Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science and Commerce

(Autonomous College)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for M.Sc.-Part II

Program: M.Sc Zoology-Biotechnology and Animal Physiology

Program Code: RJSPZOOAP

(CBCS 2020-21)

DISTRIBUTION OF TOPICS AND CREDITS

M.Sc. ZOOLOGY-BIOTECHNOLOGY-ANIMAL PHYSIOLOGY
SEMESTER III

Course code	Nomenclature	Credits	Topic
RJSPZOOBT305	Paper-I Basics of industrial & environmental biotechnology I	04	1. The implications of recombinant DNA technology of commercial products and microbial synthesis
			2. Large scale culture & production from recombinant microorganisms & genetically engineered animal cells
			3. Medical Biotechnology
			4. Environmental Biotechnology I
RJSPZOOBT306	Paper-II Genetic engineering techniques and its application-II	04	1. Genome management and analysis
			2. Manipulation of gene expression in prokaryotes
			3.Bioinformatics
			4.Animal biotechnology and human therapies.
RJSPZOOAP307	Paper-III Comprehensive Physiology-I	04	1. Level of response and Nutritional Physiology
			2. Dynamics of Physiological fluids
			3. Physiological of Motility.
			4. Neurotransmission Physiology.
RJSPZOOAP308	Paper-VIII Environmental and Applied Physiology-I	04	13. Stress, Water as environmental factors
			14. Oxygen as environmental factors
			15. Environmental Radiation
			16. Enzymes and Body Fluids as Clinical Diagnostic Tools
RJSPZOOPBT305	PRACTICAL-I	02	Practicals based on RJSPZOOBT305
RJSPZOOPBT306	PRACTICAL-II	02	Practicals based on RJSPZOOBT306
RJSPZOOPAP307	PRACTICAL-III	02	Practicals based on RJSPZOOAP307
RJSPZOOPAP308	PRACTICAL-IV	02	Practicals based on RJSPZOOAP308

DISTRIBUTION OF TOPICS AND CREDITS

M.Sc. ZOOLOGY-BIOTECHNOLOGY-ANIMAL PHYSIOLOGY

SEMESTER IV

Course code	Nomenclature	Credits	Topic
RJSPZOOBT405	Paper-I Basics of industrial & environmental biotechnology II	04	1. Microbial synthesis of commercial products
			2. Large scale culture & production for industrial biotechnology
			3. Agricultural Biotechnology
			4. Environmental Biotechnology II
RJSPZOOBT406	Paper-II Genetic engineering techniques and its application-II	04	1. Genome management
			2. Manipulation of gene expression in eukaryotes.
			3. The human genome project
			4. Regulations and patents in biotechnology.
RJSPZOOAP407	Paper III Comprehensive Physiology-II	04	1. Physiology of Respiration and Nitrogen Metabolism .
			2. Dynamics of Physiological fluids-composition.
			3. Physiology of Continuity of Life.
			4. Endocrine regulation, Sensory & effector physiology.
RJSPZOOAP408	Paper-IV Environmental and Applied physiology-II	04	1. Pressure as an Environmental factor.
			2. Temperature as Environmental factor
			3. Radiation and Physiology of Biological Rhythms.
			4. Physiological Tools for Clinical Diagnostics.
RJSPZOOPBT405	PRACTICAL-I	02	Practicals based on RJSPZOOBT405
RJSPZOOPBT406	PRACTICAL-II	02	Practicals based on RJSPZOOBT406
RJSPZOOPAP407	PRACTICAL-III	02	Practicals based on RJSPZOOAP407
RJSPZOOPAP408	PRACTICAL-IV	02	Practicals based on RJSPZOOAP408

	SEMESTER-III (THEORY)	L	Cr
	Paper- V Basics of Industrial & Environmental Biotechnology I **Paper Code: RJSPZOOBT305**	**60**	**4**
	UNIT I	**15**	
	The implications of recombinant DNA technology of commercial products and microbial synthesis		
1	1.1. The implications of recombinant DNA technology 1.1.1 *General account on applications of biotechnology 1.1.2 *Commercialization of biotechnology & biotech companies 1.1.3 Prospects of novel food technology 1.1.4 Economics of microbial biotechnology 1.1.5 Areas of significant public concern: Antibiotic resistance marker gene, transfer of allergies, pollen transfer from GM plants, social, moral & ethical issues associated with GMOs. 1.2. Amino acids & their commercial use – production strain, process of L-glutamate, L- aspartate, L-phenylalanine, L-tryptophan.		
	UNIT II	**15**	
	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells		
2	2.1. Large scale culture & production from recombinant microorganisms: 2.1.1 Batch fermentation 2.1.2 Fed batch fermentation 2.1.3Continuous fermentation 2.1.4 *Maximizing the efficiency of fermentation process 2.1.5 Harvesting, disrupting & downstream processing 2.2. Large scale culture & production from genetically engineered animal cell cultures: 2.2.1Design of bioreactors for large scale animal cell culture-Batch, Fed batch 2.2.2 Mammalian cell lines & their characteristics 2.2.3 Media for the cultivation of mammalian cells 2.2.4 *Commercial products produced with mammalian cell culture.		
	UNIT III	**15**	
	Medical Biotechnology		
3	3.1. Sub-unit vaccines 3.1.1 *Sub-unit Vaccine production against viruses-Herpes simplex, Bovine foot & mouth disease virus 3.1.2 Peptide vaccines-synthetic drugs (engineered proteins) 3.1.3 Genetic immunization-DNA vaccines, Antisense DNA, Therapeutic ribozymes 3.1.4 *Live recombinant vaccines		

	3.1.5 *****Attenuated vaccines against Cholera, Salmonella sp. 3.1.6 Vector vaccines-Vaccine directed against viruses- Rabies virus G-protein, Hepatitis B surface antigen 3.1.7 Anti-idiotypic vaccine for cancer treatment 3.2. Monoclonal antibodies (mAbs) & therapeutic applications: 3.2.1 mAbs for prevention of rejection of transplanted organs 3.2.2 Treatment of bacterial blood infection 3.2.3 Human monoclonal antibodies 3.2.4 Hybrid human-mouse monoclonal antibodies 3.2.5 HIV therapeutic agents 3.2.6 Anti-tumour antibodies		
	Unit IV	**15**	
	Environmental Biotechnology I		
4	4.1. Biomass utilization 4.1.1 Microorganisms in lignocellulose degradation 4.1.2 Isolation of prokaryotic & eukaryotic cellulase gene 4.1.3 Manipulation of cellulase gene 4.1.4 Production of single cell proteins by using biomass as raw material 4.1.5 Commercial production of fructose and alcohol from biomass 4.1.6 Improvements of fructose and alcohol production 4.1.7 Fuel ethanol from biomass 4.2. Bioremediation of aerobic compounds 4.2.1 Characteristics of xenobiotics in the environment 4.2.2 Characteristics of aerobic microorganisms for degradation of organic pollutants 4.2.3 Genetic engineering of biodegradative pathways- Manipulation by transfer of plasmid, manipulation by gene alteration 4.2.4*****Degradation of xenobiotic compounds-petroleum products, n-alkanes, alkenes, cycloaliphatic compounds, aromatic hydrocarbons, polyaromatic hydrocarbons, chlorinated organic compounds (aliphatic & aromatic) ***Marked topics are to be taken for seminar**		

M.Sc-II	Semester III Theory
RJSPZOOBT305 Paper-V **Basics of Industrial & Environmental Biotechnology- I**	**Course Objectives:** 1. To introduce to the different commercial products of recombinant technology 2. To familiarize the fermentation techniques 3. To understand application in the field of environment and medicine **Learning Outcomes:** 1. Learners will get an idea of various commercial products and its economics. 2. Learners will be able to understand the applications of biotechnology for vaccine production and environmental utility.

	SEMESTER-III (THEORY)	**L**	**Cr**
	Paper- VI Genetic Engineering Techniques and Its Application-I **Paper Code: RJSPZOOBT306**	**60**	**4**
	UNIT I	**15**	
	Genome Management and Analysis		
1	**1.1 The Basic tools of genetic engineering** 1.1.1 Chemical Synthesis of DNA-Oligonucleotide synthesis by Phosphoramidite method, Synthesis of genes 1.1.2 *DNA Sequencing -- Maxam-Gilbert method, Sanger's dideoxynucleotide method, By using bacteriophage M13 by Primer walking 1.1.3 Polymerase chain reaction and its advantages **1.2 Cloning Vectors** 1.2.1 *General purpose plasmid vectors (pUC19, pBR322) (Bacterial Vectors) 1.2.2 Bacteriophage and cosmid vectors 1.2.3 Yeast artificial chromosomes (YACs) **1.3 Analysis of genome/proteome** 1.3.1 DNA fingerprinting/physical mapping/pulsed field gel electrophoresis 1.3.2 Analysis of the proteome 1.3.3 Analysis of mRNA transcripts		
	UNIT II	**15**	
	Manipulation of Gene expression in Prokaryotes		
2	**2.1 Promoters of gene expression in prokaryotes** 2.1.1 Prokaryotic gene expression 2.1.2 Isolation of functional promoters 2.1.3 Promoter selection with E.coli plasmid pBR316 2.1.4 *Promoter selection with plasmid pKO1 2.1.5 Gene expression from strong and regulatable promoters **2.2 Expression of cloned genes in prokaryotes** 2.2.1 Increasing protein production and secretion 2.2.2 *Inclusion bodies and fusion proteins 2.2.3 Unidirectional tandem gene arrays 2.2.4 Translation expression vectors 2.2.5 Increasing protein stability		
	UNIT III	**15**	
	Bioinformatics		
3	3.1 Uses and application of computers in biological science 3.2 *DNA profiling: cDNA and EST's (expressed sequence tags) 3.3Basic research with DNA microarrays and its application in healthcare 3.4 Biomedical genome research and pharmaco genomics 3.5 *Random amplified polymorphic DNA (RAPD) 3.6Human genomic variation-SNP's (single nucleotide polymorphisms, SNP's and disease; QTL (quantitative trait loci) and its relation to SNP's		

	3.7 Satellite DNA and its types		
	Unit IV	**15**	
	Animal biotechnology and Human therapies		
4	**4.1 Animal Biotechnology** 4.1.1 ***Transgenic animals and their applications: Mice as model system for human diseases and as test case model, Cows, pigs, sheep, goats as biopharmaceuticals, Transgenic insects and birds 4.1.2 Recombinant DNA technology to prevent animal diseases 4.1.3 Conservation biology-Embryo transfer 4.1.4 Regulation of transgenic animals and patenting genetically engineered animals **4.2 Human therapies** 4.2.1 Tissue engineering: Skin, liver, pancreas 4.2.2 ***Xenotransplantation 4.2.3 Antibody engineering 4.2.4 Cell adhesion-based therapies: Integrins, Inflammation, Cancer and metastasis 4.2.5 Targeted gene replacement for correcting a mutated gene 4.2.6 Site directed mutagenesis ***Marked topics are to be taken for seminar**		

M.Sc-II	**Semester III Theory**
RJSPZOOBT306 **Paper- VI** **Genetic Engineering Techniques and Its Application-I**	**Course Objectives:** 1. To introduce to the concept of genome management. 2. To impart knowledge on gene expression in organisms. 3. To understand computer application. 4. To have insights to treatment strategies. **Learning Outcomes:** 1. Learners will get an idea of different tools of genetic engineering 2. Learners will be well-versed with the computer applications in the field of biotechnology. 3. Learners will be able to understand the applications of biotechnology for treatment of several diseases.

M.Sc - II Zoology Syllabus Semester III & IV

	SEMESTER-III (THEORY)	L	Cr
	Paper- VII Comprehensive Physiology-I **Paper Code: RJSPZOOAP307**	**60**	**4**
	UNIT I	**15**	
	Levels of response and Nutritional Physiology		
1	1.1. Levels of Physiological response- Molecular, Membrane, Organ and Organism. 1.1.1 A brief idea of physiological response at molecular level 1.1.2 Membrane physiology- Functional consequences of molecular composition and arrangement. 1.1.3 Transport across cell membrane-* Diffusion * active transport, pump; uniports, symports and antiport, co-transport by symporters and anitporters. 1.2. Physiology of Food Capture and Processing: 1.2.1 Nutritive Patterns: Origin of nutritive types. 1.2.2 Feeding patterns: a) Large particle feeding b) Surface nutrient absorption 1.2.3 Digestion: a) Bulk movement and peristalsis b) Comparative biochemistry of digestion c) Neural and hormonal regulation of secretion of digestive enzymes. 1.2.4 Regulation of nutritional intake: a) Hunger drive, Glucostatic and Hepatostatic theories of hunger drive b) Adaptation of gut to metabolic rate and diet. c) *Balanced diet: A human perspective		
	UNIT II	**15**	
	Dynamics of Physiological Fluids-Circulation		
2	2.1. Circulation of body fluids 2.1.1 a) Circulating fluids-Cytoplasm, Hydrolymph, hemolymph, lymph and Blood b) Circulatory mechanisms and Fluid compartments, movement of body fluids by somatic muscles. Hemolymph and open systems 2.1.2 Pressure and flow in vertebrate circulatory system 2.1.3 Physiological types of hearts with special reference to arthropods, annelids, mollusca, tunicates and vertebrates. 2.1.4 Pacemakers and specialized conducting fibers. 2.1.5 Selective distribution of blood flow. 2.2 Cardiac Physiology 2.2.1 Neurohormonal regulation of cardiac amplitude and frequency. 2.2.2 *Effects of exercise on cardiac vascular physiology - A human perspective.		
	UNIT III	**15**	
	Physiology of Motility		
3	Physiology of movement and locomotion 3.1.1 *Biochemistry of contractile proteins. 3.1.2 Physiology of non-muscular contractile elements: Axoplasmic movement, Chromosome involvement 3.1.3 Physiology of skeletal muscle fibre: a) Actomyosin complex b) Source of energy for muscle contraction c) *Sliding filament theory d) Excitation of contraction and mechanism of regulation of contraction by calcium e) Mechanism of relaxation 3.1.4 Comparative physiology of invertebrate muscle: a)		

	Polyneural innervation in anthropod muscle b) Insect non-oscillatory postural muscle c) Resonant flight and tymbal muscle in insects d) Catch muscle and delayed relaxation		
	Unit IV	15	
	Neurotransmission Physiology		
4	4.1. Physiology of neuronal system 4.1.1 Excitable membranes: a) Membranes potential b) Ions as current carriers - Protons, calcium, potassium, structure of cation-permeable channels and chloride channels 4.1.2 Synaptic transmission: a) Electrical transmission b) Chemical transmitters- Neuropeptide, FMRF-amide family, Gastrin, CCK family, Hypothalamic pituitary factors 4.1.3 Integrative Neurophysiology: Neurons, Interneurons, neural Circuits, Networks, Primitive Nervous Systems, Nerve nets, Central pattern Generators in Invertebrates, Chordate Nervous System, Central Nervous System processing. * Memory and Learning. * Indicate topics for learners to present seminars on.		

M.Sc-II	**Semester III Theory**
RJSPZOOAP307 **Paper VII** **Comprehensive Physiology-I**	**Course Objectives:** 1. To familiarize the learner with nutritional physiology at various structural levels from membranes to systems. 2. To familiarize the learner to circulation of body fluids and types of circulation in various phyla. 3. To familiarize the learner to intracellular and extracellular processes involved in movement and locomotion in animals. 4. To familiarize the learner to structural and functional aspects of neurophysiology. **Learning Outcomes:** **1.** The learner shall comprehend the molecular processes at membrane level and genetic level, their significance in nutrition and digestion. 2. The learner will understand the comparative mechanics and regulation of circulation 3. The learner shall discern molecular and supra-molecular structures and processes responsible for movement and locomotion in the animals. **4.** The learner shall comprehend molecular, structural and functional dimensions of neurophysiology in the animal kingdom.

	SEMESTER-IV (THEORY)	L	Cr
	Paper- VIII Environmental and Applied Physiology-I **Paper Code: RJSPZOOAP308**	**60**	**4**
	UNIT I	**15**	
	Stress, Water as an Environmental Factor		
1	1.1. Environmental Stress, Homeostasis and strategies of biochemical adaptations 1.1.1 Basic concept of environmental stress a) Plastic and elastic strain b) Stress resistance, stress avoidance and stress tolerance* – Seminar topics 1.1.2 Homeostasis and biochemical adaptation: a) External and internal environment b) Multiple control system c) Strategies of biochemical adaptations 1.2. Water and Solute problem 1.2.1 Preservation of intracellular solvent capacity 1.2.2 Strategies and degrees of ionic regulation 1.2.3 ATPase the model regulatory enzyme 1.2.5 Key role of GDH reaction 1.2.6 *Salt glands in animal kingdom.		
	UNIT II	**15**	
	Oxygen as Environmental Factor		
2	2.1 Oxygen as an environmental factor 2.1.1 *Oxygen and Origin of life 2.1.2 Oxygen dependencies in living organism 2.1.3 Anoxia adaptations in invertebrates 2.1.4 Adaptations of vertebrates during prolonged diving 2.1.5 Oxygen debt in vertebrate muscle		
	UNIT III	**15**	
	Environmental Radiation		
3	3.1. Radiation as an environmental parameter 3.1.1 The solar spectrum 3.1.2 Biomolecules involved in perception and trapping of solar radiations: Chlorophyll, Bacteriorhodospin, Rhodospin and Vitamin A. Adaptations of animals to absence of solar radiations . 3.1.3 Effects of Ionizing radiations at the cellular and molecular level 3.1.4 Phenomenon of radioprotection		
	Unit IV	**15**	
	Enzymes and Body Fluids as Clinical Diagnostic Tools		
4	4.1. Enzymes as diagnostic tools 4.1.1 Plasma specific and non-plasma specific enzymes 4.1.2 Diagnostic importance of LDH 4.1.3 Enzyme in diagnosis of myocardial infarction 4.1.4 Enzymes in Liver diseases and toxicity 4.1.5 Enzymes in muscle disease 4.1.6 *Enzymes in cancer 4.2. Body fluid parameters as diagnostic tools		

	4.2.1 Physiological fluids as diagnostic tools: Routine Blood tests, plasma composition- changes in disease Serum: Urea-N, Creatinine, Uric acid, proteins, bicarbonates, Na+ K+ Cl- 4.2.2 Glucose tolerance test, glycosylated Haemoglobin 4.2.3 Lymph and cerebro-spinal-fluid: Changes in composition in disease 4.2.4 * Urine composition/ constituents as a diagnostic tool-Routine Urine tests, Urea-N, Creatinine, Uric acid, tests for proteinurea, albuminurea, Glucosurea, chyluria (for filariasis) * Indicate topics for learners to present seminars on.		

M.Sc-II	**Semester III Theory**
RJSPZOOAP308 **Paper VIII** **Environmental and Applied Physiology-I**	**Course Objectives:** • Learner shall reinforce concepts of homeostasis and understand environmental stress and physiological adaptations to withstand the stress. • The learner shall understand the different diagnostic tests used. **Learning Outcomes:** • The learner shall comprehend metabolic strategies and physiological adaptations to withstand environmental stress in the form of ambient oxygen availability and environmental radiation. • The learner will be able to identify different biochemical tests used for detection and monitoring the prognosis of the disease.

	SEMESTER-IV (THEORY)	L	Cr
	Paper- V - Basics of Industrial & Environmental Biotechnology II **Paper Code: RJSPZOOBT405**	**60**	**4**
	UNIT I	**15**	
	Microbial synthesis of Commercial Products		
1	1.1. Microbial synthesis of commercial products 1.1.1 Organic acids & their commercial applications – Citric acid, gluconic acid, lactic acid. 1.1.2 Antibiotics – Cloning antibiotic biosynthetic gene by complementation & other methods. Synthesis of novel antibiotics & improving antibiotic production. *Aminoglycosides & their uses 1.1.3 Polysaccharides: Bacterial polysaccharides: General properties & their commercial applications- Dextran, Xanthan, Alginate Genetic engineering for the large scale production of Xanthan gum & its modification. *Marine polysaccharides: General properties & their commercial application- Agar & agarose, Chitosan 1.1.4 Polyesters: Polyhydroxyalkanoates (PHA)-Biosynthesis of PHA, Biopol- commercial biodegradable plastic.		
	UNIT II	**15**	
	Large scale Culture & Production for Industrial biotechnology		
2	2.1. Biotransformations 2.1.1 Selection of biocatalyst-screening & use of novel existing biocatalyst 2.1.2 Genetic modification of existing biocatalyst (Indigo biosynthesis) 2.1.3 Biocatalyst immobilization- Methods of immobilization- Cross linking, supported immobilization, adsorption & ionic binding, covalent coupling, lattice entrapment 2.1.4 Immobilized soluble enzymes & suspended cells 2.1.5 Immobilization of multi-enzyme systems & cells 2.1.6 *Immobilized enzyme reactors- Batch reactors, continuous reactors 2.1.7 Analytical enzymes- Enzymes in diagnostic assays: Test strip systems & Biosensors-Electrochemical & optical type		
	UNIT III	**15**	
	Agricultural Biotechnology		
3	3.1. Agricultural Biotechnology: 3.1.1 *Nitrogen fixation 3.1.2Nitogenase-Component of nitrogenase; Genetic engineering of nitrogenase cluster 3.1.3 Hydrogenase-Hydrogen metabolism 3.1.4 Genetic engineering of hydrogenase gene 3.1.5 Nodulation-Competition among nodulation organisms, genetic engineering of nodulation gene		

	3.1.6 Microbial insecticides-Toxins of *Bacillus thuringiensis*, mode of action & use of thuringiensis toxins, thuringiensis toxin gene isolation, genetic engineering of *Bacillus thuringiensis* strains & cloning of thuringio toxin gene. 3.1.7*****Developing insect resistant, virus resistant & herbicide resistant plant 3.1.8 Algal products: Fuels from algae, marine natural products & their medical potential-anticancer, antiviral compounds, antibacterial agents.		
	Unit IV	**15**	
	Environmental Biotechnology II		
	4.1. Bioabsorption of metals (Recovery from effluents) 4.1.1 *****Bioabsorption by fungi, algae, moss & bacteria 4.1.2 Mechanism of bacterial metal resistance & genetic engineering for specific proteins 4.1.3 Bioreactors for bioabsorption-packed bed, fluidized bed, rotating disc, single blanket, sequential reactors 4.1.4 Phytoremediation &its use in biotechnology 4.2. Bioleaching of metals 4.2.1 Biochemical mechanism of bioleaching 4.2.2 Extraction from mixtures 4.2.3 Types of bioleaching 4.2.4 Methods for bioleaching-Tank & heap bioleaching 4.2.5*****Microorganisms used for bioleaching ***Marked topics are to be taken for seminar**		

M.Sc-II	**Semester IV Theory**
RJSPZOOBT405 **PAPER V** **Basics of Industrial & Environmental Biotechnology II**	**Course Objectives:** 1. To introduce to several commercial products of microbial synthesis. 2. To familiarise with applications in industrial, agricultural and environmental fields. **Learning Outcomes:** 1. Learners will get an idea about types of commercial products obtained from microbes. 2. Learners will be able to apply knowledge of biotechnology to industrial, agricultural and environmental sectors.

	SEMESTER-IV (THEORY)	L	Cr
	Paper VI- Genetic Engineering Techniques and Its Application-II **Paper Code: RJSPZOOBT406**	**60**	**4**
	UNIT I	**15**	
	Genome management		
1	**1.1 The Basic tools of genetic engineering** 1.1.1Gene transfer techniques: Protoplast fusion, calcium phosphate, precipitation, electroporation, liposome, ligand mediated, gene gun or biolistic approach, viral mediated 1.1.2 Selection and screening of recombinants 1.1.3 *Nucleic acid probes and hybridization, Southern blotting and Northern blotting 1.1.4 Immunological assays for identification of gene product, Western blot **1.2 Cloning Vectors** 1.2.1 *Retrovirus and SV40 vectors 1.2.2Special purpose vectors- Expression vectors, Secretion vectors, Shuttle or bi-functional vectors, single stranded phage and phagemids		
	UNIT II	**15**	
	Manipulation of Gene expression in Eukaryotes		
2	2.1 Eukaryotic gene expression 2.2 *Introduction of DNA into fungi-yeast and filamentous fungi (fungal transformation) 2.3 Heterologous proteins production in yeast 2.4 Heterologous proteins production in filamentous fungi 2.5Cultured insect cells expression systems- Baculovirus transfer vector 2.6*Mammalian cell expression systems- Human Papova BK virus shuttle vector.		
	UNIT III	**15**	
	The Human Genome Project		
3	3.1 *The human genome, scope and goals of the project 3.2 Genetic linkage maps, chromosome walking, restriction mapping 3.3 Polymorphic DNA markers 3.4 Restriction fragment length polymorphism (RFLP) and its uses 3.5 Physical maps, Sequence tagged sites 3.6 Integrating genetic linkage and physical maps 3.7 *Mapping human diseases 3.8 Positional cloning: Getting closer to a disease causing gene 3.9 Testing for exons 3.10 Limitations of positional cloning		
	Unit IV	**15**	
	Regulations and Patents in Biotechnology		
	4.1 Regulating recombinant DNA technology 4.2*Regulatory requirements – safety of genetically engineered foods Chymosin, tryptophan, bovine somatotropin		

	4.3Regulation environmental release of genetically engineered organism (GEO). Ice minus *Pseudomonas syringae* 4.4 Regulatory agencies and laws for product regulation 4.5 Risk assessment: How much risk? 4.6 *****Open field tests of GEO 4.7 Development of policy for Human gene therapy 4.8 Patenting biotechnology inventions a) What constitutes the patent? b) The patent process c) The conditions to be satisfied for an invention to be patentable :Novelty, Inventiveness, Usefulness d) Patenting in different countries, types of inventions that are not patentable in India e) What is Paris convention? Principal features of Paris convention f) Patenting multicellular organisms g) Patenting and fundamental research ***Marked topics are to be taken for seminar**		

M.Sc-II	Semester IV Theory
RJSPZOOBT406 **PAPER VI** **Genetic Engineering Techniques and Its Application-II**	**Course Objectives:** 1. To acquaint the learners with the basic tools of genetic engineering. 2. To impart knowledge on gene expression in organisms. 3. To understand the significance of Human Genome Project. **Learning Outcomes:** 1. Learners will get an idea of different gene transfer techniques for genetic engineering. 2. Learners will be able to understand the mechanism of gene expression. 3. Learners will acquire insight of the applications of Human Genome Project for human welfare.

SEMESTER-IV (THEORY)		L	Cr
Paper VII Comprehensive Physiology-II Paper Code: RJSPZOOAP407		**60**	**4**
UNIT I		**15**	
Physiology of Respiration and Nitrogen Metabolism			
1	1.1 Respiration 1.1.1 *Transition from water to land- Vertebrates and invertebrates 1.1.2 O2 consumption, RQ and modifying agents: Activity, Temperature, Salinity, Photoperiod, Development, Hibernation, Animal size and metabolism. 1.1.3 Respiratory functions of blood: *Respiratory pigments, respiratory acidosis and alkalosis, Alkali reserve 1.1.4 Control and co-ordination of respiration 1.2. Nitrogen Metabolism 1.2.1 Amino-N Metabolism, Nucleic acid metabolism, Nitrogenous waste products. 1.2.2 Ammonia toxicity and detoxification pathways- * Ammonotely, Ureotely, Purinotely, uricotely, Storage excretion. 1.2.3 Patterns of detoxification pathways in eggs and during metamorphosis, Phylogenetic patterns.		
	UNIT II	**15**	
	Dynamics of Physiological Fluids-Composition		
2	2.1. Dynamics of fluid composition 2.1.1 Body fluid composition- water, solute and Intracellular regulation. 2.1.2 Cutaneous evaporation, Respiratory evaporation, 2.1.3 Integrated functioning for nitrogen excretion and osmoregulation Contractile vacuole, Coelomoducts, Flame cells, Green gland, Malpighian Tubules, Invertebrate Nephredia and Vertebrate Nephron 2.1.4 Comparative physiology of vertebrate kidney 2.1.5 *Kidney stones and kidney transplants - a human perspective. 2.2. Transfusion, Blood Replacement- A human perspective. 2.3. Haemodialysis and peritoneal dialysis- A human perspective.		
	UNIT III	**15**	
	Physiology of Continuity of Life		
3	Physiology of Reproduction 3.1.1 Selfish gene, evolution of gametes, maternal DNA 3.1.2 Endocrine regulation of reproduction in invertebrates, Molluscs, Crustaceans, Insects 3.1.3 Comparative account of vertebrate gonadotropins, gonadal steroids, 3.1.4 * Interaction of steroid hormones and nervous tissue. 3.1.5 Human intervention in Reproduction Contraceptives, MTP, Treatment of Infertility. Assisted Reproduction Techniques- IFV, GIFT, ICSI, ZIFT, DI, AID		
	Unit IV	**15**	
	Endocrine regulation, Sensory & Effector Physiology		
	4.1. Physiology of Endocrine Regulation 4.1.1 Specificity, Membrane bound receptor system, Cytosolic receptor system 4.1.2 *Invertebrate Endocrine System Lower invertebrates, Annelids, Molluscs, Crustaceans, Insects 4.1.3 Regulated supply of hormones: Feedback: Direct and Indirect Hypothalamo-		

	Hypophysical axis, Pineal- Pituitary gland, Thyroid and Adrenal gland, G-E-P (Gastro-entero-pancreatic) cells, Renal hormones Cardiac hormones, Prostaglandins. 4.2. Sensory and Effecter physiology 4.2.1 Sensory Physiology- Structural and Functional Classification, Modality Intensity, Sensory coding 4.2.2 Various receptors- Chemoreception, Mechanoreception , Electroreception Thermoreception, *Photoreception. 4.2.3 * Physiological effectors: Cnidoblasts, Bioluminescent systems Chromatophores, electric organs * Indicate topics for learners to present seminars on.		

	Semester IV Theory
RJSPZOOAP407 **PAPER VII** **Comprehensive Physiology-II**	**Course Objectives:** 1. To introduce the learner to physico-chemical parameters of respiration in the invertebrates and vertebrates. 2. To enable the learner to become well versed with patterns of nitrogen metabolism, excretion of wastes, osmoregulation and applied aspects of renal function in human beings. 3. To familiarize the learner to physiology of reproduction 4. To make learners aware of intricate mechanisms of endocrine system. **Learning Outcomes:** 1. Learner will become familiar with different types of respiratory pigments and there distribution in animal kingdom. 2. The learner shall discern the variations in metabolic waste products and their relationship to habitat, metabolic pathways of nitrogen metabolism in the vertebrates, role of renal functions in electrolyte balance, blood pressure and acid-base balance. 3. The learner shall understand the physiology of reproduction in different animal groups. 4. The learner shall come to know about different assisted reproduction techniques. 5. The learner shall understand the organizational aspects of sensory structures at the molecular, membrane and organ level and their functioning as transducers in reception of sensory stimuli.

	SEMESTER-IV (THEORY)	L	Cr
	Paper VIII Environmental and Applied Physiology-II **Paper Code: RJSPZOOAP408**	**60**	**4**
	UNIT I	**15**	
	Pressure as an Environmental Factor		
1	1.1 Pressure as an environmental factor 1.1 Fundamental effects of pressure on biological system 1.1.2 Rate of enzyme action with respect to pressure 1.1.3 Effect of pressure on weak bonds and the consequences for higher orders of Protein structure. 1.1.4 Effects of pressure on cellular processes viz. transcription, translation and gene regulation 1.1.5 Strategies of enzyme adaptations to pressure in marine organisms: FDPase and PK		
	UNIT II	**15**	
	Temperature as Environmental Factor		
2	2.1. Temperature Regulation/ Response to temperature fluctuations 2.1.1 Thermal limits of survival 2.1.2 Temperature and Structural effects with response to Biological molecules and biological membranes 2.1.3 Temperature and rate effects: Temperature dependent E~S affinity, Lipoprotein enzymes 2.1.4 Thermal resistance of dormant and active cells 2.1.5 Ectothermy and endothermy 2.1.6 Endothermy in invertebrates 2.1.7 Biochemical adaptations of Ectothermy: Antifreeze substances, Heat shock proteins		
	UNIT III	**15**	
	Radiation and Physiology of Biological Rhythms		
3	3.1. Physiology of Biological Rhythms and timings 3.1.1 Temporal organization of the cells 3.1.2 Circadian Rhythms. Synchronization of circadian rhythms 3.1.3 Dormancy in fresh water and terrestrial animals Preparatory phases, Induction of dormancy, Arousal from dormancy Entrainment and dormancy 3.1.4 Diapause in insects- Induction, Factors affecting and termination of Diapause, Diapause and endocrine functions 3.1.5 *Photoperiodism 3.1.6 *Biological clocks		
	Unit IV		
	Physiological Tools for Clinical diagnostics.	**15**	
	4.1. Antibodies as diagnostic tools 4.1.1 RIA- of GnRH, Gonadotropins, T3, T4, TSH, HCG, Insulin 4.1.2 * ELISA- for detection of HCG, diagnosis of Amoebiasis, Typhoid, HIV 4.1.3 Monoclonal antibodies as diagnostic tools: Detection of HCG, Diagnostic of STD, Streptococcal throat infections, Herpes and Cancer 4.2. Organ Function Tests as diagnostic tools		

	4.2.1 *Liver function tests and toxicity tests 4.2.2 Pancreatic function tests 4.2.3 Gastric function tests 4.2.4 Kidney function tests * Indicate topics for learners to present seminars on.		

M.Sc-II	Semester IV Theory
RJSPZOOAP408 **PAPER VIII** **Environmental and Applied Physiology-II**	**Course Objectives:** 1. Learner shall reinforce concepts of homeostasis and understand environmental stress and physiological adaptations to withstand the stress 2. To introduce the learner to temporal aspects of biological systems 3. To understand the basis of various diagnostic test **Learning Outcomes:** 1. The learner shall comprehend metabolic strategies and physiological adaptations to withstand stress in the form of temperature and pressure as environmental factors. 2. The learner shall understand the various types of rhythms encountered in biological systems and their manifestations through various activities. 3. The learner will understand the significance of clinical diagnostics.

SEMESTER-III PRACTICAL		**Credits**
Course Code: RJSPZOOPBT305 and RJSPZOOPBT306		**04**
Based on : RJSPZOOBT305 and RJSPZOOBT306		
	1)Demonstration of aseptic technique: Work place for aseptic handling, packing glassware (flasks, test tubes, pipettes, petri dishes) for sterilization, aseptic transfer of liquids (pipetting from flask to test tube) 2) Preparation of LB agar plate, slant, butt & demonstration of streaking technique using bacterial culture to obtain isolated colonies. 3) Determination of viable cell count in the given culture of bacteria by dilution & spreading technique. 4) Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis. 5) To estimate the number of bacteria in the given culture by nephelometry.	
	Course Code: RJSPZOOPAP307 and RJSPZOOPAP308	
	Based on Course Code: RJSPZOOAP307 and RJSPZOOAP308	**04**
2	1)Determination of activities of digestive enzymes viz. Amylase, Pepsin, Trypsin, Lipase etc. in different animals (Cockroach) 2) Study of effect on activity of any enzyme of various factors like pH, Temperature, Activator, Inhibitor 3) Determination of Km of a given enzyme 4) Total RBC, WBC and Different WBC count- A comparative study of fish, goat and human 5) Routine human blood tests like RBC, WBC, DWBC, Hb content, blood sugar. prepare a report as required by a pathological laboratory (goat blood) 6) Observation of decreasing PO2 of water on the respiratory rate of a fish 7) Effect of decreasing PO2 of water on Lactic acid in the muscle. 8) Estimation of salt loss and gain in an aquatic animal when it is transferred to a salt-free medium and to natural medium. 9) Preparation of glycerinated muscle fibre and study of its properties. 10) Effect of different concentrations of sodium chloride on the diameter of RBCs and determination of concentration isotonic to blood.	

M.Sc-II	Semester III Practical
RJSPZOOBTP305 and RJSPZOOBTP306	**Course Objectives:** • To provide hands-on training in aseptic techniques. • To teach dilution and spreading technique applicable in diagnostic areas. **Learning Outcomes:** • The learner shall acquire the skills of handling glasswares and culture in lab. Conditions. • Learners will be trained in several techniques applicable in biotech companies.

M.Sc-II	Semester III Practical
RJSPZOOPAP307 and RJSPZOOPAP308	**Course Objectives:** • To understand the isolation of enzymes from crude source. • To get a hands-on training in the basics of enzymology. • To understand the comparative hematology of birds and mammals. • Design the practicals of environmental physiology with respect to pressure, solute concentration and oxygen. **Learning Outcomes:** • The learner will be able to perform and calculate enzyme kinetics. • The learner will understand the biochemical changes accompanied by change in physical and chemical parameters of aquatic environment. • The learner will acquire training in handling of biological material and well as animals • Learner will understand the significance of animal ethics.

SEMESTER-IV PRACTICAL	Credits
Course Code: RJSPZOOPBT405 and RJSPZOOPBT406	**04**
Based on RJSPZOOBT405 and RJSPZOOBT406	
1) Immobilize Yeast cells in calcium alginate & prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column. 2) Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided. 3) Demonstrate the western blotting technique for the given sample of protein. 4) To plot a growth curve for the microorganisms provided. 5) Demonstrate the effect of medium on growth curves of given microorganism, using two different media (minimal & enriched).	
Course Code: RJSPZOOPAP407 and RJSPZOOPAP408	**04**
Based on RJSPZOOAP407 and RJSPZOOAP408	
1) Determination of Urea, Creatinine in blood -Human/goat 2) Determination of serum content of uric acid, cholesterol – Human/goat 3) Effect of injection of insulin/ glucagon on the blood sugar and liver glycogen in rat/ mouse 4) Routine urine tests and preparation of report as per pathological laboratory (treatment as in "Fundamentals of Practical clinical biochemistry pp 34-38, 40-43) 5) Performance of Ouchterlony technique to demonstrate immunodiffusion 6) Demonstration of single radical immunodiffusion of antibody and antigen 7) Influence of sub lethal (50-60ppm) ammonia (as liquor ammonia/ ammonium hydroxide/ ammonium chloride) on a suitable fish exposed to ammonia stress for 8) 3/7/15 days with reference to the following parameters: a. Level of excretory ammonia b. Level of activity of hepatic and brain glutamate dehydrogenase c. Level of amino acid content of muscle, gill, brain and liver 9)A survey based project to study physiological diagnostic tools with the help of local pathological laboratory/ hospital. 10. Effect of administration of carbon tetra chloride in rat/mice with reference to following parameters a) Total lipid and free fatty acid content of liver b) Free fatty acid content of plasma c) Level of activity of the following enzymes: AspAT, AlaAT, AICP, ACP, LDH, SDH and ATPase	

M.Sc-II	Semester IV Practical
RJSPZOOPBT405 and RJSPZOOPBT406 Practical V and VI	**Course Objectives:** 1. To provide hands-on training in the setting of a lab-scale bioreactor column. 2. To provide inputs on the blotting techniques and its applications. 3. To understand the growth characteristics of microbes in different media. **Learning Outcomes:** 1. The learner shall be trained in setting a bioreactor column and also understand the industrial applications of the same. 2. Learners will be trained in gel electrophoresis and blotting techniques. 3. Learners will understand the significance of different media in the growth pattern of microbes.

M.Sc-II	Semester IV Practical
RJSPZOOPAP407 and RJSPZOOPAP408	**Course Objectives:** 1. The learner will learn to perform toxicity testing in aquatic environment. 2. To understand the working of a pathological laboratory. 3. To get training in biochemical aspects of toxicity testing. **Learning Outcomes:** 1. The learner will get training in calculation of basic toxicity parameters. 2. Learner will gain training in basic diagnostic immunology experiments.

Semester III & IV Biotechnology

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Semester III & IV Animal Physiology

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NOTE : I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II). II) Apart from the institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees : 1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and 2) A Dissection Monitoring Committee (DMC) Composition of DMC shall be as follows : i) Head of the Concerned Department (Convener/Chairperson) ii) Two Senior Faculty Members of the concerned Department iii) One Faculty of related department from the same College IV) One or two members of related department from neighboring colleges Practicals paper patter

Practicals Paper Pattern

Semester III- Biotechnology Practical V

Total marks- 50

Q1) Determination of viable cell count in the given culture of bacteria by dilution & spreading technique. (DAY 1) (25)

OR

Q1) Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis. (DAY 1) (25)

Q2) To estimate the Demonstration of aseptic technique: Work place for aseptic handling, packing glassware (flasks, test tubes, pipettes, petridish) for sterilization, aseptic transfer of liquids (pipetting from flask to (DAY 2)
test tube. (15)

Q3) Viva (05)

Q4) Journal (05)

Biotechnology Practical VI

Total- 50 marks

Q1) Preparation of LB agar plate, slant, butt & demonstration of streaking technique using bacterial culture to obtain isolated colonies. (DAY 1) (25)

Q2) Estimate number of bacteria in given culture of nephelometry. (15)
(DAY 2)

Q3) Viva (05)

Q4) Journal (05)

Practicals paper pattern

Semester III- Physiology Practical VII

Q.1 Major Question: Prepare an extract of salivary gland/ stomatch/ intestine/ liver. Using this extract as an enzyme source, determine the activity of amylase/ trypsin/ pepsin/ lipase. Submit a report to the examiner. (25)

OR

Demonstrate the effect of pH/ temperature/ activator/ inhibitor on the activity of salivary amylase.

OR

Calculate and compare total RBC/ total WBC/ Differential WBC of any two animals (human/ goat /fish).

Q.2 Minor Question: Determine the Km of given enzyme with the help of suitable graph (15)

OR

Demonstrate the effect of ATP and Mn++/ ATP and Mg++/ATP and KCl/ATP and CaCl2 and NaCl on glycerinated fiber. Submit a report.

Q.3 Viva-voce (05)
Q.4 Journal (05)

Semester III- Physiology Practical VIII

Q.1 Major Question: Set up an experiment to demonstrate the effect of decreasing PO2 on lactic acid content of the fish muscle. Compare it with control fish and submit the report. (25)

OR

Estimate the salt loss and salt gain in fish when it is transferred to salt free medium and natural medium.

OR

Demonstrate the effect of different concentrations of sodium chloride on the diameter of RBCs and determine the isotonic concentration for the blood cells, with help of occulometer.

Q.2 Minor Question: Prepare a report from the given parameters of routine blood test. Interpret the result and submit the report (15).

OR

Set up an experiment to demonstrate the effect of decreasing PO2 of water on respiratory rate of fish by counting opercula movement and estimation of oxygen in water.

Q.3 Viva-voce (05)
Q.4 Journal (05)

Semester IV

Biotechnology Practical V

Total- 50 marks

Q1) Demonstrate the effect of medium on growth curves of given microorganism, using enriched media. (DAY 1) (25)

OR

Q1) Demonstrate the effect of medium on growth curves of given microorganism, using minimal media. (DAY 1) (25)

Q2) Immobilize Yeast cells in calcium alginate, prepare beads & keep them overnight in activation medium (DAY 1) (15)

Q3) Viva (05)

Q4) Journal (05)

Biotechnology Practical VI
Total- 50 marks

Q1) Prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column. (DAY 2) (25)

Q2) Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided. (DAY 2) (15)

OR

Q2) Demonstrate the western blotting technique for the given sample of protein. (DAY 2) (15)

Q3) Viva (05)

Q4) Journal (05)

Semester IV

Physiology Practical VII

1 Major Question: Demonstrate the effect of insulin/ glucagon on the blood sugar/ liver glycogen in the given rat/ mouse. Submit a report. (25)

OR

Estimate the content of urea/ uric acid/ creatinine/ bilirubin/ cholesterol from the given blood sample (any two).

Q.2 Minor Question: Demonstrate Ouchterlony technique to show immunodiffusion. Show the result to the examiner. (Result to be observed on the subsequent day) (15)

OR

Demonstrate Single radial immunodiffusion of antigen and antibody. Plot the graph and show the results to the examiner.

Q.3 Viva-voce (05)

Q.4 Journal (05)

Biotechnology Practical VI
Total- 50 marks

Q.1 Major Question:

Show the influence of sublethal dose of ammonia (50-60ppm) on the suitable fish exposed to ammonia stress for 3/7/15 days with reference to the following parameters: (25)

a) Level of excretory ammonia and
b) Activity of hepatic and brain glutamate dehydrogenase
OR c) Level of amino acid content of muscle/ gill/ brain/ liver.
OR Report the effect of administration of carbon tetrachloride on rat/ mouse with reference to following parameters: a) Total lipid and free fatty acid content of liver. b) Free fatty acid from plasma. c) Level of hepatic AST and ALT. d) Level of hepatic LDH and SDH.

Q.2 Project (15)

Q.3 Viva-voce (05)

Q.4 Journal (05)