Resolution No.: AC/I(21-22).2(II).RPS11

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for: PG

Program: M.Sc.

Program Code: Zoology (RPSZOO)

(Credit Based Semester and Grading System for the academic year 2022–2023)

Graduate Attributes

In the post graduate courses, S.P.Mandali's Ramnarain Ruia Autonomous College is committed to impart conceptual and procedural knowledge in specific subject areas that would build diverse creative abilities in the learner. The College also thrives to make its science post graduates research/ job ready as well as adaptable to revolutionary changes happening in this era of Industry 4.0.

GA	Graduate Attributes Description **A student completing Master's in Science program will be able to:**
GA 1	Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application and to evaluate its relevance.
GA 2	Critically evaluate, analyze and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
GA 3	Access, evaluate, understand and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
GA 4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
GA 5	Demonstrate initiative, competence and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
GA 6	Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance.
GA 7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills and lead a team for planning and execution of a task.
GA 8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM OUTCOMES

PO	Description A student completing Master's in Science program in the subject of Zoology will be able to:
PO 1	Identify, explore, understand the concept of ethology and compare the differences in the behaviour.
PO 2	Gain comprehensive knowledge about different animal species and appreciate the differences and similarities, thereby achieving proficiency in handling them experimentally or for research purposes.
PO 3	Understand and learn various behavioural patterns displayed by animals and interrelate to evolutionary pattern.
PO 4	Evaluate and analyse basics of chemical thermodynamics and various biochemical pathways with respect to metabolism.
PO 5	Analyse the various communication pathways taking place inside the cell and interrelate it with genetics.
PO 6	Compare and contrast between Mendelian inheritance, Extension of Mendelian genetics and non-Mendelian genetics
PO 7	Interpret and analyse how morphological change due to change in environment helps drive evolution over a period of time.
PO 8	Compare the different developmental stages of all the animals and connect it to the evolutionary link.
PO 9	Apply the fundamentals and techniques of molecular biology in various fields.
PO 10	Develop an ability to analyse present and interpret various concepts of Immune and Cancer Biology.
PO 11	Understand the broad concepts of Life processes, Endocrinology, Assisted reproductive techniques, Animal biotechnology and develop employable skills.
PO 12	Explore some of the unique migratory patterns of animals and understand their biological rhythms.
PO 13	Apply their knowledge in problem solving and future course of their career development in higher education and research.
PO 14	Develop critical thinking, planning and executing research projects and develop employable skills in the field of Animal Physiology.

Important Note:

In the context of UGC circular of 2006 and the need to understand animal systems better at specialization stages in Zoology, limited anatomical studies of the animals has been introduced at the level of specialization in M.Sc. Zoology. These anatomical studies have been introduced keeping in focus that all aspects of ethics of animal experimentation is informed to the students and that it will be ensured that students are made to understand the ethical use of animals in Biology. In this context, anatomical studies in a limited manner will be used for training with the following conditions:

- The college is agreed to the inclusion of anatomical studies provided, that the students are not asked to kill and cut open live animals.
- The animal specimen if used for anatomical studies will be procured dead from local food market and are items of regular consumption by people.
- The sessions of anatomical studies are arranged in a planned manner to minimize the number of animal specimens used and to reuse the same animal specimen for multiple sessions.
- Further, College will constitute an Anatomical Study monitoring board which will be informed about the use of animals and that the usage will comply to the guidelines of ethical use and handling of animals.
- Students opting for specialization in Zoology M.Sc. will be informed in advance about the inclusion of anatomical studies in the course work.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
M.Sc.-II	III	RPSZOP301	Life Processes-I	4
		RPSZOP302	Immunology and Cancer Biology	4
		RPSZOP303	Reproduction Biology	4
		RPSZOP304	Internship/Project	4
			Practical	
		RPSZOPP301	Life Processes-I	2
		RPSZOPP302	Immunology and Cancer Biology	2
		RPSZOPP303	Internship/Project	2
		RPSZOPP304	Internship/Project	2
	IV	RPSZOP402	Life Processes-II	4
		RPSZOP401	Animal Biotechnology	4
		RPSZOP402	Life Processes-II	4
		RPSZOP403	Endocrinology	4
		RPSZOP404	Biological rhythm and Ecophysiology	4
			Practical	
		RPSZOPP401	Animal Biotechnology	2
		RPSZOPP402	Life Processes-II	2
		RPSZOPP403	Endocrinology	2
		RPSZOPP404	Biological rhythm and Ecophysiology	2

Resolution No.: AC/I(21-22).2(II).RPS11

S. P. Mandali's

Ramnarain Ruia Autonomous College

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Syllabus for: Semester- III& IV

Program: M.Sc.

Program Code: Zoology (RPSZOP)

(Credit Based Semester and Grading System for the academic year 2022–2023)

Semester-III
Academic year 2022-2023

Paper Code	Unit	Topic	Credits
RPSZOP301		**Life Processes -I**	
	I	Nutritive System	4
	II	Physiology of Respiration	
	III	Circulation and fluid mechanics	
	IV	Neurophysiology	
RPSZOP302		**Immunology and Cancer Biology**	
	I	Immunology-I	4
	II	Immunology-II	
	III	Cancer Cell Biology	
	IV	Vaccines	
RPSZOP303		**Reproduction Biology**	
	I	Male reproductive physiology	4
	II	Female Reproductive Physiology	
	III	Assisted Reproductive Technique-I	
	IV	Assisted Reproductive Technique-II	
RPSZOP304			
	I	**INTERNSHIP/PROJECT WORK**	4
	II		
	III		
	IV		
Practical			
RPSZOPP301		**Life Processes -I**	2
RPSZOPP302		**Immunology and Cancer Biology**	2
RPSZOPP303		**INTERNSHIP/PROJECT WORK**	2
RPSZOPP304			2
Grand Total			**24**

Course Code: RPSZOP301

Course Title: Life Processes-I

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Outline the nutritive system, food processing, nutritive types and significance of Probiotics in therapeutic nutrition
CO 2	Explain how to use sphygmomanometer and blood pressure monitoring
CO 4	Analyze the behaviour of respiratory system in vertebrates and role of medulla in respiration process
CO 5	Contrast the structural, functional dimensions of neurophysiology, physiology of addiction and Neurophysiological disorders
CO6	Justify rheology, comparative account of circulation in vertebrates and circulatory disorders in human

RPSZOP301	Title: Life Processes-I	Credits 4
UNIT- I	***Nutritive System*** • Filter feeding - Pisces, Flamingo • Reptiles (Jacobson's organ) • Specialized compartmentalization of digestive system in vertebrates- i. Intestinal modification in herbivore and carnivore ii. Intestine in fish, bird and mammal • Comparative study of mechanical or physiological digestion – gill rakers, Dentition in Pisces, Amphibians, Reptiles, Birds and Mammals(human) • Absorptive adaptation of the Gut. • Micro-biome of human gut and its significance. • Metabolic transition between meals. • Probiotics and their role in therapeutic nutrition.	**15 Lectures**
UNIT- II	***Physiology of Respiration*** • Comparative study of Respiratory system in vertebrates: a. Aquatic, terrestrial, gas exchange in terrestrial eggs b. Reparative adaptations in African lungfish	**15 Lectures**

	• Chemistry of respiration a. Composition of atmospheric and expired air b. Aerodynamic Sub-division of air in the lungs c. Regulation of lung breathing. d. Transport of gases in the blood e. Diffusion of gases in the lungs f. Transport of CO2 in the blood g. Haldane effect- Partial pressure of gases • Dissociation of Oxyhaemoglobin and factors affecting it (temperature, electrolytes, CO2 & Carboxyhaemoglobin) • Bohr's effect • Role of medulla oblongata in respiration a. Chemoreceptor b. Mechanoreceptor and Ventilation reflexes c. Oxygen equilibrium curve and its significance • Manifestation of variation in hemoglobin saturation a. Oxygen toxicity b. Carbon monoxide poisoning c. Reparative distress during Fire hazards.	
UNIT- III	***Circulation and fluid mechanics*** • Rheology: a. Viscosity, Poiseuille (PI) b. Hagen flow formula c. Laminar and turbulent flow Resistance d. Pressure, velocity and gravity • Comparative account of Circulation in Vertebrates a. Lung fish b. Amphibians c. Reptiles d. Bird e. Special reference to Aortic arches, hepatic portal and renal portal circulations. • Introduction to Human circulatory system a. Heart structure, working and major blood vessels b. Cardiac cycle c. Stroke volume SV d. Cardiac output CO e. ECG f. Sphygmomanometer • The buffer system of the blood a. Haemoglobin buffer b. The Chloride shift • Selective distribution of blood flow • Circulatory disorders in humans – Varicose veins, PAD, tachycardia, bradycardia and Thrombosis • Physiology of therapeutic control of blood pressure. a. Beta blockers b. ACE inhibitors	**15 Lectures**

	c. Calcium channel blockers	
UNIT: IV	***Neurophysiology*** • Excitable membranes- Membrane potential, Ions as current carriers (Protons, Calcium, Potassium) • Structure of Cation - Permeable channels, Chloride channels • Primitive nervous system • Quorum sensing in prokaryotes • Irritability in Paramecium a. Nerve nets b. Ladder like nervous system of Platyhelminthes c. Gangliolated nervous system of Annelida and Arthropods • Nervous tissue- Neurons, Glial cells and its type. • Integrative neurophysiology: Interneuron's, Neural circuits • Neurotransmitters a. Excitatory b. Inhibitory • Brain plasticity • Neurophysiological disorders a. Alzheimer b. Parkinson c. Dementia • Physiology of addiction. a. Alcohol addiction b. Addiction to psychotic drugs (Cocaine, Opioids, Ecstasy)	**15 Lectures**
RPSZOPP301	**Practical Title: Life Processes-I**	**Credits 2**
	1. Determination of activities of digestive enzymes viz. Amylase, Trypsin in suitable animals (e.g. prawn/ crab/ cockroach/ chicken, etc.) **2**. LDH isoenzymes isolation and detection using agarose gel electrophoresis in heart /skeletal muscle of any suitable animal (e.g., Chicken heart) **3**. Detection and measuring of heart beats (Manually) in Daphnia. **4**. Effect alpha blocker/ beta blockers on heart rate of 48 hours of chick. **5**. Effect of xenobiotics on digestive enzyme activity of any suitable animal (cockroach). **6**. Study of nerve cells and neurosecretory cells of cockroach. **7**. Study of irritability in *Paramaecium.* **8**. Problems related to Cardiac output. **9**. Hands on training sphygmomanometer and recording the pulse rate of the patient. (Compare supine, walking, sleeping and 5 mins jogging variations in BP).	
References:		

1. Biology of Animals- Cleveland P. Hickman JR Larryds. Roberts
2. Darnell, Loddish, Baltimore: "Molecular Cell Biology" Scientific American Books.
3. C. A. Keil, E. Neil & E.N. Joeb (1982): "Samson Wright, Applied Physiology" Oxford Univ. \ Press.
4. R. Eckert& D. Randall (1982): "Animal Physiology: 2nd Ed." W. H. Freeman & Co.
5. W. A. Hoar (1982): "General & Comparative Animal Physiology 3rd Ed." Prentice Hall Inc.
6. C. L. Prosser (1973): "Comparative Animal Physiology" W. B. Saunders.
7. C. Ladd Prosser Ed. (1991): "Neural & Integrative Animal Physiology" "Comparative Animal Physiology", 4th Ed. Wileg – Liss Publ.
8. C. Ladd Prosser Ed. (1991): "Environmental & Metabolic Animal Physiology" "Comparative Animal Physiology" 4th Ed. Wileg – Liss Publ.
9. Withers, P.C. (1983): "Comparative Animal Physiology" International Ed. Saunders College Publishing.
10. K. Schmidt – Niel (1983): "Animal Physiology: Adaptation & Environmental" 3rd Ed. Cambridge Univ. Press.
11. R. W. Hill (1978): "Comparative Physiology of Animals – An Environmental Approach" Harper & Row Publ.
12. Harold Harper: "Review of Physiology Chemistry" 4th Ed. Maruzen Asian Ed. Lang Medical Publ
13. OECD guideline for testing of chemicals - https://www.oecd-ilibrary.org/environment/test-no-425-acute-oral-toxicity-up-and-down-procedure_9789264071049-en
14. Animal Physiology ----- Samson & Writy
15. Animal Physiology ----- Nelsion & Nelsion
16. Animal Physiology ----- Medical Physiology-Guiton
17. Textbook of Animal Physiology ----- Nagbhushenen
18. Textbook of Animal Physiology ----- Geise
19. Textbook of Animal Physiology ----- A.K. Berry
20. Textbook of Endocrine Physiology -----James E. Griffin and Sergio R. Ojeda, Oxford University
21. Handbook of Neuroendocrinology --- Mandal A. (1994). EMKY Publication .
22. Wilson and Walker – Principles and Techniques of Practical Biochemistry. Cambridge Univ.Press

Course Code: RPSZOP302

Course Title: Immunology and Cancer Biology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Explain the immune response in human systems
CO 2	Summarize the camel nanobodies and its significance in human health care
CO 3	Comment on monoclonal antibodies and its role in hybridoma technology and therapeutics
CO 4	Evaluate various factors involved in development of Cancer

CO 5	Compare different types of vaccines and its application in human health care with special reference to various COVID-19 vaccines

RPSZOP302	**Title: Immunology and Cancer Biology**	**Credits 4**
UNIT: I	***Immunology-I*** • Overview of the immune systems a. Components of the immune system, b. Principles of innate (non-specific) and adaptive(acquired) immunity, c. Antigen and immunogenicity, d. Clonal selection theory. e. Antibodies (vertebrates & invertebrates) • Antigen recognition by immune cells: a. Innate Immunity- Pattern recognition in the innate immune system, b. TLRs and their role in innate immune response c. Adaptive immunity-Antibody structure d. Antigen recognition by B lymphocytes e. Molecular mechanism behind BCR formation f. B lymphocyte development and survival. • Structure and function of MHC complex: a. Antigen processing cells, b. Antigen processing and presentation to T lymphocytes, c. MHC restriction. • Camel nanobodies (Mini- antibodies) and their significance in human healthcare • Monoclonal antibodies**:** Hybridoma technology, Commercial production, Clinical applications (overview), Therapeutic MABs, (e.g., Tacilizumab, Basiliximab, blinatumomab).	**15 Lectures**
UNIT: II	***Immunology-II*** • TCR structure and function: a. T-cell receptor gene rearrangement. b. T-lymphocyte development and survival. c. Antigen recognition by T-cells, d. signalling through TCR and T-cell activation, e. co- receptors and their role in T –cell functioning. f. Co-stimulation. • Effector mechanisms and regulation of immune responses: a. Induced innate response to infection, b. Innate memory, c. Complement system, d. NK and NKT cell functions, e. Humoral immune response,	**15 Lectures**

	f. Production of effector T- cells, g. Cytotoxic T- cell effector mechanisms h. Interferons, cytokines, chemokines in immune response i. Cytokine storm • Immunity in health and disease: Allergy and hypersensitivity, Autoimmunity, Immunodeficiency diseases, Immunity and Infection, Tumour-immunology, Transplantation.	
UNIT: III	***Cancer Cell Biology*** • Extracellular control of cell division • Cell growth and apoptosis • Morphological and biochemical features of apoptosis • Necroptosis • Caspases (effector molecules) • Executioners of the apoptosis process • Extrinsic and intrinsic apoptotic pathway • Cell death effectors released from mitochondria. • Poly – ADP –ribose Polymerase (PARP) proteolysis as an indicator of cell death • Senescence and cancer • Chemoresistance and cancer • Immunogenicity of cancer cell death • Autophagy and Role of autophagy in tumor survival, oncogenic genes that regulate Autophagy. • Cancer diagnosis &treatment using antibodies radiolabeled MABs, Immunotherapy for cancer management.	**15 Lectures**
UNIT: IV	***Vaccines*** • Sub-unit Vaccine- Herpes simplex, Bovine foot &mouth disease virus • Peptide vaccines-synthetic drugs (engineered proteins) • Genetic immunization-DNA vaccines, Antisense DNA, Therapeutic ribozymes • Live recombinant vaccines • Attenuated vaccines against Cholera, Salmonella sp. • Vector Vaccines-Vaccine directed against viruses-Rabies virus G-protein, Hepatitis B surface antigen. • Anti-idiotypic vaccine for cancer treatment. • Multivalent subunit vaccine. • Microbiome • Vaccines in Epidemics & Pandemics: Overview of types of vaccines, Overview of steps in vaccine production, Vaccine for COVID -19; (mRNA, adenovirus based, recombinant protein, attenuated), Nasal vaccines and their significance.	**15 Lectures**
RPSZOPP302	**Practical Title: Immunology and Cancer Biology**	**Credits 2**

	1. Performance of Ouchterlony technique to demonstrate immune diffusion. **2**. Demonstration of single radical immune-diffusion of antibody and antigen. **3**. Study of counter-current immune-electrophoresis. **4**. Study of Agglutination Reaction: a. Tube Agglutination Reaction b. Slide Agglutination Reaction c. Indirect Agglutination Inhibition Reaction **5**. Identification of histological slides of lymphoid tissue: a. Spleen b. Thymus c. Lymph node d. Bone marrow e. Payers patches f. Bursa of Fibricus **6**. Antibiotic Sensitivity test **7**. Identification of tools used in Artificial Insemination in cows.	

References:

1. Immunology - Introductory Textbook; Shetty, N.; New Age International; 2005
2. Immunology – Essential and Fundamental; Pathak, S., &Palan, U.; Science Publishers;2005
3. Immunology: A textbook; Rao, C. V.;Alpha Science Int'l Ltd.; 2005
4. Ananthanarayan and Paniker's textbook of microbiology; C.J. Paniker (Ed.); Ananthanarayan, R.; Orient Blackswan; 2005
5. Textbook of Immunology; Haleemkhan, Rajendra Sagar, Sadguna
6. Prescott's Microbiology;Ninth Edition; JoanneM.Willey,Linda M. Sherwood & Christopher J.Woolverton; McGraw-Hill Education; 2014
7. Cellular and molecular immunology; Abbas, A. K., Lichtman, A. H. &Pillai S.; Elsevier Health Sciences; 2014
8. Roitt's essential immunology (Vol. 20); Delves,P. J., Martin, S. J., Burton, D. R., &Roitt, I.M.;JohnWiley& Sons; 2011
9. The elements of immunology; Khan,F. H.; Pearson Education, India; 2009
10. Janeway's Immunobiology; Murphy,K., &Weaver, C.; Garland Science;2016
11. Fundamental Immunology; Paul, W.E.; Philadelphia: Lippincott-Raven;1999
12. Bernard R. Glick and Jack J. Pasternack, Molecular Biotechnology – Principles and applications of recombinant DNA, ASM Press, Washington DC.
13. Bob Old and S. B. Primrose, Principles of Gene Manipulation, 5th Edition, Wiley Blackwell Pub

Course Code: RPSZOP303

Course Title: Reproduction Biology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Illustrate Reproductive Biology and Physiology
CO 2	Explain the various Molecular Events of fertilization, Implantation Process, Pregnancy, Parturition and Lactation
CO 3	Compare different IVF techniques, gamete collection process and sensitize regarding ethical issues involved in this field
CO 4	Evaluate the hormonal control of spermatogenesis, sperm maturation and about the potential male contraceptives
CO 5	Elaborate Assisted Reproductive technology

RPSZOP303	Title: Reproduction Biology	Credits 4
UNIT-I	***Male reproductive physiology*** • Functional morphology of mammalian testis. • Brief description of histomorphology and hormonal control of male accessory organs *viz*., epididymis, vas deferens, seminal vesicles, ventral prostate, bulbourethral gland and preputial gland • Sperm maturation – morphological and biochemical events, influence of accessory organ secretions; capacitation • Biochemistry of semen • Kinetics of spermatogenesis – wave and cycle, Stem cell renewal • Hormonal control of spermatogenesis • Ultrastructure of spermatozoa • Abnormalities of sperm • Potential Male contraceptives**:** E.g., Cyproterone acetate, Cotton Seed, papaya seed extract etc.	**15 Lectures**
UNIT-II	***Female Reproductive Physiology*** • Onset of puberty in human female, factors affecting onset of puberty. • Estrous cycle and it is hormonal regulation. • Menstrual cycle and it is hormonal regulation. • Fertilization – Molecular Events of fertilization • Implantation – Process, Types and hormonal control	**15 Lectures**

	• Pregnancy – length of gestation, hormonal control • Parturition – Process of birth and influence of hormones • Lactation – Hormonal control of mammary gland development and lactogenesis • Female contraceptives: Pills, Spermicides, Copper T, Mechanical barrier (diaphragm)	
UNIT-III	***Assisted Reproductive Technique-I*** • Maintaining an IVF laboratory. a. Setting up an ART laboratory b. Quality Control • Gamete Collection & Analysis a. Semen Analysis: - Sperm count, Motility, Morphology and abnormality b. Physical parameters: - Coagulation/viscosity, Liquification, appearance, odour, volume, pH, presence of other cell debris c. Semen preparation technique: Swim up, Density gradient.	**15 Lectures**
UNIT -IV	***Assisted Reproductive Technique-II*** • Intrauterine Insemination (IUI) • Oocyte Retrieval: - oocyte corona cumulus complex evaluation, Oocyte nuclear maturity evaluation. • Intracytoplasmic sperm Injection (ICSI) • Cryopreservation of ovum and cord blood • Preimplantation genetic screening- PGS • Ethical issues • Case Study- Designer baby (Ethical and legal aspects)	**15 Lectures**
RPSZOPP303	**Internship / Project Work**	**Credits 2**

References:

1. Martin H. Johnson,Essential Reproduction, Wiley-Blackwell Publication.
2. E. L. Marieb,Human Anatomy and Physiology, Pearson Education Low PriceEdition
3. Taylor, Green and Stout, Biological Science, Cambridge Publication
4. E. P. Solomon, L. R. Berg, D. W. Martin, Biology, Thompson Brooks/Cole
5. Daniel D Chiras Jones and Bartlett, Human Biology
6. E.K.Nobil and J. U. D.Neil,The Physiology of Reproduction Vol I & II, Raven Press,New York.
7. David Gardner, Ariel W and et.al, Textbook of Assisted Reproductive Technologies, Third Edition.
8. Examination and Processing of human semen, WHO laboratory manual.
9. Dr. Kamini A. Rao, Principles and Practice of Assisted Reproductive Technology

Course Code: RPSZOP304

Course Title: Internship / Project Work

Academic year 2022-23

RPSZOP304	**Internship / Project Work**	**Credits 4**
RPSZOPP304	**Internship / Project Work**	**Credits 2**
	RPSZOPP303+RPSZOP304+RPSZOPP304 **Credits- (2+4+2)** **Total Credits- 8** **Marks- 200**	

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr. No.	Evaluation type	Marks
1.	Two Assignments/Case study/Project/Research paper review	20
2.	One class Test (multiple choice objective question)	20

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **2 hours 30 mins** duration.
2. Theory question paper pattern:

Paper Pattern:

Questions	Options	Marks	Questions on
Q.1	**Any 1 out of 2**	**12**	**Unit- I**
Q.2	**Any 1 out of 2**	**12**	**Unit- II**
Q.3	**Any 1 out of 2**	**12**	**Unit- III**
Q.4	**Any 1 out of 2**	**12**	**Unit- IV**
Q.5	**3 short notes out of 5**	**12**	**All Units**

Practical Examination Pattern:

C) External Examination: 50 Marks

Particulars	Marks
Journal	05
Experimental tasks/ Viva	45
Total	50

Overall Examination & Marks Distribution Pattern
Semester-III

Course	301		302		303		304 (Internship/Project)		Grand Total
	Int	Ext	Int	Ext	Int	Ext	Int	Ext	
Theory	40	60	40	60	40	60	100		400
Practical	50		50		100 (Internship/Project)				200

Semester IV
Academic year 2022-2023

Paper Code	Unit	Topic	Credits
RPSZOP401		**Animal Biotechnology**	
	I	Laboratory Animals in Biotechnology	4
	II	Testing for Endocrinological and Reproductive Biological studies	
	III	Animal Tissue Culture	
	IV	Animal Biotechnology & Human therapies	
RPSZOP402		**Life Processes-II**	
	I	Thermoregulation	4
	II	Muscle Physiology	
	III	Osmoregulation and Excretion	
	IV	Sensory and Effector Physiology	
RPSZOP403		**Endocrinology**	
	I	Introduction to invertebrate endocrinology	4
	II	General Endocrinology	
	III	Phylogeny and Ontogeny of endocrine glands	
	IV	Study of endocrine glands	
RPSZOP404		**Biological Rhythm and Ecophysiology**	
	I	Physiology of Migration	4
	II	Biological rhythms & sleep	
	III	Environmental Radiation	
	IV	Temperature as environmental factor	
Practical			
RPSZOPP401		**Animal Biotechnology**	2
RPSZOPP402		**Life Processes-II**	2
RPSZOPP403		**Endocrinology**	2
RPSZOPP404		**Biological Rhythm and Ecophysiology**	2
Grand Total			**24**

Course Code: RPSZOP401

Course Title: Animal Biotechnology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Summarize the holistic approach of animal biotechnology and human therapies
CO 2	Interpret techniques involved in animal tissue culture
CO 3	Employ different media preparations and passaging techniques for animal tissue culture
CO 4	Choose the various animal models used in biotechnology and understand their applications
CO 5	Demonstrate handling of laboratory animals and their maintenance and care
CO 6	Analyze various animal models and instruments used for Animal tissue culture

RPSZOP401	Title: Animal Biotechnology	Credits 4
UNIT-I	***Laboratory Animals in Biotechnology*** • Animal Care and Management of Laboratory Animals a. Rat b. Mouse c. Rabbit d. Guinea pig • Animal House – Necessities Design and maintenance: Infrastructure, Cages, Conditions and other requirements for Maintenance, Biology of four laboratory animals • Breeding cycles and breeding and maintenance- Rat/ Mouse • Nutritional requirements for normal breeding and maintenance. • Modifications for nutritional experimental work (at least two examples viz protein deficient diet and supplementation) • Animal ethics and associated laws and issues. • Physiological models and their use in drug testing • Animal ethics and CPCACA guidelines.	**15 Lectures**
UNIT- II	***Testing for Endocrinological and Reproductive Biological studies***	**15 Lectures**

	• In vivo studies of estrous cycle, implantation, pregnancy • Gonadectomy, Adrenalectomy, Hypophysectomy, and Sham operated rats • Drug induced liver toxicity- CCl4 model, paracetamol model, cirrhosis model • Aging Models: Drug induced models (Galactosamine), Naturally aged animals • Models for diabetes • Hypercholesterolemia Models • Thyroidectomized rat • Models to study immunological phenomena	
UNIT-III	***Animal Tissue Culture*** • Equipment and Materials for animal Cell Culture Technology • Basic Aseptic Techniques • Design of Tissue Culture Laboratory • Equipment: Laminar Flow Hoods, Bio safety cabinets, CO2 incubator, Open and closed cultures, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipment, Materials, filters, Miscellaneous Items, Cryopreservatives. • Characters of cells: Cells in primary culture, Established Cell lines, Tumor/cancer originated cells. • Nutritional Requirements of Cells and growth media- Basal salt solution (BSS), Minimum Essential Medium, Serum dependent defined media, Serum independent defined media, Natural and Artificial media, Cell specific media. • Media preparation (anyone) • Passaging of cell Lines- adherent and non-adherent	**15 Lectures**
UNIT- IV	***Animal Biotechnology & Human therapies*** • Transgenic animals and their applications: a. Mice as model system for human diseases and as test case model b. Cows, pigs, sheep, goats as biopharmaceuticals, c. Transgenic insects and birds. • Recombinant DNA technology to prevent animal diseases. • Regulation of transgenic animals and patenting genetically engineered animals. • Knockout mice (Cre- loxP system) • Human therapies a. Tissue engineering: Skin, liver, pancreas b. Xenotransplantation	**15 Lectures**
RPSZOPP401	**Practical Title: Animal Biotechnology**	**Credits 2**
	1.Handling and feeding of the animals. **2**. To study Estrous cycle and breeding. **3**.Preparation of glass wares for cell culture.	

	4. Separation of cells by suitable methods- Trypsinization **5**. Viable cell count **6**. Paracetamol toxicity in fish in vitro. **7**.Animal house maintenance group project. **8**.Effect of administration of carbon tetra chloride in suitable organism with reference to following parameters: Level of activity of the following enzymes: AspAT, AlaAT, ACP, SDH.	

References:

1. Bruce Albert et al "Molecular Biology of the Cell"
2. Cell and Tissue Culture
3. Methods in enzymology (Cell culture).
4. Animal Cell Culture: A practical approach by R.I. Freshney, IRL press.
5. A manual of basic techniques by R.I. Freshney, Willy-Liss and Sons publication.
6. Animal cell culture technique by Martin Clynes, Springer publication.
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8. R. Basega : Cell growth and division : A practical approach , IRL press Oxford University press, Oxford.
9. Ed. Martin Clynes: Animal cell culture techniques, Springer- Verlag, New York. F.Grasveld, George V. Kallias: Transgenic Animals, Academic press, Sandiego, USA.
10. Asok Mukhopadhyay: Animal cell technology, IK International publishing House, New Delhi.
11. R. E. Speir, J. B. Griffiths, W. Berthold (Ed), Animal Cell Technology – Products of today, prospects of tomorrow, Butterworth –Heinman Publishers

Course Code: RPSZOP402

Course Title: Life Processes-II

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Summarize the process of thermoregulation and temperature compensation in homeotherms and poikilotherms
CO 2	Interpret the detailed process of Dialysis and Kidney care
CO 3	Differentiate between the various physiologies of osmoregulation of freshwater, marine and terrestrial animals
CO 4	Compare between the physiology of skeletal, smooth and cardiac muscle
CO 5	Evaluate curious questions on COVID 19 related loss of sense of smell and taste

RPSZOP402	Title: Life Processes-II	Credits 4
UNIT –I	***Thermoregulation*** • Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. • Impact of temperature on the rate of biological functions. • Arrhenius equilibrium, Q 10 • Temperature compensation and temperature regulation in poikilotherms and homeotherms. • Adaptations for extreme environments, aestivation, hibernation, Diapause and Awakening.	**15 Lectures**
UNIT – II	***Muscle Physiology*** • Comparative physiology of skeletal, smooth and cardiac muscles. • Skeletal muscle- ultra structure and molecular organization. Red and white muscles, muscle proteins. • Mechanism of muscle contraction and relaxation. • Energetics of muscle contraction. • Effect of exercise on muscles. • Catch muscle and fibrillar muscle. • Physiology of muscle cramps and its management • Physiology of Sprinting and Marathon running.	**15 Lectures**
UNIT – III	***Osmoregulation and Excretion*** • Osmoregulation in fresh water, marine and terrestrial animals. • Excretion in vertebrates. • Physiology and regulation of urine formation, Hormonal regulation of urine formation. • Regulation of water balance, electrolyte balance and acid-base balance. • Dialysis (artificial kidney), kidney transplantation, Dialysis water (requirements)	**15 Lectures**
UNIT –IV	***Sensory and Effector Physiology*** • Classification of somatic senses and somatic receptors, exteroceptors, interoceptors, modality of sensation, secondary sense cells, transduction, relationship between stimulus, intensity and response, sensory coding. • Chemical senses: taste, smell, mechanism of reception, COVID 19 and loss of taste and smell. • Mechanoreceptors: hair cell, organs of equilibrium, vertebrate ear, mechanism of hearing, electro and thermoreceptors. • Vision: Structure of invertebrate and vertebrate eye. Physiology of vision. • Pain: pain receptors, headache and thermal senses, pain suppression (analgesia).	**15 Lectures**

	• Tactile sensation: touch receptors, Physiological role of touch and environment in premature infants- Kangaroo care.	
RPSZOPP402	**Practical Title: Life Processes- II**	**Credits 2**
	1. Observation of decreasing PO2 of water on the respiratory rate of a fish. **2.** Effect of decreasing PO2 of water on Lactic acid in the muscle. **3.** Estimation of salt loss and gain in an aquatic animal when it is transferred to a salt- free medium and to natural medium. **4.** Preparation of glycerinated muscle fibre and study of its properties. **5.** Influence of sub lethal concentration (50-60ppm) ammonia (as liquor ammonia / ammonium hydroxide / ammonium chloride) on a suitable fish exposed to ammonia stress for 3 / 7 / 15 days with reference to the following parameters: a. Level of excretory ammonia b. Level of activity of hepatic glutamate dehydrogenase **6.** Histology of Sense organs. **7.** Histology of Striated and Non striated muscle fibre.	

References:

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3. Brijlal Gupta and J.A. Ramsay, 1977. Transport of Ions and Water in Animals. Academic Press, New York.
4. Chatterjee, C.C. 1997. Human Physiology. Medical allied agency, Calcutta.
5. Ganong, W.F 1987. Review of Medical physiology. Appleton and lang, Norwalk.
6. Hill, W.R., Wyse, G.A and Anderson, M. 2007. Animal Physiology (2nd edn). Sinauer Associates Inc. Publishers, MA, USA.
7. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi.
8. Hochachka, P.W. and Somero, G.N. 1984. Biochemical Adaptation. Princeton University Press, New Jersey.
9. Hochachka, P.W. and Somero, G.N 2002. Biochemical Adaptation: Mechanism and Process in Physiological Evolution. Oxford University Press, New York.
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Course Code: RPSZOP403

Course Title: Endocrinology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Summarize about neuro endocrine integration and reflexes and a deep insight about hormones and its types
CO2	Compare & contrast developmental and phylogenetic relationship of endocrine glands between different vertebrates' group
CO 3	Enlist the invertebrates' endocrine organs & systems, its anatomical organization and role of hormones in complex physiological process like reproduction and development.
CO 4	Distinguish the various endocrine glands of vertebrates, their position, micro anatomy, hormones and complex interrelationship between them
CO 5	Explore new technologies in studying the endocrine glands

RPSZOP403	Title: Endocrinology	Credits 4
UNIT –I	***Introduction to invertebrate endocrinology*** • General organizartion of endocrine system of invertebrates: a. Corpora cardiac b. Corpora allata c. Moulting glands d. X-organ and Y-organ of Crustaceans e. Prothoracic gland f. Green gland, Epitracheal gland and Inka cells g. Mandibular organs in crustaceans • Reproduction, development, somatic retinal and pigmentation and metamorphosis (including diapause and molting) in insects. • Hormonal control of metabolism, retinal and somatic pigmentation, reproduction and moulting in Crustaceans.	**15 Lectures**
UNIT –II	***General Endocrinology*** • General introduction to hormone • Neuroendocrine integration a. Afferent pathways b. Integration center's	**15 Lectures**

	c. Efferent pathways • Neuroendocrine reflex a. First order b. Second order c. Third order • Hormones as messengers. • Hormones and eukaryotic metabolic regulation • Classification and Discovery of hormones a. Protein hormones b. Steroid hormones • Hormonereceptors • Cascade of reaction linked to signal transduction. • Prostaglandins	
UNIT –III	***Phylogeny and Ontogeny of endocrine glands*** • Phylogeny of Pituitary, Pancreas, Adrenal, Thyroid, parathyroid and Pineal gland in Pisces, Amphibia, Reptiles and Mammals • Ontogeny of Pituitary, Pancreas, Adrenal, Thyroid, parathyroid and Pineal gland in Pisces, Amphibia, Reptiles and Mammals • Caudal neurosecretory system in fishes- Dahlgren cells • Corpuscles of Stannius.	**15 Lectures**
UNIT –IV	***Study of endocrine glands*** • Endocrine glands - Anatomy and Microstructure and disorders of - Pituitary, Thyroid, Parathyroid, Ultimobranchial glands, Adrenal, Pancreas, Pineal • Role of hypothalamus and the higher brain centers in reproductive behavior • Special endocrine organs a. Thymus b. Placenta c. Corpus Luteum d. GI tract e. Kidney f. Heart	**15 Lectures**
RPSZOPP403	**Practical Title: Endocrinology**	**Credits 2**
	1. Demonstration and localization of endocrine glands of vertebrate group (rat / mice). (Simulation / Photographs / ICT) **2**. Preparation and submission of slides of adrenal, ovary and testis in vertebrate (Goat / Chicken) using microtomy technique. (Student activity) **3**. Estimation of calcium level in given blood sample. **4**. Estimation of glucose level in given blood sample. **5**. Estimation of blood glucose before and after eye stalk ablation in Crab. **6**. Effect of Adrenalin on fish chromatophores. **7**. Study of Endocrine disorders in human (Slides / Photographs / TC tools / models / charts / photographs) **8**. Phytosteroids that mimics animal steroids: (Soybean, Ashwagandha, Shatavari, Dioscorea)	

References:

1. Mandal A. (1994). Handbook of Neuroendocrinology, EMKAY Publications.
2. Comparative Endocrinology of the Invertebrates, Kenneth C. Highnam, Second Edition, ELBS Low price Edition.
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4. Invertebrate Endocrinology-Tombes, Academic Press. 5. Insect Endocrinology-Edited by Lawrence I Gilbert, Academic Press.
5. Barington (1979) Hormones and Evolution Vol. I&II Academic Press, New York.
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11. Benjamin Levin-Gene VII, Oxford University Press.
12. Lodish et.al. Molecular Cell Biology
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19. Endocrinology-P.R.Yadav, Discovery publishing House Ltd. New Delhi.
20. Endocrinology, Hormones and Human Health-Prakash S. Lohar, MJP Publisher, Chennai.
21. Franlyn F. Bolander, Molecular Endocrinology – (Third Edition), Academic Press, An Imprint of Elsevier, California, U.S.A.

Course Code: RPSZOP404

Course Title: Biological rhythm and Ecophysiology

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Summarize the migration amongst animal and complex biochemical and physiological process that regulate it
CO 2	Explain temperature as an important environmental factor and biochemical adaptation of animals at different thermal range
CO 3	Differentiate between the complex physiological processes that govern sleep, dream and biological rhythms

CO 4	Analyse the effects of radiation at the cellular & molecular level, role & elaborate the phenomenon of radio protection

RPSZOP404	**Title: Biological rhythm and Ecophysiology**	**Credits 4**
UNIT –I	***Physiology of Migration*** • Physiological stimulus of Migration • Orientation and Navigation • Energetic • Timing • Synthesis • Migration for food, reproduction, territory • Migration as factor in life cycle • Adaptations for Migration • Communication during Migration.	**15 Lectures**
UNIT –II	***Biological rhythms & sleep*** • The nature of sleep and dreams • The functions of sleep • Mechanism of sleep and arousal • Biological rhythms • Disruption of sleep and rhythms • Chronobiology: Experiments to study human circadian rhythms; subterranean rooms, deep cave dwelling etc.	**15 Lectures**
UNIT –III	***Environmental Radiation*** • Radiation as an environmental parameter. • The solar spectrum • Biomolecules involved in perception and trapping of solar radiations: Chlorophyll, Bacterio-rhodospin, Rhodospin and Vitamin A. Adaptations of animals to absence of solar radiations. • Effects of Ionizing radiations at the cellular and molecular level. • Phenomenon of radioprotection.	
UNIT –IV	***Temperature as environmental factor*** • Temperature Regulation/ Response to temperature fluctuations • Thermal limits of survival • Temperature and Structural effects with response to biological molecules and biological membranes. • Temperature and rate effects: Temperature dependent E~Saffinity, Lipoprotein enzymes. • Thermal resistance of dormant and active cells. • Ectothermy and endothermy. • Endothermy in invertebrates.	

	• Biochemical adaptations of Ectothermy: Antifreeze substances, Heatshock proteins.	
RPSZOPP404	**Practical Title: Biological rhythm and Ecophysiology**	**Credits 2**
	1. To study the effect of temperature on respiratory rate of any suitable fish. **2.** Study of effect of electrolyte stress on angiogenesis using chick embryo. **3.** Study of migration in animals in relation to food, reproduction and environment. (Olive Ridley turtle, Monarch butterfly, Amur Falcon) **4.** Central Asian Flyway and its location on map. **5.** To study the effect of temperature on the activity of human saliva. **6.** To study different types of sleep disorders: Sleep Apnea, Narcolepsy, Sleep walking, Restless leg Syndrome, Sleep Paralysis, Snorting.	

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8. P. W. Hochachka& G. M. Somero (1973): "Strategies of Biochemical Adaptation".
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10. C.S. Negi (2009): " Introduction to Endocrinology". Eastern Economy Edition.
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12. H. Wagner & K. Silber: Physiological Psycology.

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr. No.	Evaluation type	Marks
1.	Two Assignments/Case study/Project/Research paper review	20
2.	One class Test (multiple choice objective question)	20

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **2hours 30 mins** duration.
2. Theory question paper pattern:

Paper Pattern:

Questions	Options	Marks	Questions on
Q.1	**Any 1 out of 2**	**12**	**Unit- I**
Q.2	**Any 1 out of 2**	**12**	**Unit- II**
Q.3	**Any 1 out of 2**	**12**	**Unit- III**
Q.4	**Any 1 out of 2**	**12**	**Unit- IV**
Q.5	**3 short notes out of 5**	**12**	**All Units**

Practical Examination Pattern:

D) External Examination: 50 Marks

Particulars	Marks
Journal	05
Experimental tasks/ Viva	45
Total	50

Overall Examination & Marks Distribution Pattern
Semester-IV

Course	401		402		403		404		Grand Total
	Int	Ext	Int	Ext	Int	Ext	Int	Ext	
Theory	40	60	40	60	40	60	40	60	400
Practical	50		50		50		50		200