz & A. M. Weiner. The Benjamin Cummings publishing company. Inc. Tokyo.
5. Basic Human Genetics - EJ. Mange, Arthur P. Mange. Indian Print, 1997.
6. Genetic disorders of Man by M. R. Good man.
7. An introduction to modem genetics by Ch. Waddinsgton.
8. Dobzhansky, Th. Genetics and origin of species, Columbia University press.
9. Genetics - Monrve W. Strickberger. 3rd Ed., May, 2000.
10. Genetics- K. B. Ahluwallia-1985.
11. Principles of Genetics - EJ. Gardner. M J. Simmons & D.P. Snustad.
12. Dobzhansky, Th., F.J. Ayala, GL. Stebbin and J.M. Valentine volution: Surjeet publications, New Delhi latest edition.
13. P.A. Moody Introduction to Evolution II ed/latest: Kalyani publishers, New Delhi.

COURSE OUTCOME

On the successful completion of course students will be able to		Knowledge
CO1	Demonstrate knowledge of Concept of Gene,Genome organization ,Gene mapping and types of Crossing Over	K2
CO2	Understand the mutations,Pedigree Analysis,Eugenics and Euphenics	K2
CO3	Demonstrate the Evolutionary time scale ,Concepts of Darwinism, Isolation and Models of Speciation	K3
CO4	Gain the knowledge of Population Genetics and Molecular Evolution	K3

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	1	1	2	3	2
CO2	2	3	3	1	2	2	1	3	2	1
CO3	3	2	3	2	2	2	1	2	2	3
CO4	2	3	2	3	2	2	1	1	3	2

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PROGRAMME	**M.Sc Zoology**	**SEMESTER**	II
COURSE CODE & TITLE	**20RMSCZOO202: MOLECULAR BIOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1. To understand the molecular nature of Genome and DNA damage and repair 2. To get knowledge about the DNA replication 3. To understand the mechanism of Transcription ,Translationand post translational modifications 4. To make students understand how molecular machines are constructed and regulated so that they can accurately copy, repair, and interpret genomic information in prokaryotes and eukaryotic cells. 5. Further, to appreciate the subject of molecular biology as a dynamic and ever-changing experimental science.		

UNIT	CONTENT	NO. OF HOURS
I	**MOLECULAR NATURE OF GENOME** Properties of DNA (C – Value paradox, Cot Value). Nuclear and mitochondrial genome.Structure of Gene (Cistron, Muton, Recon, Cis- trans test).DNA damage and repair: Biological induction of repair, Photo reactivation, Excision repair, Recombination repair, SOS repair, and Mismatch repair	15
II	**REPLICATION** Replication in Prokaryotes: *Geometry* of DNA replication, semi conservative replication. Enzymology of DNA replication: DNA polymerase I, II and III; Replication of Eukaryotic chromosomes; Eukaryotic DNA polymerases; Multiple forks; Replication of Chromatin. Discontinuous Replication: Fragments in replication fork and detection of fragments; replication fork; De novo initiation and covalent extension. Events in the Bidirectional replication,Termination of replication.	15
III	**TRANSCRIPTION AND TRANSLATION** Transcription, Enzymes and molecular mechanisms involved in transcription Processing of rRNA, tRNA and mRNA in Prokaryotes and Eukaryotes Translation: Genetic code, Polypeptide chain initiation, elongation and termination Post-translational modifications, Role of antibiotics in protein synthesis.	15
IV	**GENE EXPRESSION AND MOLECULAR BIOLOGY TECHNIQUES** Genetic regulation: Induction, Repression, Lac Operon, Lambda Operon Tryptophan operon, Britten and Davidson model for eukaryotic regulation DNA sequencing, DNA finger printing, Polymerase chain reaction cDNA library, Genomic library, Micro arrays	15

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PRACTICALS	**MOLECULAR BIOLOGY** 1) Isolation and Purification of genomic DNA from bacteria 2) Isolation and Purification of plasmid DNA 3) Agarose gel electrophoresis of chromosomal and plasmid DNA 4) Restriction Digestion of chromosomal and plasmid DNA 5) Seperation of DNA fragment from agarose gel 6) Quantitativeestimation of RNA using Orcinol method. 7) Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).	

REFERENCES

1) Molecular Biology by David Freifelder, 1993
2) Molecular Biology of Gene by D.Watson, 1988
3) Harper's review of Biochemistry by D.W. Martin et al., 1990
4) Biochemistry by A.L. Lehniger
5) Cell and Molecular Biology- E.D.P. De Robertis and E.M .F.
6) Concepts in Molecular Biology- S.C. Rastogi, V.N. Sharma and Ananda Tandon (1993)
7) Genes - VII by Benjamin Lewin.

COURSE OUTCOME

On the successful completion of course students will be able to		**Knowledge**
CO1	Demonstrate knowledge of Molecular nature of Genome	K2
CO2	Understand the Replication in Prokaryotes and Eukaryotes	K2
CO3	Demonstrate the organization and function of Trancription and Translation.	K3
CO4	Gain the knowledge of Gene expression and Molecular BiologyTechniques	K3

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	3	2	2
CO2	2	3	3	1	2	2	1	2	1	1
CO3	3	2	3	2	2	2	1	2	3	3
CO4	2	3	2	3	2	2	1	3	2	2

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PROGRAMME	**M.Sc Zoology**	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCZOO203: CHEMISTRY OF BIOMOLECULES		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1) The course provides an introduction to the structure of biomolecules 2) To provide knowledge about the structure and function of Carbohydrates ,proteins and Lipids. 3) To understand the concepts of Protein folding and forces responsible for protein stability. 4) To gain knowledge about Ramachandran plot 5) To understand the structure and types of DNA and RNA		

UNIT	CONTENT	NO. OF HOURS
I	Principles of thermodynamics. pH, pKa, acids, bases, buffers, chemical bonding, properties of water Carbohydrates- classification and properties of carbohydrates, monosaccharides, disaccharide, polysaccharides. Sugar acids, alcohols, deoxy sugars and amino sugars. Structure and functions of mucoplysaccharides. Lipids – Classification, structure and biological function of fatty acids, glycolipids, triacylglycerols, phospholipids, terpenes and steroids. Physico-chemical properties and analysis of fats and oils. Structure and functions of prostaglandins, leukotrienes, thromoboxanes. Types and function porphyrins, pigments, growth regulators.	15
II	Amino acids – Classification, Essential and non-essential amino acids, Isomerism. Biosynthesis of non-essential amino acids. Acid-base titrations of amino acids. Physical and chemical properties of amino acids. Structure of peptides and types – Properties of peptides. Peptide synthesis by solid-phase technique.	15
III	Proteins-classification, isolation and purification of protein, criteria of homogeneity. Structure of proteins-primary, secondary, tertiary and quaternary structure of proteins. Protein folding – anfinsen's experiment on ribonuclease and Creighton's studies of BPT1. Forces responsible for protein stability, Ramachandra Plot-Protein folding. Denaturation and Renaturation of proteins – Effect of melting temperature, salt and chaotropic agents. Structure and function of glycoproteins and lipoproteins.	15

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IV	Nucleic acids – structure of purines, pyrimidine, nucleosides and nucleotides, Watson and Crick double helix structure. Properties and functions of nucleic acids (DNA and RNA). Different forms of DNA (A, B and Z forms), DNA base composition and Chargoff's rule. RNA types (mRNA, rRNA, tRNA and snRNA). Three-dimensional structure of RNAChemical difference of DNA, RNA and significance. Isolation of nucleic acids, denaturation and renaturation of nucleic acids cot curves and chemical synthesis of DNA	15
PRACTICALS	**CHEMISTRY OF BIOMOLECULES** 1)Estimation of protein by Biuret method. 2). Estimation of protein by Lowry's method. 3) Estimation of Enzyme activity (e.g. Urease). 4). Effect of pH and temperature on enzyme activity- Amylase. 5). Effect of substrate concentration on enzyme activity. 6). Purification & Estimation of Casein in milk. 7). Estimation of cholesterol. 8). Estimation of glycogen. 9). Estimation of lipids & phospholipids. 10). Estimation of sugars	

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1. Textbook of Biochemistry. West and Todd. 1968. Mac Millan, New York.
2. Principles of Biochemistry. Lehninger, A. L. 1993. C. B.S., India.
3. Biochemistry. Voet, D and J. Voet. 1995. 2nd Edn. 1995. John Wiley and Sons, USA.
4. Harper's Biochemistry. Murray, R. K., D. K. Granner, P. A. Mayes and V. W. Rodwell. 2002. Mc Grew Hill Publishing Company, New Delhi.
5. Biochemistry. Berg, J. M., L. J. Tymcozko and L. Stryer, 2002. 5th Edn. W. H. Freeman and Company, New York.
6. Textbook of Biochemistr y with Clinical Correlation. Devlin, T. M. 1997. 4th Edn. Wiley-Liss, New York.
7. Introductory Practical Biochemistry. Sawhney, S. K and R. Singh. 2001. Narosa Publishing House. New Delhi.
8. Biochemistry. Lehninger. A.L. 1978. 2n d Edn. Kalyani Publishers, New Delhi.

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Understand the importance of Carbohydrates and Lipids	K2
	CO2	Demonstrate Knowledge of Aminoacides.	K2
	CO3	Gain the Knowledge of Protein structure .	K3
	CO4	Understand the concepts in the structure of DNA&RNA	K3

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COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	2	2	3	1
CO2	2	3	2	2	3	3	3	3	2	2
CO3	3	2	2	3	3	2	3	2	3	3
CO4	2	1	1	2	1	2	2	3	2	2

PROGRAMME	**MSc Zoology**	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCZOO204: **DEVELOPMENTAL BIOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1. The major objective of this course is to provide students with a sound coverage of human reproductive biology within the framework of Human Biology. 2. It also envisages the detailed structure and function of the male and female reproductive tracts, gametogenesis, fertilization, early embryogenesis, 3. Provide the knowledge about foetal development, preparation for birth, and maternal adaptations to pregnancy.		

UNIT	CONTENT	NO. OF HOURS
I	**INTRODUCTION TO DEVELOPMENTAL BIOLOGY.** Introduction to developmental biology. Gametogenesis, Spermatogenesis, structure of sperm. Oogenesis – origin and growth of oocyte, maturation of egg, egg envelops, vitellogenesis Types of eggs – Fate maps. Events of fertilization – Formation and structure of Acrosome; Acrosomal reaction (pre fertilization events).	15
II	**CELLULAR DIFFERENTIATION** Cleavage– Patterns of cleavage – radial, spiral and bilateral; Types – meroblastic, holoblasticand superficial – factors affecting cleavage. The unique nature of mammalian cleavage. Cellular differentiation – cyto differentiation and chemo differentiation. Stem cells –totipotency and pleuripotency. Embryonic stem cells and their applications. Blastulation: Marula, Blastula–Mammalian gastrulation, Formation of extra embryonic membranes and sacs. Placenta: Types of placenta and formation of placenta	15

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III	**ORGANOGENESIS** Nucleus cytoplasmic interaction in embryonic development. Formation of Axis: Axis formation in mammals, Morphogenetic movements and gastrulation. Organogenesis – Ectodermal derivatives: formation of central nervous system – development of brain, eye in frog. Mesodermal derivatives: heart and kidney in frog. Regeneration: Types of regeneration – amphibian limb regeneration – stimulus and suppression of regeneration. Hormonal regulation of metamorphosis: in Amphibian and Insects	15
IV	Environmental regulation of normal development. Chromosomal sex determination in mammals: Primary and secondary sex determination, Temperature- dependent sex determination in reptiles, Induction and competence. Precaution and health care during pregnancy and gestation. Impotency: Causes of Impotency and sterility male and infertility in female. Concept of test tube baby –Artificial Insemination in humans – In Vitro Fertilization (IVF) and Gamete – Intra –Fallopian Transfer (GIFT). Theories of ageing, Influence of telomere on ageing.	15

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2) Schatten and Schatten. Molecular Biology of Fertilization.
3) F.T. Longo, Fertilization, Chapman & Hall.
4) R. G. Edwards, Human Reproduction.
5) S.F. Gillbert, Developmental Biology, Sinauer Associates Inc., Massachusetts.
6) Molecular Developmental Biology – 2008, T. Subramonian, Narosa Publishing House.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
CO1	Comprehension of gametogenesis,oogenesis and fertilization process	K2
CO2	Understand the patterns of cleavage ,cellular differentiation and formation of placenta .	K2
CO3	Illustrate the organization and function of organogenesis	K3
CO4	Gain the knowledge of Chromosomal sex determination,Concept of test tube baby and theories of Ageing	K1

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COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	3	2	2
CO2	2	3	3	1	2	2	1	2	1	1
CO3	3	2	3	2	2	2	1	2	3	2
CO4	2	3	2	3	2	2	1	3	2	3

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PROGRAMME	**MSc Zoology**	**SEMESTER**	**III**
COURSE CODE & TITLE	20RMSCZOO301: **ENVIRONMENTAL BIOLOGY & BIODIVERSITY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1) The main objective is to get deeper knowledge in environmental biology and biodiversity 2) To understand the biology of different Environments 3) To get knowledge about the pollution ,epidemiology ,environmental monitoring,and assessment,Bioremediation 4) To understand the principles of biodiversity and conservation 5) To know about the wild life protection acts and organizations		

UNIT	CONTENT	NO. OF HOURS
I	**BIOLOGY OF DIFFERENT ENVIRONMENTS:** Environment: definition, Types of environment. General account of biomes and their environments. Types of Ecosystems: Marine and Fresh water Ecosystem – classification and characteristics and stratification of the ecosystem. Terrestrial Ecosystem– classification and characteristic and stratification of the ecosystem. Energetics of Ecosystem: tropic dynamic view of ecosystem. Energy flow – primary productivity and secondary productivity. Factors influencing productivity. Biomagnification. Energy Budget: Estimation of Energy Budget and Methods of measuring productivity for different Ecosystems – harvesting method, CO2 assimilation method, oxygen production method, chlorophyll method.	15
II	**POLLUTION, EPIDEMIOLOGY, ENVIRONMENTAL MONITORING AND ASSESSMENT BIOREMEDIATION** **Concept of Pollution:** Types, composition, impact, treatment and disposal of pollutants. Aquatic Pollution; Agricultural waste and Heavy Metal **Pollution:** Hg, Pb, Cd, Cr as sources; and Impact on biota - Related episodes in India and abroad. Epidemiology: Role of environmental epidemiological studies and health indices in evaluation of environmental health hazards. Environmental epidemiological episodes in India and abroad. **Environmental Impact Assessment (EIA):** Methods for EIA assessment, Socio-economic effects and impacts. Environmental Laws. Bioremediation: Need and Scope of Bioremediation, environmental applications of bioremediation. Phyto-remediation – Biotechnological cleaning up of the environment.	15

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III	**BIODIVERSITY AND CONSERVATION** **Introduction:** Definition, Scope and Importance of biodiversity. Levels of biodiversity; Values of Biodiversity and Its importance at Global, National and Local level. Threats to Biodiversity; Causes for loss of biodiversity. Types of listing of threatened biodiversity – IUCN categoris, Red data book; Endemism. **Conservation:** Definition, Need and Importance of conservation of Biodiversity. **Types of Conservation:** *In- situ* and *Ex-situ* conservation. Conservation Tools and their Role: Biological parks, Zoos, Zoological Parks, Wildlife Sanctuaries, Forest Research Institutes and Agricultural Research Institutions, Gene Pools, Cryopreservation Centers, Interpretation Centers, National Parks & Tiger Reserves.	15
IV	**WILDLIFE PROTECTION ACTS AND ORGANIZATIONS** **Bio-geographic realms of the world;** Bio-geographic Zones of India and Current status of biodiversity (flora and fauna) ; Hotspots in the world and in India; Biosphere Reserves in India. Conservation approaches of Indian animals. Captive breeding (Lion tailed macaque, white tiger and vultures) and reintroduction (Tiger, rhinoceros, gaur). Wildlife Protection Acts. Government Organizations - Wildlife Institute of India, Ministry of Environment and Forests (MoEF), National Biodiversity Authority (NBA), Zoological Survey of India (ZSI), Botanical Survey of India (BSI), Salim Ali Centre for Ornithology and Natural History (SACON), Centre for Ecological Sciences (CES) - their role in Conservation of Biodiversity. NGOs –Bombay Natural History Society (BNHS), Worldwide Fund for Nature (WWF), Wildlife Trust of India (WTI), Nilgiri Wildlife and Environment Association (NWEA), Wildlife Conservation Society (WCS) - their role in Conservation of Biodiversity	15

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PRACTICALS	**ENVIRONMENTAL BIOLOGY** 1) Estimation of Dissolved oxygen (Wrinkler's method), Salinity, pH, Chemical Oxygen Demand (COD), free CO2, carbonate and Bicarbonates in water samples. 2) Identification of Zoo planktons (fresh water/marine) 3) Hydrobiological studies of water samples from Textile/ Paper Mill/ sewage effluent with special reference to pollution – O2, free CO2 and Salinity. 4) Study of Eutrophic ponds /lakes /river. 5) Estimation of Biomass by Wet weight and Dry weight. 6) Estimation of calcium and magnesium in polluted water. 7) Soil analysis for calcium carbonate. 8) Estimation of sulphate in polluted water **BIODIVERSITY CONSERVATION** 1) Mark and locate biodiversity hotspots and reserves in India by using the map. 2) Insect diversity in soil. 3) Study of fauna of different zoogeographical regions - with minimum three examples from each region. 4) Biodiversity studies of fishes, amphibians, reptiles, aves, mammals available in the local area. 5) Study of biodiversity indices with suitable examples. 6) Study of endangered fauna of Andhra Pradesh. 7) A study tour to various places of ecological importance is essential. A tour report should be submitted along with the record.	

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<table>
<tr><td>REFERENCES</td><td colspan="3">

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3) The Ecology of wastewater treatment - H. A. Hawkes pergoman press, 1963.
4) Biochemical ecology and water pollution - PRDugan, plenum press, London, 1972.
5) Pesticides in the environment – R. White Stevenns, Marcel Dekker Inc. New York, 1971.
6) Environmental Science Research Volu mes: Vol.1. Indicators of environmental quality - WA. Thomas, 1972. Vol. 3. Environmental pollution by pesticides - C. A. Edwards, 1974. Vol. 5. Environmental dynamics of pesticides - R. Hague and V. H. Preed, 1975.
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8) Field Biology & Ecology - Allen H Benton & E. Werner, J R, 1980.
9) Encyclopedia of environmental pollution and control, enviromedia, Karad , Vol. 1 & 2, R. K Trivedi.
10) Ecotechnology for pollution control and environmental management, enviromedia, Karad, R K. Trivedi.
11) Health hazards and human environment, World Health Organization (WHO) 1972.
12) Current pollution research in India - R K. Trivedy and P.K. Goel. Karad.
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19) Hosetti, B.B. Venkateswarlu, M. Trends in wildlife Biodiversity Conservation and Management.
20) Kumar & Sija., Biodiversity Principles & Conservation, Published by Upadesh Purohit by Agrobios (India), Jodhpur, 2002.

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<tr><td rowspan="5">COURSE OUTCOME</td><td colspan="2">On the successful completion of course students will be able to</td><td>Knowledge</td></tr>
<tr><td>CO1</td><td>Demonstrate knowledge of Biology of Different environments,Energitics of Ecosystem</td><td>K2</td></tr>
<tr><td>CO2</td><td>Understand the pollution ,epidemiology,Environmental monitoringand assessment,Bioremediation</td><td>K2</td></tr>
<tr><td>CO3</td><td>Demonstrate the organization and function of Biodiversity and Conservation</td><td>K3</td></tr>
<tr><td>CO4</td><td>Gain the knowledge of wild life protection acts and organizations</td><td>K3</td></tr>
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PROGRAMME		**SEMESTER**	III
COURSE CODE & TITLE	20RMSCZOO302: ENZYMOLOGY AND METABOLISM		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1) To understand the classification & nomenclature of enzymes and the factors effecting enzymatic reaction. 2) Learn about the mechanism of Enzyme action. 3) Familiar about the chemical nature of enzymes and their function in biochemical reactions. 4) Study the effects of the inborn errors of metabolism. 5) Understand the synthesis & degradation process of carbohydrates, lipids, amino acids & nucleic acids.		

UNIT	CONTENT	NO. OF HOURS
I	**GENERAL PROPERTIES OF ENZYMES** 1.1 Classification of enzymes and nomenclature. Enzyme specificity (optical specificity, group specificity) 2.1 Quantitative measurement of enzyme activity Isolation of enzymes, Intracellular distribution of enzymes. 3.1 Kinetic properties of Enzyme kinetic theory and collision theory. Effect of reactant concentration (Rate constant, First order, Second order and Zero order reactions). 4.1 Effect of enzyme concentration, pH and temperature. Effect of substrate concentration, Determination of kinetic constants (Km and Vmax)	15
II	**REGULATION OF ENZYME ACTIVITY** Inhibition of enzyme activity (competitive, non-competitive, uncompetitive and mixed inhibition). Kinetics of Allosteric enzymes. Regulation of enzyme activity (Metabolic regulation), Catalytic efficiency of enzymes (Feedback inhibition, covalent modification). Mechanism of enzyme action (Lock and key; Induced fit model), catalytic site, Role of metal ions. Application of enzymes Enzymes in clinical diagnosis. Immobilized enzymes and their applications. Isozymes- definition- types of Isozymes, significance. Enzyme engineering- Principles of enzyme engineering – Steps in enzyme engineering – applications	15
III	**INTERMEDIARY METABOLISM:** Glycolysis, TCA cycle and their Biomedical importance. Pentose phosphate pathway, Gluconeogenesis. Regulation of carbohydrate metabolism. Redox Potentials, Mitochondrial electron transport system, High energy Phosphates in energy capture and transfers. Beta-oxidation of palmitic acid; Biosynthesis of long chain fatty acids. Oxidative deaminaiton, decarboxylation and transamination of amino acids. Biosynthesis of Urea and detoxification of Ammonia. Biosynthesis of polyamines.	15

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IV	**NUCLEOTIDES AND PORPHYRINS** Biosynthesis of Nucleotides- Types of nucleotides, biosynthesis of purines, biosynthesis of pyrimidines, importance of nucleotides. Degradation of Nucleotides- Degradation of purines and pyrimidines, pathways of degaradation. Clinical disorders of purine metabolism – Lesch-Nyhan disease adenylosuccinatelyase deficiency, Myoadenylatedeaminase deficiency, Adenosine deaminase deficiency, deoxyguonosine deficiency. Types and function of Porphyrins, Pigments Growth regulation.	15
PRACTICALS	**ENZYMOLOGY AND METABOLISM** 1. Blood glucose estimation 2. Estimation of Salivary amylase 3. Estimation of serum protein 4. Estimation of Cholesterol 5. Immobilization of enzymes activity 6. Estimation of uric acid 7. Substrate concentration on SDH 8. Effect of pH on SDH 9. Effect of Temperature on SDH 10. Estimation of creatine 11. Estimation of lipase	

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2) D. Voet and J.G Voet, Biochemistry,1.Wiley & Sons.
3) David L. Nelson and Michael M. Cox, Lehninger; Principles of Biochemistry, McMillan worth Publishers.
4) Enzyme kinetics by D.V Roberties, Cambridge University Press.
5) Enzyme Kinetics by1.W.Segil.
6) BiochemicalcalculationsbyI.H. Segel2ndEd.JohnWiley&Sons.
7) Biochemistry byD.Voetand J.G. Voet,J.Wiley&Sons

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
CO1	Understand the classification and Kinetic properties of enzymes.	K2
CO2	Gain the Knowledge about the Regulation of Enzyme activity	K2
CO3	Demonstrate the Knowledge of different concepts of Intermediary metabolism .	K3
CO4	Understand the concepts of Biosynthesis and degradation of nucleotides of Purina Metabolism , Prophysins	K3

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CO4	2	3	2	1	2	3	1	3	2	2

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PROGRAMME	**M.Sc. Zoology**	**SEMESTER**	**III**
COURSE CODE & TITLE	20RMSCZOO303: ANIMAL BIOTECHNOLOGY AND MICROBIOLOGY		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1) The tools and techniques used in genetic engineering and Recombinant DNA technology and to create interest in advanced studies. 2) The application of biotechnology in veterinary science and medicine, and gene therapy 3) Different types of bacteria, virus and fungi found in environment and in human body 4) How bacterial, viral, fungal and protozoan diseases spread and their control. 5) The beneficial role of microorganisms in fermented foods and in food processing. The bioreactors and different types of fermentation processes.		

UNIT	CONTENT	NO. OF HOURS
I	History and development of animal tissue -culture. Equipment and materials (culture vessels, CO2 incubator, inverted microscope, cell counters). Principles of sterile techniques. Introduction to balanced salt solutions. Primary culture-Mechanical and enzymatic mode of disaggregation, Establishment of primary culture. Subculture-Passage number, split ratio, seeding efficiency, criteria for subculture. Cell lines–Definite and continuous cell lines, characterization, authentication, maintenance and control, cell transformation. Normal *vs.* transformed cells, growth characteristics of preservation of cell lines. Contamination–Bacterial, viral, fungal and mycoplasma, detection and transformed cells. Application of animal cell culture-Vaccine production, specialized cell types. Concepts of tissue engineering –Skin, liver, kidney, bladder and heart.	15
II	In vitro fertilization–Concept of super ovulation, collection, maintenance, and maturation of oocytes, fertilization of oocytes. Maintenance and assessment of embryos. Embryo transfer–Artificial insemination, preparation of foster mother, surgical and non- surgical methods of embryo transfer, donor and recipient after care. Cloning: concept of nuclear transfer, nuclear reprogramming and creation of Dolly. Transgenic animals–Retroviral, micro injection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals –Biopharming, disease models, functional knock outs. Gene therapy– Ex-vivo and in vivo gene therapy methods, and their applications. Stem cells: Isolation and culture, embryonic and adult stem cells, plasticity and concept of regenerative medicine.	15

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III	Applied microbiology in the field of food, agriculture, industry and environment. History and scope of Microbiology. Microbial nutrition, growth and their control. Normal microbial flora of Human Body: Skin, Nose, Oral cavity, Pharnyx, Respiratory tract, Eye, Ear, stomach, Intestine, Genitourinary tract.Microbial diseases and their control. Bacterial diseases: Tuberculosis, Plague, Anthrax, Tetaus, Cholera. Viral diseases :Influenza, AIDS, Rabies, Hepatitis, Poliomyletis. Fungal diseases: Superficial mycoses, Cutaneous mycoses, Subcutaneous mycoses	15
IV	**Microbiology of fermented food**: Diary products, Meat and Fish, Microorganisms as Sources of food. **Industrial Microbiology**: Types of fermentation process, Types of fermentors, Down stream processing, Alcoholic beverages. **Manufacture of various chemicals** : Lactic acid, Acetic acid and Citric acid. **Therapeutic compounds**: Antibiotics (Pencillin), Industrial enzymes (Amylase,	15
PRACTICALS	**ANIMAL BIOTECHNOLOGY** 1. Sterilization methods 2. CO2 incubator demonstration 3. Primary cell culture technique 4. Cell separation from chicken liver tissue by tripsin digestion 5. Cryopreservation of cell lines 6. Stem cell technology **MICROBIOLOGY** 1) Sterilisation principle and methods-moist heat-dry heat and filtration methods. 2) Mediapreparation: Liquid media, Solid media, Agar slants, Agar plates. Basal, enriched, selective media preparation-quality control of media, growth supporting properties, sterility check of media. 3) Pure culture techniques: Streak plate, pour plate and decimal dilution. 4) Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description and demonstration of pigment production. 5) Staining techniques: Smear preparation, simple staining, Gram's staining, Acid fast staining and staining for metachromatic granules. 6) Morphology of microorganisms. 7) Antibiotic sensitivity testing: Disc diffusion test- Quality control with standard strains	

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4) Cell Growth and Division: A Practical Approach. Basega, R. IRL Press, New Delhi.
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11) Elements of Microbiology, by C.B. Powar & H.F. Daginawala 1st Edition, Himalaya Publishing House, Bombay, 1982.
12) Textbook of Microbiology, by R Ananthanarayanan & C.K. Jayaram Panikar, 4th Edition, Orient Longmen, Hyderabad, 1990.

COURSE OUTCOME

On the successful completion of course students will be able to		Knowledge
CO1	Demonstrate the usage of different culture equipments, types of tissue culture and application of animal cell culture.	K2
CO2	Gain the Knowledge about Invitro fertilization steps, cloning,stemcells,Gene therapy and transgenic animals	K3 & K2
CO3	Demonstrate the Knowledge of different concepts of applied microbiology	K3 & K2
CO4	Understand the concepts of Industrial Microbiology and production of therapeutic compounds	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
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CO2	3	2	3	1	2	1	2	3	2	2
CO3	2	3	2	3	2	2	1	2	3	2
CO4	2	3	2	2	3	2	1	2	3	1

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PROGRAMME	**MSc Zoology**	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCZOO304: **AQUACULTURE**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1) This course will give the students an understanding of the principles, scope and basis of of aquaculture 2) Provide knowledge about preparation and management of pond 3) The course will include an opportunity to conduct hands-on activities related to culture, health management, and processing of fish and shrimp 4) To get the job opportunities after the completion of this course 5) To know about Culture methodologies with special reference to fish and prawn.		

UNIT	CONTENT	NO. OF HOURS
I	**Concept, types, and cultivable species:** Definition, Scope and Basis of Aquaculture; History and present status of Aquaculture Culture systems: Freshwater aquaculture, Brackish water culture, Mariculture: Major cultivable species for aquaculture. Culture practices - Traditional, extensive, modified extensive, semi-intensive and intensive cultures of fish and shrimp. Monoculture, Poly-culture, Composite culture, Mono-sex culture and integrated fish farming. Culture systems - Ponds, Raceways, Cages, Pens, Rafts and water re-circulating systems.	15
II	**Preparation and Management of Pond:** Criteria for the selection of site for freshwater and brackish water pond farms. Seed resources: Natural seed resources and Procurement of seed for stocking: Selection of species for culture. Design and construction of aqua farms: Design and construction of aqua farms:. Management of culture ponds: Culture of Indian major carps – Nursery, Rearing and Production ponds. Stocking of open waters and Ranching Pre-stocking management – Dewatering, drying, ploughing/desilting; Predators, weeds and algal blooms and their control, Liming and fertilization; Stocking density and Post-stocking management – Feeding, water quality, growth and health care; and harvesting of ponds.	15

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III	**Nutrition, Health management** Nutrition and feeds: Nutritional requirements of a cultivable fish and shellfish. Natural food and Artificial feeds and their importance in fish and shrimp culture. Supplementary feeds; Feed additives and Preservatives; Role of probiotics. Factors affecting the health in aquaculture. Major diseases of aquaculture species. Disease diagnosis and health management: fish immunization and vaccination; Symptoms, prophylaxis and therapy of common diseases in fish and shrimp ponds	15
IV	**Processing and Management** Processing and preservation of fish & shrimp and its by-products: Traditional methods - sun drying, salt curing, pickling, and smoking. Advanced methods – chilling or icing, refrigerated sea water, freezing, canning, Irradiation and Accelerated Freeze dry (AFD). Sanitation in processing plants - Environmental hygiene and Personal hygiene in processing plants. Quality Control of fish and fishery products; pre-processing control, control during processing and after processing. Seafood Quality Assurance and Systems: Good Manufacturing Practices (GMPs); Good Laboratory Practices (GLPs); Standard Operating Procedures (SOPs); Concept of Hazard Analysis and Critical Control Points (HACCP) in seafood safety. Sustainability and environmental management of Aquaculture.	15
PRACTICALS	**AQUACULTURE AND ECONOMIC ZOOLOGY** 1) Identification and study of important cultivable and edible fishes - Any ten 2) Identification and study of important cultivable and edible crustaceans - Any five 3) Identification and study of fish and shrimp diseases - Using specimens / pictures. 4) Autopsy of fish – Examination of the internal organs. 5) Identification and study of common zooplankton, aquatic insects and aquatic weeds – Each 5 6) Visit to a shrimp hatchery / shrimp farms and submit a project report or visit to a shrimp processing unit and submit a project report	

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4. ICAR. 2006. *Hand Book of Fisheries and Aquaculture.*
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9. Mcvey JP. 1983. *Handbook of Mariculture.* CRC Press.
10. New MB. 2000. *Freshwater Prawn Farming.* CRC Publ.
11. Honeybees and their management S. B. Withhead. Axis books Publisher, Jodhpur.
12. A Handbook of Beekeeping Dharamsing and D. P. Singh (, Agrobios India (Publisher), Jodhpur.
13. Hanumappa (1978): Sericulture for Rural Development, Himalaya Publications Delhi.
14. Bhatnagar, R.K. and Palpa, R.K. 1996 Vermiculture and Vermicomposting, Kalyani Publishers, New Delhi.
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16. Shukla, G.S. and Xupadhyay G.S. Economic Zoology, Rastogi Publications, Meerut.

COURSE OUTCOME

On the successful completion of course students will be able to		Knowledge
CO1	Understand the different types of culture systems and culture practices .	K2
CO2	Gain the Knowledge about the Preparation and management of pond	K3 & K2
CO3	Demonstrate the Knowledge of different concepts of Nutrition and health managementof fishes and prawns	K3 & K2
CO4	Understand the concepts of processing and preservation of fish and shrimp and Sustainability of environmental management	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	2	3	2	2
CO2	2	3	2	2	3	2	2	2	3	2
CO3	3	2	1	1	2	2	2	2	3	1
CO4	2	1	3	2	3	2	1	2	1	1

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PROGRAMME	**M.Sc. Zoology**	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCZOO305: **ANIMAL HUSBANDRY AND DAIRY TECHNOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**4**
COURSE OBJECTIVES	1) The course provides Introduction to Animal husbandary and farm animals . 2) To enlighten the students to the intensive study in livestock production, and management 3) Students can understand the concepts in marketing, nutrition, breeding, production records 4) Final objective is to understand the selection, animal health, waste management, and conservation practices.		

UNIT	CONTENT	NO. OF HOURS
I	**Introduction to Animal Husbandary and related Enterprises**,Classification of farm animals –cattle,sheep,goat,poultry,Livestock census; Breeds of Dairy cattle, Buffaloes and Goats.Indigenous,Exotic and Crossbred Cattle breed, Anatomyof Udder; Development of udder;Lactogenesis and Galactopoises; Let down of milk.	
II	**Artificial insemination**; Oestrous cycle; Symptoms of heat in cows and buffaloes. Conception, Pregnancy diagnosis in cattle. Multi-ovulation and embryo transfer technique. Cloning.Economic traits of Dairy cattle. Methods of selection of dairy animals. Systems of Dairy cattle breeding. Inbreeding, out breeding, Cross breeding, Grading	
III	Basics in Dairy Technology, Reception of Milk,Pasteurization, Sterilization and Homogenization of milk, Standardization of milk. Packaging of milk, Disposal of dairy effluents:sourcesdairywaste; Necessity of treatment of dairy waste; Methods of treatment: low cost methods, conventional methods: Activated sludge process and trickling filters.	
IV	**Cream:** Types of cream, composition, methods of cream separation, gravity and centrifugal methods, Types of cream separators, factors affecting fat losses in skim milk and fat percentage in cream.Butter: PFA standards, classification, composition, method of manufacture of butter by creamery butter method. Over run in butter. Composition, uses, method of manufacture, standards, composition and classification of cheese, Ice cream and Indigenous Milk products like Khoa, Channa, Ghee, Dahi and Kulfi	
PRACTICALS	**ANIMAL HUSBANDARY AND DAIRYBTECHNOLOGY** 1) Study of various breeds of cattle (photographs/microfilms) 2) Study of various activities carried out in a dairy farm and submission of a report. 3) Estimation of quality of milk from different dairy farm units – specific gravity, fat content,	

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REFERENCES

1) Textbook of Animal Husbandry - G C Benarjee
2) Handbook of Animal Husbandry - ICAR Edition
3) Principles and practices of Dairy Farm –Jagdish Prasad
4) Textbook of Animal Husbandry - G C Benarjee
5) Handbook of Animal Husbandry ICAR Edition
6) Outlines of Dairy Technology - Sukumar De
7) Milk products preparation and quality control - C P Ananthakrishnan
8) The Technology of milk processing - C P Ananthakrishnan
9) Modern Dairy products - Lincoln M Lampert
10) Outlines of Dairy Technology - Sukumar De
11) Milk products preparation and quality control - C P Ananthakrishnan
12) The Technology of milk processing - C P Ananthakrishnan
13) Modern Dairy products - Lincoln M Lampert

COURSE OUTCOME

On the successful completion of course students will be able to		**Knowledge**
CO1	Understand the breeds of Dairy cattle and process of Let down of Milk	K2
CO2	Gain the Knowledge about the Cloning,Artificial insemination and systems of Dairy cattle breeding.	K3 & K2
CO3	Get Knowledge of Dairy Technology and disposal of dairy effluents .	K3 & K2
CO4	Understand the cream seperators and Manufacture of Milk by products	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	1	2	3	2
CO2	2	3	1	2	3	1	2	2	2	3
CO3	2	3	2	1	3	2	1	2	3	2
CO4	3	2	1	2	3	1	2	3	2	1

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PROGRAMME	**MSc. Zoology**	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCZOO401: **NEUROBIOLOGY AND ANIMAL BEHAVIOUR**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1. From this paper introduced about the animal behavior and its neurophysiology. 2. It is aimed to make the students to understand about Structure and functioning of Nervous system, 3. CNS, PNS and ANS, Neuron and its types, bioelectrical properties of Neurons, Synapses, Neurotransmitters and different neuro disorders 4. It describes about various patterns of behaviors and innate behaviors, homeostasis and Behaviors, animal communications, memory and forgetting, social organization in insects and primates, parental care and sexual selection		

UNIT	CONTENT	NO. OF HOURS
I	Structure and function of the Nervous system: Structure of Neuron; Types and functions of neurons and associated structures, Structure and organization of central nervous system – Brain, Spinal cord. Peripheral Nervous system – Cranial Nerves, Spinal Nerves; Autonomous Nervous System – Sympathetic Nervous System. Bioelectrical properties of neuron: The resting membrane potential, The sodium and potassium pump; Propagation of the nerve impulse, generation of the action potentials	15
II	Ultra structure of Synapses: Morphology and types of synapses, Synaptic transmission – EPSPs and IPSPs. Chemical and Electrical synaptic transmission. Neurotransmitters: Types, Catecholamines, Acetylcholine, Dopamine, Norepinephrine, Serotonin, Histamine, Epinephrine, Glutamate, Aspartate, NO2, and CO - storage and release of neurotransmitters, transmitter action. Neuropeptides - Oxytocin, Vasopressin, Thyrotropin releasing hormone substance Neuro-degenerative diseases - Schizophrenia; Affective disorders (depression); Parkinson's disease; Alzheimer's disease, Psychological disorders, Addiction etc	15
III	Introduction - Definition, Concept of Ethology; Mechanism of Behaviour; Patterns of behaviour. Innate Behaviour – Reflexes; Orientation; Taxis; Kinesis; Learning and Instincts: Conditioning (classical and operant); Cognitive learning, Insight learning (Reasoning); Habituation, Imprinting. Homeostasis and behaviour: Motivational system, physiological basis of motivation, control of hunger and thirst drive, role of hormone; Migration and Navigation	15

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IV	Animal Communications: Purpose and Importance of communications. Types of Communications: Visual, Auditory, Olfactory, Chemical perception, Vocalization in birds and mammals Memory and Forgetting: Theories of Memory; Kinds of remembering; Nature of Forgetting, Improving memory Social organization in Insects and Primates; Altruism – reciprocal altruism; Group selection, Kin selection; Inclusive fitness; cooperation; alarm call; Parental care. Sexual selection: Hormones and pheromones influencing behaviour of animals. Intra sexual selection (male rivalry), Inter-sexual selection (female choice), Infanticide, Sperm competition, Mate	15
PRACTICALS	**NEUROBIOLOGY** 1) Dissection and study of cockroach/prawn nervous system. 2) Response of neurons to external stimuli. 3) Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining. 4) Estimation of brain Acetylcholine 5) Estimation of brain Acetylcholine esterase **ANIMAL BEHAVIOUR** 1) Study the responses of woodlice to hygrostimuli. 2) study the geotaxis behaviour of earthworm. 3) Study the orientational responses of 1st instar noctuid larvae to photo stimuli. 4) Study the median threshold concentration of sucrose solution in eliciting feeding responses of housefly. 5) Study the orientational responses of larvae to volatile and visual stimuli. 6) Habituation behaviour in snails	
REFERENCES	1) Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015. 2) From Molecules to Networks: An Introduction to Cellular and Molecular 3) Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004 4) Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and JessellMcGraw-Hill Companies-2000 5) Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David YoungCUP-2003 6) Essential Psychopharamacology- Neuroscientific Basis and Practical 7) Applications-2 nd Edn.-Stephan M. Stahl-CUP-2000 Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998. 8) The Human Brain Book - Rita Carter-2009 9) Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA. 10) Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK. 11) Animal Behaviour, John Alcock, Sinauer Associate Inc., USA. 12) Perspective on Animal Behaviour, Goodenough, McGuire and Wallace, John Wiley & Sons, USA. 13) Exploring Animal Behaviour, Paul W. Sherman & John Alcock, Sinauer Associate Inc., Massachusetts, USA. 14) An Introduction to Animal Behaviour, A. Manning and M.S Dawkins, Cambridge University	

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COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Understand the importance of structure and types of nervous system.	K2
	CO2	To demonstrate the functions of nervous system	K3 & K2
	CO3	To gain Knowledge of Types of Behaviour and relation between Homeostasis and Behaviour .	K3 & K2
	CO4	To Understand the concepts in Animal communications ,Social organization , forgettings and memory.	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	1	2	3	2	2
CO2	2	3	1	3	2	1	2	2	3	3
CO3	1	2	3	1	2	3	2	3	2	2
CO4	1	3	2	3	2	1	3	2	3	1

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PROGRAMME	**M.Sc. Zoology**	**SEMESTER**	**IV**
COURSE CODE & TITLE	20RMSCZOO402: **APPLIED TOXICOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1. This paper is aimed to create awareness of Toxicant, heavy metal toxicity and environmental pollution and ecological impact assessment 2. To emphasize on principles of toxicology- toxins, dose, doe effect and dose response relationships, factors of toxicity, metabolism of toxicants 3. To describe about Biochemical Toxicology- mechanism and reactions of toxicants, Lipid peroxidation, Oxidative stress 4. To make the student understand about the knowledge of systemic toxicology, Environmental and Occupational Toxicology		

UNIT	CONTENT	NO. OF HOURS
I	**PRINCIPLES OF TOXICOLOGY:** Definition, scope and importance of toxicology; classification of toxic agents -natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins. Dose, dose effect and dose response relationship – Acute toxicity, chronic toxicity; toxic kinetics. Factors affecting toxicity - species and strains, age, sex, nutritional status, hormone, environmental factors. Absorption and distribution of toxicants, portals of entry- Skin, gastrointestinal tract and respiratory system. Bio-accumulation, bio-magnification, bio-transformation and elimination of xenobiotics.	15
II	**BIOCHEMICAL TOXICOLOGY:** Mechanism and reactions of toxicants - Covalent bonding, non-covalent bonding and enzymatic reactions. Lipid peroxidation – Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS); Mechanism of Reactive Oxygen Species production; Superoxide, hydrogen peroxide and hydroxyl radicals in toxicity of xenobiotics. Oxidative Stress - Antioxidant defense mechanism – Role of glutathione, superoxide dismutase, metallothionine. Xenobiotic induced intracellular and cellular alterations.	15
III	**SYSTEMIC TOXICOLOGY** Basics of organ toxicity - Target organs, organ selectivity and specificity. Hepatotoxicity - susceptibility of the liver; Types of liver injury and biochemical mechanism. Pulmonary toxicity –systematic lung toxins, lung pathology, Renal toxicity –Chemical induced renal injury. Neuro toxicity – Effect of toxic agents on neurons, ion channel neurotoxins; Lesions	15

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IV	**ENVIRONMENTAL AND OCCUPATIONAL TOXICOLOGY** Eco-toxicology of heavy metals –Mechanism of heavy metal toxicity; Case studies of Arsenic, Mercury and Cadmium. Toxicity of organochlorine and organophosphate pesticides; case studies of DDT, endosulphan, parathion and malathion. Occupational hazards - physical, chemical, biological and mechanical hazards. Occupational diseases: Pneumoconiosis, silicosis, asbestosis; Prevention of occupational diseases. Legislation and Regulation – Federal government, State government; Legislation and regulation in other countries.	15
PRACTICALS	**APPLIED TOXICOLOGY** 1) Determination of LC50/LD50 of selected toxicant (bioassay method). 2) Effect of toxicant on glycogen, glucose and amino acids. 3) Hepato-toxicant effect on Total Bilirubin Content (direct and indirect method). 4) Estimation of SGOT and SGPT as a marker enzyme for hepatotoxicity. 5) Estimation of serum creatinine activity as a marker enzyme for Renal toxicity. 6) Micronuclei test. 7) Estimation of Hemoglobin and RBC in Lead exposed experimental animals. 8) Estimation of AchE activity as a marker of pesticide poisoning.	

REFERENCES

1. Toxic interactions – R.S.G oldstein, W .R .H ew itt and J.B .H ook. A cadem ic Press –1 9 9 0 .
2. Pesticides and H um an W elfare – D .L .G unn and J.G .R .Stevens. O xf ord U niversity Press – 1 9 7 8 .
3. Pesticides action and M etabolism – O 'B rien.
4. Environmental toxicology of Pesticides – F.M astim ura, G .M .B oush and T.M isato.
5. The encyclopedia of A m ericana – V ol.15 .
6. Introduction to B iochem ical Toxicology – E.H odgson & F.E.G utherie .
7. C asarett & D oul's – Toxicology – The basic science of poisons – C.D .K lassen, M ary, O .D .& John D oull.
8. C oncepts of Toxicology D r.O m kar, V ishal Publishing C . 2003 .

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Gain knowledge on dose relation ship,factors affecting the toxicity and absorption and biotransformation of Xenobiotics.	K2
	CO2	Understanding the bonding between toxicant and biological molecules and oxidative stress	K3 & K2
	CO3	Demonstrate the Knowledge of Basic organ toxivcity.	K3 & K2
	CO4	Understand the concepts of Ecotoxicology,occupational toxicology and Legislation rules	K4

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COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	3	1	2	1	3	3	2	2
CO2	2	3	2	1	2	1	2	2	1	1
CO3	3	2	1	2	3	3	2	3	2	2
CO4	2	3	1	2	3	2	3	2	3	1

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PROGRAMME	**MSc. Zoology**	**SEMESTER**	**IV**
COURSE CODE & TITLE	20RMSCZOO43: **BIOSTATISTICS AND BIOINFORMATICS**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1) The course is aimed at introducing the application of bioinformatics and statistics in biology. 2) The course gives an insight into the key concepts and methods used in bioinformatics; and computer storage, retrieval, analysis, visualization and distribution of information data related to biological macromolecules like DNA, RNA and proteins. 3) It provides foundation on statistical methods to enable students to compute and interpret basic statistical parameters. 4) As an interdisciplinary field it integrates biology, computer science, chemistry and statistics together 5) It provides sequence analysis structure analysis and functional analysis of biological data.		

UNIT	CONTENT	NO. OF HOURS
I	**BIOSTATISTICS** Data: Data types, collection of data, classification and tabulation. Measures of central tendencies – Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation. Probability: Addition and multiplication theories, conditional probability and probability distributors - Binomial, poisson and normal distribution	15
II	**BIOSTATISTICS** Correlation and linear regression – Scatter diagram method – Karnal Pearson's Rank correlation methods. Regression lines – fitting of regression lines by least squares method – Regression coefficients and properties. Small sample tests – t, F and chi square tests. ANOVA – one way and two-way classifications. CRD, RBD, LSD, Duncan's multiple range (DMR) test. Statistical basis of biological assays- LD50, ED50, TCID50, PD 50.	15
III	**BIOINFORMATICS** Introduction – Origin of bioinformatics biological data (genome projects), computer and information technology contributions. Disciplines of bioinformatics – Genomics, transcriptomics, proteomics, functional genomics, structural genomics, metabolomics, pharmacogenomics, structure prediction and drug design. Genome projects - General introduction to genome projects (rice genome project and Mycobacterium tuberculosis genome project). Special emphasis on Human Genome Project (HGP), Science behind HGP, benefits of HGP, ELSI of HGP in use of genetic information, genetic testing standard, quality and commercialization. Biological database - Introduction of database (DB), need, organization, search of DB. An overview of biological databases - NCBI, EMBL, DDBJ, SWISS-PROT, PDB, and KEGG pathways.	15

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IV	**BIOINFORMATICS** Database querying with NCBI using key words, sequences (proteins and genes), finding similarities, identifying genes and proteins from different organisms. Sequence alignment - Introduction, significance of sequence alignments and use of dot matrices. Pair wise and multiple sequence alignment (MSA) using Clustal programs. Sequence analysis - concepts of sequence analysis and their importance. BLAST - blastn, blastp, blastx, tblastx, output analysis. Proteomics - Introduction, principle, technique, 2-D database. Gel analysis software, post gel analysis, MALDI-TOF. Significance and applications of proteomics in modern biology	15
PRACTICALS	**BIOSTATISTICS** 1) Use of MS Excel in data presentation. 2) Examples of some common statistical tests. 3) Making a ICT enabled scientific presentation. 4) Graphic presentation of data – bar diagram, histogram, frequency polygon and pie chart 5) Calculation of measures of central tendencies – mean, median and mode 6) Calculation of measures of dispersions – range, mean deviation, standard deviation, variance and coefficient of variance 7) Computation of test of significance – comparison of sample mean with population mean and two sample means 8) Calculate the coefficient of correlation between two variables 9) Computation of linear regression 10) Computation of Oneway Analysis of Variance (ANOVA) 11) Using Chi Square Test, test the independence of two variables **BIOINFORMATICS** 1) Use of search engines like Scopus, Science direct for reference material collection and management. 2) Nucleic acid and protein sequence databases. 3) Data mining for sequence analysis. 4) Web– based tools for sequence searches and homology screening. 5) Primer designing for gene amplification and gene cloning. 6) Construction of phylogenetic trees for DNA and proteins. 7) Identification of peptide fingerprint by nano LC- MS/MS and database search	

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1. Statistical methods by S.P. Gupta.
2. Fundamentals of mathematical statistics. S.C. Gupta & Kapoor.
3. Statistical methods in biological and Health Science. J.S. Milton & J.O. Tsokan.
4. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms. Primrose SB. 2nd Ed. 1998. Blackwell Science: Oxford. ISBN0 - 632 -04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed. 2000. Oxford University Press: Oxford, New York.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreille's Publication.
7. Bioinformatics sequence, structure and data banks ed. By Des Higgins Willie Taylor. (2006).
8. Statistics made simple- Do it yourself on PC. 2001 by K.V.S.Sarma, Printice Hall.
9. Introduction to Bioinformatics, 2001 by T.A. Attwood and D.J.Parrysmith. Pearson Education Asia Publcations.
10. Principle of Biostatistics. 2000, Marello Pagno. Published by Duxbury, USA

COURSE OUTCOME

On the successful completion of course students will be able to		Knowledge
CO1	Understand the Basics of Biostatistics,variation and probability.	K2
CO2	Gain the Knowledge about the correlation,regression and statistical basis of biological assays	K3 & K2
CO3	Demonstrate the origin of bioinformatics in biological data,Application of bioinformatics in genome project.	K3 & K2
CO4	Understand the concepts of data basesquerying with NCBIusing key words,sequence Analysis and proteomics	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	2	3	2	3
CO2	3	2	2	3	3	2	3	3	1	2
CO3	2	1	2	3	2	1	3	3	2	1
CO4	2	3	2	3	2	3	1	3	2	2

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PROGRAMME	**MSc. Zoology**	**SEMESTER**	I
COURSE CODE & TITLE	20RMSCZOO404: **GENETIC ENGINEERING**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1. To familiarize the use of the data and techniques of engineering and technology in biology for the study of living organisms, or derivatives of thereof, to make or modify products or processes for specific use. 2. Also, to find solution of problems concerning human activities including agriculture, medical treatment, industry and environment		

UNIT	CONTENT	NO. OF HOURS
I	An introduction to genetic engineering, Enzymes used in genetic engineering- Restriction endonucleases, DNA polymerase, Reverse transcriptase, Polynucleotide kinase, DNA ligase, Terminal deoxynucleotidyl transferase, Alkaline phosphatase. Enzymes in modification- Polynucleotide phosphorylase, DNase (DnaseI, DNaseII, Exonuclease III and Mung bean nuclease), Phosphatases, Methylases, Ligases, Polynucleotide kinase and RNase. Oligonucleotides- primers, linkers and adaptors; Vectors for cloning- types, plasmid and phage vectors, cosmids, phagemids, BAC & YAC, Filamentous phage vectors, cosmids, BAC and YAC vectors, Shuttle vectors, Expression vectors. Ligation of DNA fragments with vectors-Homopolymer tailing, Linkers, Adaptors	15
II	Properties of yeast as host for cloning, Types of vectors designed for cloning in yeast, Vectors for cloning in animal cells– SV 40, Adenovirus, Baculovirus, Retrovirus vectors. DNA viruses that infect plants – Caulimoviruses vectors, Gemini viruses vectors, Types of vectors used in higher plants- Tumour-inducing (Ti) plasmids, binary and cointegrate vectors Methods of introduction of foreign DNA in animal system- DNA/calcium phosphate coprecipitate method, Phospholipids as gene-delivery vehicles, Electroporation, Microinjection PCR for gene amplification and detection: PCR principle and mechanism, Enzymes of PCR-Taq polymerase, Reverse Transcriptase, factors affecting PCR, different types of PCR (RT-PCR, nested PCR, Multiplex PCR and real time PCR) and their applications	15

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III	Introducing genes into prokaryotes: Natural gene transfer methods, Calcium chloride mediated transformation, Transfection with phage vectors, Probes: Oligonucleotide, DNA and RNA probes, methods for radioactive and non-radioactive labeling; Strategies for molecular cloning: Choice of vector for cloning, preparation of DNA molecules for cloning, ligation, transformation into bacterial cells, screening and identification of positive clones Cloning strategies- Construction of genomic and cDNA libraries, Shot gun cloning, Selection and screening of recombinant clones, Methods based on nucleic acid hybridization, Finding specific clones by functional complementation, Chromosome walking, Reporter genes. Prokaryotic expression systems- Gene expression based in bacteriophage T7 RNA polymerase, Studying of gene function through protein interactions-Two hybrid screening, Phage display libraries, RNA interference- siRNA, miRNA, Concept of gene knock out technique.	15
IV	Principles and methods for DNA sequencing, Advantages of automatic gene sequencers, Blotting techniques –Southern, Northern, Western, Polymerase chain reaction, Site directed mutagenesis, Transposon mutagenesis, Fluorescence *in-situ* hybridization, Electrophoretic mobility shift assay, DNA foot printing, Restriction mapping, DNA fingerprinting, Patenting and basic concepts of IPR. Gene expression: Construction of vectors for expression- choice of promoter, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and reporter genes; Over expression of heterologous protein in bacterial, purification and detection and analysis of recombinant protein. Vaccines-Types of vaccines, subunit vaccines, peptide vaccine, vector vaccines. Gene therapy- Ex vivo and *invivo* gene therapy methods; Applications of genetic engineering	15
PRACTICALS	**GENETIC ENGINEERING** 1) Culture of *E.coli* cells & plasmid isolation 2) Preparation of competent cells. 3) Calcium chloride mediated transformation 4) Ligation of DNA 5) Polymerase chain reaction 6) Restriction fragment length polymorphism 7) Random amplified polymorphic DNA 8) Cloning of GFP protein	

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REFERENCES

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10) Gene VI by Lewin,1997, Oxford University Press.

COURSE OUTCOME

	On the successful completion of course students will be able to	**Knowledge**
CO1	Understand the Enzymes used in Genetic Engineering and ligation of DNA fragments	K2
CO2	Gain the Knowledge about the Types of vectors designed for cloning, methods of introduction of foreign DNA	K3 & K2
CO3	Illustrate the Knowledge of gene transfer methods and cloning stratergies .	K3 & K2
CO4	Understand the concepts of DNA sequencing and Gene expression	K4

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3	1	2	3	2
CO2	2	2	3	2	1	2	3	3	2	2
CO3	3	3	2	2	1	2	3	2	3	1
CO4	3	2	3	2	2	2	1	3	2	2

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PROGRAMME	**M.Sc. Zoology**	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCZOO405: **WILDLIFE CONSERVATION BIOLOGY**		
NUMBER OF CREDITS	**4**	**NUMBER OF HOURS**	**6**
COURSE OBJECTIVES	1) The course is an introduction to wildlife management and gives an account of the tools used by wildlife managers. 2) Topics covered are to equip students with adequate knowledge of various biodiversity monitoring methodologies, conservation and management issues of vertebrate pests, 3) To enhance the knowledge of wildlife conflict and over abundant species, wildlife health		

UNIT	CONTENT	NO. OF HOURS
I	**Wildlife Biology** Wildlife: Basic concepts and principles of wildlife, Importance and Values of wildlife; Wildlife heritage of India, Reasons for wildlife depletion in Indian context. Concept of threatened fauna – IUCN categories of species; Distribution of wildlife in India. Human and animal Conflicts: Basic concepts, reasons for conflicts, Identification of damages caused by wild animals and control measures, Socio-economic issues related to human – wildlife interactions. Animal Relationships: Mutualism; Commensalisms; Parasitism; Ammensalism; Predation and Competition with relevant examples.	15
II	**Wildlife Conservation Biology** Conservation of wildlife – Types of Conservation; Case studies – Wildlife sanctuary, National parks, Zoological parks, Biosphere reserves, Tiger reserves etc. Government and Non-government organizations and their role; Important NGO movements – Chipko movement, Narmada Bachavo Andolan, seed movement, Pani panchayat). Wildlife protection Acts; Wildlife management before and after implementation of Wildlife (Protection) Act, 1972. Projects undertaken for protection of wildlife: Project Tiger, Project Lion, Project Crocodile, Project elephant etc. Translocation of wild animals – Principles, methods and application	15
III	**Field Biology** Vegetative analyses – Quadrat method, Point centered quadrat, Strip transect; Habitat manipulation: Food, Water, Shade, impact and removal of invasive alien species Basic survey techniques of Habitats: Map reading, Google map, satellite images (types of forests, hilly areas, Valleys, boundaries, drainages, buildings, roads etc.) Population Estimation: Basic concepts and applications - Direct count (block count; transect methods, Point counts, visual encounter survey, waterhole survey). Indirect count (Call count, track and signs, pellet count, pugmark, nests, camera trap, DNA finger printing and aerial photography).	15

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IV	**Application of Information Technology in Wildlife** Audio records: Various audio recording techniques, sonogram evaluation, Applications of audio recordings (Bird songs, insect calls, habitat usage by bats etc.) Use and application of GPS (Global Positioning System) – Way points, tracks etc. Use and applications of GIS (Geographic Information System) software's. Use and applications of Remote Sensing in wildlife conservation – Satellite imageries and false color imaging	15
PRACTICALS	**WILDLIFE CONSERVATION BIOLOGY** **I. Wildlife Management Techniques** 1) Vegetation analysis –Quadrat method 2) Population estimation of herbivores – Block count method 3) Population estimation of carnivores - Pugmark tracing 4) Introduction to sampling and sample size. 5) Sampling units- Quadrats & Transects 6) Sampling of various life forms (herbs, shrubs, trees, lianas) 7) Species area curve, species abundance distribution, 8) Girth class distribution, Regeneration 9) Estimating bird, insects, mammal densities using appropriate strategies 10) Use of software for identification of plants & animals. 11) Harnessing information through Internet regarding Biodiversity. **II. Conservation Biology** 1) Prepare housing facilities for captive breeding of Lion-tailed macaque and vulture) 2) Mark and locate biodiversity hotspots in India by using the map 3) Mark and locate biosphere reserves of India by using the map 4) Introduction to Maps – Contours, Field Maps 5) Study of SOI Toposheets and its use in sampling 6) Use of Compass & GPS for making field maps **III. Spotters** 1) Identification of indirect evidences – scat, pellet, dung, droppings 2) Identification of pugmark of tiger, leopard and wild dog 3) Population estimation of herpeto fauna – pit fall trap 4) Call Identification of common birds – any five birds 5) Identification of venomous and non-venomous south Indian snakes 6) Study of inter relationships parasitism, symbiosis, commensalisms (2-3examples from each). 7) Study of adaptations in animals from pieces, amphibian, reptilian, birds &mammals (2-3 examples from each).	

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<tr><td>CO1</td><td>Understand the Importance and Values of wild life,Concept of threatened Fauna</td><td>K2</td></tr>
<tr><td>CO2</td><td>Gain the Knowledge about the wild life conservation biology</td><td>K2</td></tr>
<tr><td>CO3</td><td>Evaluate the Knowledge of Field Biology.</td><td>K5</td></tr>
<tr><td>CO4</td><td>Applying the knowledge of information technology in wild life</td><td>K3</td></tr>
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