Resolution No.: AC/II(22-23).3.RPS11

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for: PG

Program: M.Sc.

Program Code: Zoology

As per the guidelines of NEP2020-Academic year 2023-24

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

GA	Graduate Attributes Description **A student completing Master's in Science program will be able to:**
GA1	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 validateit 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 dataanalysis and presentation.
GA 4	Articulate scientific ideas, put forth a hypothesis, design and execute testing toolsand 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. Effectivelycommunicate 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 IntellectualProperty 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 ateam 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 happening in this era of Industry 4.0.

PROGRAM OUTCOME

PO	Description A student completing Master's in Science program in the subject ofZoology will be able to:
PO 1	Identify, explore, understand the concept of ethology and compare the differences in the behavior.
PO 2	Gain comprehensive knowledge about different animal species and appreciate the differences and similarities, thereby achieving proficiency in handling themexperimentally or for research purposes.
PO 3	Understand and learn various behavioral 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 analyze 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 analyze 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	TYPE OF COURSE	COURSE TITLE	CREDITS
	I	RPSZOO.O501	Discipline Specific Core I	Comprehensive Zoology-I	3
		RPSZOOP.O501	Practical DSC I	Comprehensive Zoology-I	1
		RPSZOO.O502	Discipline Specific Core II	Biochemistry and Metabolism – I	3
		RPSZOOP.O502	Practical DSC II	Biochemistry and Metabolism – I	1
		RPSZOO.O503	Discipline Specific Core III	Bioanalytical techniques	3
		RPSZOOP.O503	Practical DSC III	Bioanalytical techniques	1
		RPSZOO.O504	Discipline Specific Core IV	Traditional Knowledge and IPR	2
		RPSRMZOO.O505		Research Methodology	4
		RPSZOO.O506	Discipline Specific Elective	Aquarium Management	3
		RPSZOOP.O506	Practical DSE VI	Aquarium Management	1
	II	RPSZOO.E511	Discipline Specific Core I	Comprehensive Zoology-II	3
		RPSZOOP.E511	Practical DSC I	Comprehensive Zoology-II	1
		RPSZOO.E512	Discipline Specific Core II	Biochemistry and Metabolism- II	3
		RPSZOOP.E512	Practical DSC II	Biochemistry and Metabolism- II	1
		RPSZOO.E513	Discipline Specific Core III	Genetics and Molecular Biology	3
		RPSZOOP.E513	Practical DSC III	Genetics and Molecular Biology	1
		RPSZOO.E514	Discipline Specific Core IV	Bioinformatics and Molecular Modelling	2
		RPSZOO.E515		Research Project/ Field Project	4
		RPSZOO.E516	Discipline Specific Elective	Wildlife Biology	3
		RPSZOOP.E516	Practical DSE	Wildlife Biology	1

Semester-I

Academic year 2023-2024

Paper Code	Unit	Topic	Credits
RPSZOO.O501	**Comprehensive Zoology-I**		
	I	Animal Behaviour-I	3
	II	Introduction to model organisms-I- *Hydra* & *Drosophila*	
	III	Developmental Biology	
RPSZOO.O502	**Biochemistry and Metabolism – I**		
	I	Biomolecules- a structural and functional approach-I	3
	II	Metabolic pathways, Integration of Metabolism-I and Biochemical Thermodynamics	
	III	Regulation of metabolism and inborn errors of metabolism	
RPSZOO.O503	**Bioanalytical techniques and IPR**		
	I	Microscopy	3
	II	Spectroscopy and PCR	
	III	Chromatography and Tracer Techniques	
RPSZOO.O504	**Traditional Knowledge and IPR**		2
	I	Traditional Knowledge	
	II	Intellectual Property Rights	
RPSRMZOO.O505	**Research Methodology**		4
	I	Research Methodology-I	
	II	Research Methodology-II	
	III	Research Methodology-III	
	IV	Biostatistics	
RPSZOO.O506	**Aquarium Management**		3
	I	Introduction to Aquarium Fish Keeping	
	II	Creating the Aquatic Environment & Maintenance of Aquarium	
	III	Basics of Fish breeding	
Practical			
RPSZOOP.O501		Practical- I	1
RPSZOOP.O502		Practical- II	1
RPSZOOP.O503		Practical- III	1
RPSZOOP.O506		Practical- VI	1
Grand Total			**22**

Discipline Specific Core Course

Course Code: RPSZOO.O501

Course Title: Comprehensive Zoology-I

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Describe the broad concepts of animal behavior and its applications in various fields of Research.
CO 2	Compare and contrast the insights of behavioral patterns displayed by different animals.
CO 3	Interrelate the working and different systems and understand the role of model organisms in the field of research.
CO 4	Analyse different concepts in developmental biology.
CO 5	Enumerating the various aspects of regeneration.

RPSZOO.O501	Unit	Title: Comprehensive Zoology-I	Credits-3 Hours-45
	I	***Study of Animal Behavior*-I** • Development of behavior: Significance of animal behavior, influence of environment hormones and genes, Cognition. • Reflexes and complex behavior: Latency, after discharge, summation, warm up, fatigue inhibition and feedback control. • Instinctive Behavior - Fixed action pattern, Types of sign stimuli and releasers as triggers, Genetic basis of instinctive behavior. • Learning- Classical conditioning experiment, latent and insight learning, social learning, Altruism. • Biological communication- Role of pheromone- Insects social organization; pheromone effects in mammals- Lee Boot, Whitten, Bruce, Collidge and Castro-Vandenberg effects.	**1C/15 Hours**
	II	***Introduction to model organisms- Hydra & Drosophila*** • Hydra as a model organism: Setting up Artemia hatchery (temperature, salinity, pH, lifecycle and nutritional value), Hydra regeneration, Different types of cells in Hydra.	**1C/15 Hours**

		• Drosophila as a model organism: Drosophila development: a. Embryonic development b. formation of body axes c. Segmentation genes d. Homeotic genes and their functions e. Larval stages f. Imaginal discs g. Pupa and metamorphosis h. Adult morphology	
	III	***Developmental Biology*** • Basic concepts of Developmental Biology- Potency, induction, determination and differentiation; Apoptosis, Stem cells, genomic equivalence; imprinting; mutants and transgenic in analysis of development. • Cell aggregation and differentiation in *Dictyostelium* • Axis formation and pattern formation: *Xenopus* • Organogenesis • Vulva formation in *Caenorhabditis elegans*. • Regeneration as a replay of development stages (intro, brief account of epimorphogenesis, morphylaxis & compensatory regeneration).	**1C/15 Hours**
RPSZOOP.O501	**Practical based on: Comprehensive Zoology-I**		**Credit 1**
	1. Hydra media preparation. **2**. Study of Hydra regeneration. **3**. Culturing and maintaining *Drosophila*. **4**. Visualizing different developmental stages of *Drosophila* embryogenesis. **5**. Behavioral interaction between individuals of Siamese Fighter fishes (*Betta splendens*). **6**. Nest construction behavior and altruism in green ants. **7**. Planting and maintaining of larval host plants of different butterfly species. (Student Activity) **8**.Field activities: field visits- zoos/sanctuaries/national parks.		

References:

1. Sinha, A.K, Adhikari S and Ganguly BB: Biology of Animals (vol. I & II), Central Book Agency, Kolkata
2. Alcock, J. (2001): Animal Behaviour, an Evolutionary Approach. Sinauer associates, INC. Sunderland, Massachusetts. USA
3. Bernard, C. (2004): Animal Behaviour, Mechanism, Development function and evolution. Pearson and Prentice Hall Publication. New York

4. Dunlap, J. C., Loros J. J. and Decoursey P. J. (2004): Chronobiology Biological Timekeeping. Sinuaer Associates, Inc. publishers, Sunderland, Massachusetts, USA
5. Goodenough, J.E., Mc Guire, B. and Wallace, R. A. (1993): Perspectives on Animal Behaviour. John Wiley and Sons, New York.
6. Mandal, F. B. (2010): Textbook of Animal Behaviour. PHI Learning Private Limited, Estern Economy Edition. New Delhi -110001
7. Manning, A. and Dawkins M.S. (1997): Introduction to Animal Behaviour, 5th edition, Cambridge University Press. UK.
8. Scott, G. (2005): Essential Animal Behaviour. Black Well Publishing, University of Hull, UK.
9. Stumpter, T. J. D. (2010): Collective Animal Behaviour; Princeton University Press. Oxford.
10. F Scott. Gilbert, Sinauer Associates Inc: Developmental Biology.
11. T. Subramanian: Developmental Biology; Narosa Publ.
12. Philip Grant: Biology of Developing System; Holt Saunders International Ed.
13. M. W. Strikberger: Evolution; CBS Publ.
14. Sumitra Sen and Dipak Kumar Kar: Cytology and Genetics; Narosa Publ.
15. R.M. Twyman, Bios: Instant Notes- Developmental Biology; Scientific Pub. Ltd.
16. Bier, E. 2005. Drosophila, the Golden Bug, Emerges as a Tool for Human Genetics. Nature Reviews Genetics 6: 9-23.
17.Fly: http://flybase.bio.indiana.edu:82/
18. Biology of Hydra: https://doi.org/10.1016/B978-0-12-145950-5.X5001-0
19. J.A.Pechenik: Biology of Invertebrates; 4th Ed, Tata McGraw Hill Publication.
20. Russell, W.D. Hunter, McMillan: Life of Invertebrates.
21. Bares, R.D: Invertebrate Zoology, Saunders Publication.
22. Barrington, E J W, (1976): Structure and Functions of Invertebrates.
23. Hyman, L.H: The invertebrates (all volumes), McGraw Hill, Philadelphia, USA

Discipline Specific Core Course

Course Code: RPSZOO.O502

Course Title: Biochemistry and Metabolism – I

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Enumerate the classification, structures, and functions of Carbohydrates, Lipids and Nucleic acids.
CO 2	State the law of Biochemical thermodynamics, ETS chain reaction and oxidative phosphorylation concepts.
CO 3	Explain about the antioxidants and free radicals quenching to cancer research and anticancer activity.

CO 4	Differentiate between metabolic pathways and its significance.
CO 5	Justify the different cell signaling pathways and apply it in the field of cancer genetics.
CO 6	Calculate Normality, Molarity and prepare solutions of different strengths.

RPSZOO.O502	**Unit**	**Title: Biochemistry and Metabolism-I**	**Credits-3 Hours-45**
	I	***Biomolecules- a structural and functional approach-I*** • Carbohydrates: Monosaccharides- structure, classification, D- and L-isomers, Anomers and mutarotation, open chain and ring forms, pyranose and furanose forms, reactions of monosaccharides, glycocydic bonds and nomenclature. Oligosaccharides, Polysaccharides- homo- and hetero-polysaccharides. • Lipids: Classification: simple and complex lipids, Fatty acids- Even and odd carbon fatty acids, numbering the carbon atoms, saturated and unsaturated fatty acids, cis- and trans-configuration, nomenclature and shorthand representation of fatty acids. • Acylglycerols- Mono-, di- and triglycerides, stereospecific numbering of glycerols in glycerides, properties of triacylglycerol. • Complex lipids- Phospholipids, Sphingolipids, Sterols and waxes, Amphipathic lipids Membrane lipid bilayers. • Nucleic acids: Types of RNA and DNA- Components: Pentose, Nitrogenous bases, Nucleosides, tautomeric forms of purines and pyrimidines. different forms of DNA double helix. • Glycoproteins: Blood group substances • Glycolipids: Gangliosides • Lipoproteins: Classification and functions- chilomicrons, VLDL, LDL, HDL, and free fatty acid-albumin complex.	**1C/15 Hours**
	II	***Metabolic pathways, Integration of Metabolism-I and Biochemical Thermodynamics*** • Carbohydrate Metabolism- Glycolysis: Reaction sequence, flow of carbon, conversion of pyruvate to lactate and Acetyl coenzyme-A, significance of pyruvate-lactate interconversion, aerobic and anaerobic glycolysis and energetic of glycolysis. Regulation of glycolysis. Gluconeogenesis: Reaction sequence from pyruvate, gluconeogenesis from amino acids, glycerol, propionate, lactate. Regulation of gluconeogenesis. • Glycogen metabolism: Glycogenesis, Glycogenolysis. Regulation of the two pathways.	**1C/15 Hours**

		• Significance of following pathways: Hexose monophosphate shunt as a multifunctional pathway, Uronic Acid Pathway; Glyoxalate cycle. • Lipid Metabolism- Dynamics of body lipids, mobilization of fats, regulation of hormone sensitive TG- lipase, fate of glycerol and free fatty acids. Fatty acid metabolism: Oxidation of even-carbon and odd- carbon atom fatty acid, oxidation of unsaturated fatty acids, biosynthesis of fatty acids including desaturation, metabolism of phospholipids, cholesterol and alcohol. • Biochemical Thermodynamics: Laws of thermodynamics, free energy, entropy, enthalpy, exergonic and endergonic reactions • High energy compounds: ATP, ADP, ATP-ADP cycle, ATP-AMP ratio. • Biological Oxidation: Electron transport chain and mitochondria; Oxidative phosphorylation- mechanism, uncoupling of oxidative phosphorylation and its significance. • Free radicals, antioxidants and antioxidant system.	
	III	***Regulation of metabolism and inborn errors of metabolism*** • Carbohydrate metabolism: Glycogen storage disease, G-6-PD deficiency. • Lipid metabolism: Metabolic disorders of cerebrosides. • Protein metabolism: PKU, Albinism, Cysteinurea • Purine metabolism: Primary Gout • Mineral metabolism and diseases: Hypocalcimia, Hypercalcimia, Osteoporosis. • Teratology: a. Teratogens and their effects b. Sensitive period of teratogen c. Specificity of teratogen d. Thalidomide syndrome e. Teratocarcinoma and Teratoma f. Environmental teratogens g. Evaluation of teratogenicity of chemicals.	**1C/15 Hours**
RPSZOOP.O502	**Practical based on: Biochemistry and Metabolism – I**		**Credit 1**
	1. Determination of glycogen in the given tissue (liver/ skeletal muscle/ kidney/ brain). **2.** Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method. **3.** Determination of acid value of fats/ oils.		

	4. Determination of saponification value of fats/ oils. **5.** Agarose gel electrophoresis of DNA separated from suitable samples. **6.** Solutions and Buffers: Mode of expressing concentration of solutions- Molarity (M), normality (N), Mass concentration, mass fraction, mass percentage: %(w/w), % (v/v), % (w/v) parts per million (ppm) with practical exercises.	

References:

1. U. Satyanarayan: Biochemistry- 2nd Ed. 2002, Books and Allied Publ.
2. S.C. Rastogi: Biochemistry- 2nd Ed., Tata McGraw Hill.
3. J.I.Jain, S. Chand and Co. Publ : Fundamentals of Biochemistry- 3rd Ed. 1988.
4. Lehninger, A. L., Nelson, D. L. and Cox, M. M., 2nd Edn.: Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
5. Conn, E. E., Stumpt, P. K., Bruencing, G. and Dol, R. G. (1995): Outlines of Biochemistry. John Wiley, Singapore.
6. Murray, RK., Garner, D.K., Mayes P.A. and Rodwell, V.W. (2003): Harper's Illustrated Biochemistry, 26th Edn. Lange Medical Books, McGraw Hill, New York.

Discipline Specific Core Course

Course Code: RPSZOO.O503

Course Title: Bio analytical techniques

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Illustrate the basic principles, working and applications of chromatography.
CO 2	Develop a deeper understanding of different forms of IPR's, procedures and the process of patent filing.
CO 3	Apply biostatistics tools to interpret the given data.
CO 4	Determine the basic principles of tracer techniques and PCR and their applications.
CO 5	Compare and contrast between the principles, working and applications of various bioanalytical techniques.

RPSZOO.O503	Unit	Title: Bio analytical techniques	Credits-3 Hours-45
	I	***Microscopy*** • Principles, instrumentation, working and applications of: a. Fluorescence microscopy,	**1C/15 Hours**

		b. Polarization microscopy, c. Phase contrast microscopy, d. TEM, e. SEM • Biological sample preparation for electron microscopy.	
	II	***Spectroscopy and PCR*** • Principles, instrumentation, working and applications of: a. IR b. GC MS c. LC MS d. AAS e. ICP- AES, f. Plasma Emission spectroscopy, g. NMR, h. 2D NMR. • PCR: Principle, Steps in PCR, Constraints in PCR Modifications of PCR techniques and its applications.	**1C/15 Hours**
	III	***Chromatography and Tracer Techniques*** • General Principle of chromatography. • Techniques and applications of Ion exchange, Affinity Chromatography and HPLC Application / validation of herbal drugs using HPTLC. • Radioactive isotopes and autoradiography-Principle, instrumentation & technique: Geiger-Muller counter, Liquid scintillation counters. • Applications of isotopes in biology • PET scan, CT scan, Radionuclide imaging. • Blotting techniques- Southern blotting, Western blotting and Northern blotting.	**1C/15 Hours**
RPSZOOP.O503	**Practical based on: Bio analytical techniques**		**Credit 1**
	1.Preparation of buffers of different pH using Henderson- Hasselbalch equation and its verification using pH meter. 2. Preparation of buffers (phosphate and acetate) **2.** Determination of pKa. **3**. Density gradient centrifugation **4.** Analysis of heavy metals from soil/plant sample by AAS **5**. Separation of pigments from leaves or flowers by adsorption Column chromatography. **6**. Separation and identification of amino acids by 2D paper chromatography. **7**. Analysis of volatile oils by GC-MS.(Demonstration). **8.** Separations of proteins by ion exchange chromatography. **9.** Activity based learning: Anchrom Lab visit/ Ramnathan lab/TDM lab visit. (Demonstration of HPTLC technique using animal source)		

	10. DNA amplification using PCR.	

References:

1. Berlyn GP and Miksche JP. 1976. Botanical micro-techniques and cytochemisty
2. Chang R (1971). Basic principles of spectroscopy. McGraw Hill.
3. Garry D Christian, James E O'reilvy 1986. Instrumentation analysis. Alien and Bacon, Inc.
4. Gordon MH and Macrae M. 1987. Instrumental analysis in the biological sciences.
5. Henry B Bull (1971). An Introduction to physical biochemistry. F A Devis Co.
6. Wilson K and Walker JM.1994. Principles and techniques of practical biochemistry.
7. Allan Peacock, H. 1966. Elementary Microtechnique. Edward Arnold Publ.
8. Duddington, C.L, 1960. Practical microscopy. Pitman publ.
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10. Pesce A J, Rosen C G, Pasty T L. Fluorescence Spectroscopy: An introduction for Biology
11. Vanholdem K.E. and W.C.Johnson, 1998. Principles of Physical Biochemistry
12. Hamilton, C. (2006) Biodiversity, Biopiracy and Benefits: What allegations of Biopiracy tell us about intellectual property. Blackwell publishing Ltd., Oxford.
13. Heink, U and Kowarik,I. (2010) What criteria should be used to select biodiversity indicators . Biodiversity Conservation 19:3769-3797.
14. Ram Reddy,S. Surekha ,M. and Krishna Reddy,V (2016). Biodiversity Traditional Knowledge Intellectual Property Rights. Scientific Publishers.
16. Unnikrishna,P and Suneetha,M. (2012). Biodiversity, traditional knowledge and community health: strengthening linkages. Institute for Advanced Studies, United Nations University, Tokyo.
17. Wood, A., Pamela, S.E.and Johanna, M. (2000). The root causes of biodiversity loss. United Kingdom: Early –Scan Publications.

Discipline Specific Core Course

Course Code: RPSZOO.O504

Course Title: Traditional Knowledge and IPR

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Learn the procedure of obtaining patents, copyrights, trade Marks & industrial design.
CO 2	Recall the importance of IP and basic concepts of Intellectual Property Rights.
CO 3	Understand the statutory provisions of different forms of IPRs in simple forms.
CO 4	Identify the significance of practice and procedure of patents.

RPSZOO.O504	Unit	Title: Traditional Knowledge and IPR	Credits-3 Hours-30
	I	***Traditional Knowledge*** • Protection of traditional knowledge– objective, concept of traditional knowledge, holders, issues concerning bio-prospecting and biopiracy; geographical indications, industrial designs, advantages of IPR, some case studies. • Recognition and Documentation of Traditional Knowledge – Databases – Traditional Knowledge Digital Library "TKDL" – AYUSH Systems of Medicines – Biodiversity Register. Prevention of plundering TK- neem, basmati and turmeric patents. • Traditional Knowledge as Property – Nature of Property in genetic Resources and associated traditional Knowledge - Ownership in Traditional Knowledge: Nature and Elements of Ownership – Exclusivity and Protection –Benefit Sharing. • International Depositary authority, Gene patenting, National gene bank. • Plant variety protection, farmer's rights, plant breeders' rights. • Protection of Plant Varieties and Farmers' Rights Act, 2001. • Registration of Plant Varieties – Duration and effect of Registration, GM crops.	1C/15 Hours
	II	***Intellectual Property Rights*** • IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS. TRIPS & Patent laws: Introduction and standards for patent protection. • Different types of IPR's. • Patent Act 1970 – amendments of 1999, 2000, 2002 and 2005 Patentable subject matter, Patentability criteria, non-patentable inventions, Drafting a patent specification. • Prior art/ Novelty search: Free and paid databases. • Rights of patentee, Procedure for granting a patent and obtaining patents, Grounds for opposition, Working of Patents, Compulsory License Acquisition, Surrender, Revocation, restoration, Transfer of patent rights PCT, Types of patent applications, patent forms, guidelines, fee structure, priority date. • Patent protection: Pharmaceutical products and process, Patenting life forms. Patenting biotech inventions –	1C/15 Hours

		minimum 5 case studies • Ethics in IPR: Public health and Intellectual Property Rights Case study—Novartis Pharmaceuticals • Bayer Pharmaceuticals • Meaning of Copyright: Idea Vs Expression Dichotomy, Copyright Vs Moral rights, Performer's right, Copyright in Literary, Drama, and musical works, Sound Records, Cinematograph films, computer programmes. • Copyright Act, 1957 – Salient features of the Act (Amendment Act 2012) - Ownership of copyright – Assignment of Copyright – Term of Copyright – Copyright Office – Copyright Board, Copyright: registration and duration.	

Reference:

1. Conn, E. E., Stumpt, P. K., Bruencing, G. and Dol, R. G. (1995): Outlines of Biochemistry. John Wiley, Singapore.
2. Murray, RK., Garner, D.K., Mayes P.A. and Rodwell, V.W. (2003): Harper's Illustrated Biochemistry, 26th Edn. Lange Medical Books, McGraw Hill, New York.
3. Hamilton, C.(2006) Biodiversity, Biopiracy and Benefits: What allegations of Biopiracy tell us about intellectual property. Blackwell publishing Ltd., Oxford.
4. Heink, U and Kowarik,I. (2010) What criteria should be used to select biodiversity indicators . Biodiversity Conservation 19:3769-3797.
5. Ram Reddy,S. Surekha ,M. and Krishna Reddy,V (2016). Biodiversity Traditional Knowledge Intellectual Property Rights.Scientific Publishers.
6. Unnikrishna,P and Suneetha,M. (2012). Biodiversity, traditional knowledge and community health: strengthening linkages. Institute for Advanced Studies, United Nations University,Tokyo.
7. Wood, A., Pamela, S.E.and Johanna, M. (2000). The root causes of biodiversity loss. United Kingdom: Early –Scan Publications.

Course Code: RPSRMZOO.O505

Course Title: Research Methodology

Academic year 2023- 24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Enlist the resources for accessing scholarly articles, published papers, abstract writing and bibliographic management.
CO 2	Illustrate the skills to design good research hypotheses and select an appropriate data analysis method.

CO 3	Make use of methods of data collection, tools for data analysis and ethical issues in educational research.
CO 4	Apply basic computer skills and required numerical skills necessary for the conduct of research.

RPSRMZOO.O505	**Unit**	**Title: Research Methodology**	**Credits-4 Hours-60**
	I	***Research Methodology- I*** • Introduction: Research design principles, execution of work, interpretation of results. • Review of literature • Library: Types of sources, Structure of a scientific library, journals, books, Digital library and E books • Catalogue: Classification of Books (Universal Decimal System) • Journals: Indexing journals, H-index, abstracting journals, research journals, review journals, e-journals. • Impact factor of journals, NCBI-Pub Med. • Reprints, Secondary storage devices, Internet, open access initiative for biological sciences, INFLIBNET, INSDOC, Google Scholar, Ruia Library OPAC, OATD, Shodhganga, Shodhgangotri & N-LIST. • Research Metrics – Impact factor of journals, H-index, Indexing databases – Web of Science, Scimago, Indian Citation Index etc.	**1C/15 Hours**
	II	***Research Methodology- II*** • Introduction to scientific writing: Meaning of Scientific and non-scientific writing; Scientific Vocabulary and grammar. Synopsis, Dissertations, Thesis, Posters. • Correspondence: Formal letters, cover letters, drafting emails, replying to reviewers. • Writing a Research paper: Title, Abstract, Introduction, Review of literature, Methodology, Observations, Results, Discussions, Summary, Conclusion, and Bibliography (Referencing and citation styles). Supplementary data. • Writing a Research Grant Proposal: Funding agencies, guidelines, structure of research proposals – Setting a budget (Manpower, Consumables, Equipment, Travel, Contingencies, Overheads) with justifications, expected outcomes, Cost benefit analysis, Work plan, and Time schedule of activities. • Bioethics: Definition – moral, values, ethics and ethics in	**1C/15 Hours**

		biology; Role and importance of ethics in biology; Legal and regulatory issues; Bioethics in healthcare, agriculture, modern biology, biotechnology, animal welfare & right / animals in research, wildlife conservation and management, commercialism in scientific research. • Scientific misconduct: Fabrication, Authorship conflicts, Salami, Plagiarism, imalas publication.	
	III	***Research Methodology- III*** • Literature review: Search, query formulation and organization of review. • Reference management tools: Using Mendeley/ EndNote/ Zotero. (Validation of methods/selecting appropriate method for analysis) • Interpretation of result • Word Processing systems: Microsoft Word, Google Docs, LATEX. • Image Editors: Guidelines for publishing images, Inkscape, GIMP, Image J. Creating a multi-panel vector and raster image for research paper publishing. • Graphing & Statistics: Using Microsoft Excel, Google Sheets, GraphPad Prism, MaxStat, IBM SPSS and R. • Presentation and Design: Microsoft PowerPoint, Google Slides, Microsoft Publisher. Presenting numerical data - Graphical, Tabular, Animations, Slides, etc. • Creating a website for scientific communication: Google sites, Wix website design and publishing. • Miscellaneous Tools and AI	**1C/15 Hours**
	IV	***Biostatistics*** • Hypothesis testing: Theory of errors – Type I and Type II errors • Null Hypothesis & Alternate Hypothesis • Z-test • Test of significance • Introduction to ANOVA, One-way & Two-way ANOVA • Randomized Block Design and Latin Square. (5 problems to be solved in each category) • Dunett's test	**1C/15 Hours**

Reference:

1. Anderson J, Durston B H, Poole 1970. Thesis and assignment writing. Wiley eastern.
2. Bedekar V. H.1982. How to write assignment and research papers, dissertations and thesis. Kanak publications.
3. Kothari– C.R. 2004. Research Methodology –Methods and Techniques, New Age International

Ltd. Publishers, New Delhi.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B.1986. Fundamentals of Statistics (Vol.2). The world press Private limited, Calcutta. 17. Gupta, S.C. and Kapoor, V .K.1993. Fundamentals of applied statistics. Sultan Chand and Sons, New Delhi 18.
5. Gupta,S.P. 2001. Statistical methods. Sultan Chand and Sons, New Delhi.
6. Khan I and Khanum (2008) Fundamentals of Biostatistics, Ukaaz Publications, Hyderabad.

Discipline Specific Elective

Course Code: RPSZOO.O506

Course Title: Aquarium Management

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Comprehend the key skills needed to set up and successfully maintain a fresh water aquarium.
CO 2	Identify and differentiate aquarium/ornamental fishes, invertebrates and aquatic plants.
CO 3	Enlist the various feeding habits and nutritional requirements of different fishes and invertebrates Comprehend the various fish diseases and their treatment options.
CO 4	Describe the breeding peculiarities of various fishes and fresh water invertebrates and establish a small breeding and hatchery setup at lab level.
CO5	To obtain a broader view pertaining to scope of commercial aspects of establishing a small commercial setup

RPSZOO.O506	Unit	Title: Aquarium Management	Credits-3 Hours-45
	I	***Introduction to Aquarium Fish Keeping*** • Introduction: History, Why Set Up an Aquarium, advantages – Personal, Family, Social, Creativity, Proximity to Nature, New Learning, Different Than Keeping Other Pets, Easy to Do It, Hobby for Lifetime. • Before you start: Myths and Realities of Aquarium Keeping, Types of Aquariums, Choosing Right	**1C/15 Hours**

		Aquarium, Choosing right Location, Background Preparation, Safety and Precautions, Do's and Don'ts aquarium. • A Delicate Balanced Ecosystem What Is Ecosystem, Elements of Aquatic Ecosystem, Substrate – Aerobic and Anaerobic Conditions, Water – Temp, Ph, Hardness, Clarity, Gases – CO2, O2, Nitrogen Cycle, Ammonia, H2S, Methane, Light – Photoperiod, Aquatic Animals – fish, shrimp, snails, Aquatic Plants and Mosses. • Introduction to the Aquarium Hardware: Reverse Osmosis filters for pure source of water, UV Sterilizers, Importance of Filtration, Types of Filters, Filtration Media, Aerators, Thermometers, Heaters, Pressurized CO2 System, DIY CO2 System. • Lighting -Its Importance – Types of Lighting, Water Testing Equipment and Kits, timers, Auto Feeders etc.	
	II	***Creating the Aquatic Environment & Maintenance of Aquarium*** • Types Of Aquatic Biotopes, Principles of Aqua scaping, Types of Aquascapes, Types of Substrates, Use of Rocks, Driftwoods, How to Set Up an Aquarium Step Wise Guidelines, Do's and Don'ts, Cycling Of Aquarium, Water quality requirements: PH, hardness, Maintenance and Temperature control Testing of Water. Assembling a tank, Equipment and accessories. • Balanced aquarium: Choosing the bed, Decor and background, Final preparations. • Aquarium Maintenance: Myths and Realities, Dos and Don'ts, Maintenance Schedule, Daily, Weekly, Monthly and Annual Maintenance Schedule, Water Change, Cleaning of Glass and Other Articles. Taking Care of Aquarium While on Vacation, Maintenance tool kit. • Choosing the Right Fish, Stocking of Fish, Choosing Healthy fish, Handling of Fish, Acclimatization, Quarantine Tank, Fish Care, Avoiding Cruelty to Fish Due to Ignorance, Irresponsible Petting. • Introduction To Common Tropical Aquarium Fishes, Their Origin, Habitat Details, typical characters and sexual dimorphism And Care. • Endemic Aquarium Fishes – Zebra Danio & Honey Gourami, Freshwater ornamental fishes - Guppy, Siamese Fighter fish, Gold fish and Angel fish. • Brackish ornamental fishes - Black Molly and Sword tail.	**1C/15 Hours**

		• Marine and brackish water ornamental fish introduction. • Ornamental Fresh water Aquarium Plants. • Introduction to different types of stem plants, Rosette plants, Epiphytic plants and their importance and role in Aquarium environment. Foreground, midground, background plants. • Emersed and Immersed grown plants vs Tissue cultured plants for aquariums. • Procurement, precautions, planting, pruning and maintenance and propagation of aquatic plants. Liquid fertilizers and plant growth additives. • Common Fish Feeding Behaviors as per their morphology & origin / habitat • Live food options – Tubifex worms, Chironomus larvae, Mosquito larvae, Daphnia, Moina, and Brine Shrimps, Live fish in case of larger carnivorous fish. Processed food / dry feed options – fish feed formulations. • Identification of Common Fish Diseases: Root cause of fish diseases in aquariums, types of common fish diseases, White Spot, Fin rot, Dropsy, Head in the hole, Flukes and worm infestation, Planaria etc • Treatment: Treatment options with temperature control, Methylene Blue, Malachite Green, Chloromycetin, Common salt etc.	
	III	***Basics of Fish breeding*** • Live bearers - Sexual Dimorphism, Selection, Preparation & Isolation of Brood stock, Preparing Breeding Tank for Live Bearers, Breeding of Live Bearers, Isolating Fries, Cross Breeding of Livebearers, Avoiding interbreeding, Breeding of Guppies, Platys, Mollies, Sword tails. • Egg Layers Types – Sexual Dimorphism, Selection, Preparation & Isolation of Brood stock, Preparing Breeding Tank For egg layers Scatterers, Floaters, Adherers, Nest Builders, Breeding Of common egg laying fishes like Zebras, Angels, Fighters, Gourami's, barbs and carps. • Preparation of Feed for Young Fries, Care of fries and juveniles, Handling, Packaging and transport of fish, shrimps and aquatic plants. • Introduction to Entrepreneur opportunities in Freshwater. • Aquarium Industry: Overview – Aquarium Industry & its Stake holders (govt agencies, banks and financial	**1C/15 Hours**

		institutions and organized commercial players and unorganized commercial players) New pet rules and its implications on aquarium industry in near future Opportunities ahead for developing professionals and entrepreneurs in Aquarium industry (retail shops and aqua scaping, Wholesale shops, Import export trading, Aquarium dry goods manufacturing and supply etc.)	
RPSZOOP.O506	**Practical based on: Aquarium Management**		**Credit 1**
	1. Setting of freshwater aquarium tank. **2**. Activity based learning: Preparation Wet and dry fish food **3**. Measuring the physical and chemical water parameters: a. Dissolved Oxygen, b. Nitrites and Nitrates, c. Temperature, d. pH, e. Salinity, f. Hardness **4**. Identify and describe food and its Types. **5**. Identify and describe aquarium plants (any five). **6**. Identify and describe aquarium fishes (Freshwater, Marine and Brackish water).		

References:

1. Aquarium: Fish Keeping C B L Srivastava Published by Kitab Mahal.
2. Marine Aquarium (Fish: Keeping and Breeding Them in Captivity) Boruchowitz, Davie. Published by Chelsea House Publications (1998).
3. Aquarium Setting Up (Fish: Keeping and Breeding Them in Captivity) Axelrod, Herbert R. Published by Chelsea House Publications (1998).
4. The Tropical Freshwater Aquarium Problem Solver: Practical and Expert Advice on Keeping Fish and Plants Sand ford, Gina Published by Voyageur Press (MN) (1998).
5. Aquariums: The Complete Guide to Freshwater and Saltwater Aquariums, Jan 2009 by Thierry Maitre- alain (Author), Chrisitan Piednoir (Author)

Modality of Assessment

Modality of Assessment-DSC/DSE

Theory Examination Pattern:

A) Internal Assessment- 40%- 30 Marks

Sr. No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	20
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**30**

B) External Examination (Semester End)- 60%- 45 Marks

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of two hours.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1	7/8 marks questions with option to any one	15	Unit-I
Q.2	7/8 marks questions with option to any one	15	Unit-II
Q.3	7/8 marks questions with option to any one	15	Unit-III
	TOTAL	**45**	

Practical Examination Pattern:

Sr No	Evaluation type	Marks
1	Journal	5
2	Viva & Practical Tasks	45
	TOTAL	**50**

Duration – The duration for these examinations shall be of **4 hours**.

Modality of Assessment-DSC – 2credit

Question	Unit	Options	Marks
Q.1	I	Any two out of three	20
Q.2	II	Any two out of three	20
Q.3	I & II	Short notes: Any two out of three	10
Total			**50**

Modality of Assessment-DSE

Theory Examination Pattern:

A) Internal Assessment- 40%- 20 Marks

Sr No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	10
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**20**

Modality of Assessment-RM

Theory Examination Pattern:

B) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Scientific Writing assignment (Abstract /Research Article)	20
2	Research Review/ Research Proposal Writing	20
	TOTAL	40

C) External Examination (Semester End)- 60%- 60 Marks
Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of **two Hours**.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
1	7/8 marks questions with option to any one	15	Unit I
2	7/8 marks questions with option to any one	15	Unit II
3	7/8 marks questions with option to any one	15	Unit III
4	7/8 marks questions with option to any one	15	Unit IV
	TOTAL	**60**	

Semester II

Academic year 2023-2024

Paper Code	Unit	Topic	Credits
RPSZOO.E511		**Comprehensive Zoology-II**	
	I	Animal behavior-II	3
	II	Introduction to model organisms- *C. elegans* and *Danio rerio* - II	
	III	Cell Communication	
RPSZOO.E512		**Biochemistry and Metabolism- II**	
	I	Bio-molecules- a structural and functional approach-II	3
	II	Enzymes and Enzyme kinetics	
	III	Metabolic pathways and Integration of metabolism	
RPSZOO.E513		**Genetics and Molecular Biology**	
	I	Genetics	3
	II	Molecular Biology- I	
	III	Molecular Biology- II	
RPSZOO.E514		**Bioinformatics and Molecular Modeling**	2
	I	Bioinformatics	
	II	Molecular Modeling & Molecular Dynamics simulations	
RPSZOO.E515		**Research Project/Field Project**	4
RPSZOO.E516		**Wildlife Biology**	
	I	Wildlife Management	3
	II	GIS and its interpretation	
	III	Wild life Photography and Ecotourism	
RPSZOOP.E511		Practical-I	1
RPSZOOP.E512		Practical-II	1
RPSZOOP.E513		Practical-III	1
RPSZOOP.E516		Practical-VI	1
Grand Total			**22**

Discipline Specific Core Course

Course Code: RPSZOO.E511

Course Title: Comprehensive Zoology-II

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Comprehend the broad concepts of animal behavior and its applications in various fields of research.
CO 2	Correlate the different aspects of animal behavior, social behavior and learning or memory to evolutionary aspect.
CO 3	Interrelate the working and different systems and understand the role of model organisms in the field of research
CO 4	Justify the different cell signaling pathways and apply it in the field of cancer genetics

RPSZOO.E511	Unit	Title: Comprehensive Zoology-II	Credits-3 Hours-45
	I	***Animal behavior-II*** • Learning and memory: Innate behavior (orientation, kineses, taxes, motivation, tropism, reflex and nest building), learned behavior (sensitization and habituation, associative learning, imprinting, reasoning, trial-and-error,discrimination, biased and language learning), neural mechanism of learning. Memory- nature, types and anatomy of memory, and memorystorage. • Evolution and Genetics of behavior: Hamilton's rule, kin selection, cost and benefits of sex and sexual selection, phylogeny of behavior,genetic control of behavior (single and multiple gene effect). Genetics of burrow shape in Oldfield mouse and Deer mouse. • Social behavior: Types of social groups, advantages of grouping, social organization- primates, Cost and benefits of sociality, Eusocialbehavior.	**1C/15 Hours**

	II	***Introduction to model organisms- C. elegans and Danio rerio - II*** • *C.elegans* as a model organism: Lifecycle, different larval forms, preparation of media, culturing and maintenance of *C. elegans*. • *Danio rerio* (Zebrafish) as a model organism: Zebrafish husbandry and setting up of tank, identification of sex, lifecycle, breeding techniques. Studying zebrafish developmental stages of embryos. Nutritional requirements. • Importance of zebra fish in research.	**1C/15 Hours**
	III	***Cell Communication*** • Cell signaling: Cell surface receptor- G-Protein Coupled Receptor (GPCR), Inotropic Receptor, Enzyme Linked Receptor. Lipid and Steroid based receptor- Intra cellular receptor, Cytoplasmic receptor. Signaling, secondary messenger and regulation through G-protein coupled receptors. Hormones and their receptors, Bacterial and plant two-component systems, Light signaling in plants, Bacterial chemotaxis and quorum sensing. • General principles of cell communication- Cell adhesion molecules (cadherins, selectin, immunoglobin super family, integrin). • Cell Junctions- occluding junction (tight junction septate junction), anchoring junction (adherens junction, focal adhesion, desmosomes, hemi-desmogens), communication junction (Gap junction, Plasmo-desmata).	**1C/15 Hours**
RPSZOOP.E511	**Practical based on: Comprehensive Zoology-II**		**Credit 1**
	1.To study the repellent activity of lemon extract against the pest. **2.** Culturing and maintaining *C. elegans*. **3.** Studying the different larval stages of *C. elegans*. **4**. To observe the positive and negative taxis of *C. elegans* against different biotic and abiotic factors. **5.** Maintaining the tank of Zebra fish. **6.** To study different behavioral patterns of Zebra fish: a. Light and dark test, b. Novel tank test, c. Natural diving response, d. Mirror biting test, e. Predator avoidance, f. Shoaling behavior, g. Color Preferences Assay.		

References:
1. Alcock, J. (2001): Animal Behaviour, an Evolutionary Approach. Sinauer associates, INC. Sunderland, Massachusetts. USA
2. Bernard, C. (2004): Animal Behaviour, Mechanism, Development function and evolution. Pearson and Prentice Hall Publication. New York
3. Dunlap, J. C., Loros J. J. and Decoursey P. J. (2004): Chronobiology Biological Timekeeping. Sinuaer Associates, Inc. publishers, Sunderland, Massachusetts, USA
4. Goodenough, J.E., Mc Guire, B. and Wallace, R. A. (1993): Perspectives on Animal Behaviour. John Wiley and Sons, New York.
5. Mandal, F. B. (2010): Textbook of Animal Behaviour. PHI Learning Private Limited, Estern Economy Edition. New Delhi -110001
6. Manning, A. and Dawkins M.S. (1997): Introduction to Animal Behaviour, 5th edition, Cambridge University Press. UK.
7. Scott, G. (2005): Essential Animal Behaviour. Black Well Publishing, University of Hull, UK.
8. Stumpter, T. J. D. (2010): Collective Animal Behaviour; Princeton University Press. Oxford.
9. Howe K et al. The zebra fish reference genome sequence and its relationship to the human genome. Nature 2013.
10. Pennisi, E. (1998). Worming secrets from the C. elegans genome. Science, 282,1972-1974.
11. Fly: http://flybase.bio.indiana.edu:82/
12. Worm: http://www.expasy.ch/cgi-bin/lists?celegans.txt. http://www.wormbook.org/
13.Zebrafish: http://www.ncbi.nlm.nih.gov/genome/guide/D_rerio.html
14. Robert H. Tamarin: Prin. Of Genetics; 7th Ed. Tata McGraw Hill.
15. Elaine Johansen Mange and Arthur Mange: Basic Human Genetics; Indian Reprint; 1997; Rastogi Publ.
16. A.P. Jha: Genes and Evolution; MacMillon India.
17. William S. Kluge: Concepts of Genetics; M.R.Cummings, Pearson Edu .

Discipline Specific Core Course

Course Code: RPSZOO.E512

Course Title: Biochemistry and Metabolism- II

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Explain the classification, structures, and functions of Proteins and Enzymes.
CO 2	Enumerate the concept of enzyme kinetics.
CO 3	Differentiate between competitive, non-competitive and uncompetitive mechanism of enzyme kinetics and correlate it with Vmax and Km.

CO 4	Compare and contrast between different metabolic pathways and understand its Significance.
CO 5	Analyse and understand the different inborn errors of metabolism.

RPSZOO.E511	**Unit**	**Title: Biochemistry and Metabolism- II**	**Credits-3 Hours-45**
	I	***Biomolecules- a structural and functional approach-II*** • Proteins as polymers of amino acids Amino acids: structure, classification based on structure, polarity, nutritional requirement and metabolic fate; properties of amino acids; derivatives of amino acids, non-transcribed amino acids as protein constituents, D-amino acids. • Organization of protein structure: Primary structure and peptide bond, secondary, tertiary and quaternarystructure; conjugate proteins- hemoglobin, cytochromes, myoglobin; bonds involved in protein organization. • Properties of proteins: classification, denaturation and protein folding. • Biological functions of proteins. Biologically important peptides:glutathione, octa-, nano-, and deca-peptides. • Ramachandran plot.	**1C/15 Hours**
	II	***Enzyme kinetics*** • Enzyme kinetics: a. Mechanism of enzyme catalysis. b. enzyme activation and inhibition. c. factors affecting enzyme activity. d. Michaelis Menton equation. e. Lineweaver-Burk plot. • Significance of Vmax and Km (including non-competitive, Uncompetitive and competitive inhibitions). • Regulatory enzymes: covalently modulated, allosteric regulation,Isoenzymes (LDH, CK, ALP, ADH) • Non-protein enzymes- Ribozymes, Ribonuclease & Peptidyltransferase.	**1C/15 Hours**
	III	***Metabolic pathways and Integration of metabolism*** • Protein Metabolism: Metabolism of amino acids: Amino acid pool, transamination; oxidative and non- oxidative deamination; metabolismof branched chain amino acids; fate of carbon skeleton of amino acids.	**1C/15 Hours**

		• Metabolism of ammonia: Urea cycle. • Metabolism of nucleic acids: Synthesis of ribo nucleotides- a brief ideaof *de novo* pathway and salvation pathway. Conversion of ribo nucleotides to deoxyribo nucleotides. Degradation of nucleotides. • Integration of Metabolism, Energy demand and supply. Integration of major metabolic pathways of energy metabolism;Intermediary metabolism; Organ specialization and metabolic integration. Metabolism in starvation.	
RPSZOOP.E512	**Practical based on: Biochemistry and Metabolism- II**		**Credit 1**
	1. Determination of total cholesterol and HDL cholesterol from serum. **2**. Colorimetric estimation of protein by Peterson-Lowry method **3**. Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA. **4.** Determination of creatinine in serum. **5**. Determination of urea in serum. **6**. SDH specific activity. **7**. Enzyme kinetics - pH variation & Temperature-fungal amylase. **8**. SDS PAGE of milk protein or blood plasma.		

References:

1**.** U. Satyanarayan: Biochemistry- 2nd Ed. 2002, Books and Allied Publ.
2. S.C. Rastogi: Biochemistry- 2nd Ed., Tata McGraw Hill.
3. J.I.Jain, S. Chand and Co. Publ : Fundamentals of Biochemistry- 3rd Ed. 1988.
4. Lehninger, A. L., Nelson, D. L. and Cox, M. M., 2nd Edn.: Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
5. Conn, E. E., Stumpt, P. K., Bruencing, G. and Dol, R. G. (1995): Outlines of Biochemistry. John Wiley, Singapore.
6. Murray, RK.Garner, D.K., Mayes P.A. and Rodwell, V.W. (2003): Harper's Illustrated Biochemistry, 26th Edn. Lange Medical Books, McGraw Hill, New York.
7. www.enzymesIndia.com

Discipline Specific Core Course

Course Code: RPSZOO.E513

Course Title: Genetics and Molecular Biology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Identify different cell cycle checkpoints and correlate them with cancer.

CO2	Justify the concept of non-disjunction as a genetic anomaly with different genetic disorders and maternal age.
CO 3	Illustrate the concepts of DNA replication, DNA repair and protein synthesis.
CO 4	Discuss the concepts of RNA synthesis and processing, Protein synthesis.

RPSZOO.E513	**Unit**	**Title: Genetics and Molecular Biology**	**Credits-3 Hours-45**
	I	***Genetics*** • Mitosis- Interphase and cell cycle, genetic control of cell cycle, stages of mitosis. • Meiosis: An overview of meiosis, the first meiotic division, the second meiotic division, comparison of spermatogenesis and oogenesis in animal cells. • Non-disjunction and its implications. • Significance of telomeres; telomeres and cancer • Genetics of cancer- Relationship of cell cycle to cancer, Oncogenes, Tumor suppressor genes, Mutator genes, Chemicals and radiations as carcinogens. • Alleles and phenotypes: a. Incomplete or partial dominance and co-dominance b. Epistasis – Dominant and Recessive c. Complementation analysis d. Multiple alleles • Lethal alleles (recessive and dominant lethal alleles)- Penetrance and expressivity • Quantitative inheritance: a. Traits controlled by many loci. b. Location of polygenes c. Heritability: measurement of heritability • Linkage, crossing over and gene mapping: Chromosomal theory of linkage, Mechanism and types of crossing over, Mapping in prokaryotes and bacterial viruses, Gene mapping in eukaryotes (three- point cross) • Genetic mapping in humans- Physical chromosome mapping: deletion mapping, somatic cell hybridization mapping, mapping by in situ hybridization; correspondence of genetic and physical maps. • Practical application of chromosome mapping- tracking the inheritance of an allele with coupled DNA markers.	**1C/15 Hours**
	II	***Molecular Biology- I*** • DNA replication, repair and recombination- Meselson-	**1C/15 Hours**

		Stahl experiment, Enzymes involved in prokaryotic and eukaryotic replication, Structure of DNA polymerase-III(Prokaryotes), Unit of replication (Prokaryotic and Eukaryotic replication process)- Inititiation, Elongation and termination fidelity of replication, extra chromosomal replicons (Plasmid and Mitochondria). • DNA damage and repair mechanisms (Direct repair- Photoactivation, Alkylation and Methyltransferase; Single stranded repair- Base excision repair, Nucleotide excision repair and Mis-match repair), Double stranded repair- homologous and non-homologous repair, site-specific recombination.	
	III	***Molecular Biology- II*** • RNA synthesis and processing- Structure and function of different types of RNA, RNA transport transcription factors and machinery (Prokaryotes and Eukaryotes), formation of initiation, elongation andtermination complex. RNA polymerases, capping, RNA processing, RNA editing, splicing, and polyadenylation. • Protein synthesis and processing- Ribosome, Prokaryotes and Eukaryotes- Formation of initiation complex, Initiation factors & theirregulation, elongation and elongation factors, termination. • Genetic code, Aminoacylation of tRNA, t-RNA identity, Aminoacyl oftRNA synthetase, Translational proof reading. • Post translational modifications.	**1C/15 Hours**
RPSZOOP.E513	**Practical based on: Genetics and Molecular Biology**		**Credit 1**
	1.Temporary squash preparation of onion/garlic root tip cells to study stages of mitosis and calculating the mitotic index. **2**.Temporary squash preparation of Tradescantia pollen to study stages of meiosis. **3**. Temporary preparation of polytene chromosomes from salivary gland cells of Chironomus larva Quantitative estimation of DNA in a suitable tissue- comparative study- by diphenyl amine method. **4**. Quantitative estimation of RNA in a suitable tissue-comparative study by orcinol method. **5**. Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing		

	agarose gel electrophoresis. **6**. 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.	

References:

1. Epstein, R. J. (2003): Human Molecular Biology. Cambridge Univ. Press, Cambridge

2. Watson, J. D., T. A. Baker S. P. Bell, A Cann, M. Levine and R. Losick, (2004). Molecular Biology of Gene V Edition, Pearson Education RH Ltd. India.

3. Alberts, B, Johnson, J Lewis, M. Raff, K Roberts and P. Watter. (2014): Molecular Biology of the cell. 6th edition. Garland Science, New York.

4. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. (2016): 8th Edition, Molecular Cell Biology. W. H. Freeman and Co., N. Y.

5. Brachet, J. (1985) Molecular Cytology, Academic Press, N. Y.

6. Pollard, T. D. and W. C. Earnshaw. (2002): Cell Biology. Saunders.

7. Forensic Science in India and the World, Deepak Ratna and Mohd. Zaidi, Alia Law Agency, Allahabad.

13.Fundamentals of Forensic Science, Second Edition, Max M. Houck and Jay A Siegel, Academic Press.

14. Forensic Science, Third Edition, Stuart H James and Jon. J. Nordby.

15. Forensic Biology, Richard Li, CRC Press.

16. Forensic Science: An introduction to Scientific and Investigative Techniques by S. H James, J. J. Nordby.

17. Illustrated Guide to Home Forensic Science Experiments by Robert Bruce Thompson and Barbara Fritchman Thompson, First Edition. (Online Pdf available)

Discipline Specific Core Course

Course Code: RPSZOO.E514

Course Title: Bioinformatics and Molecular Modeling

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOMES	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Evaluate the broad concepts of Bioinformatics.
CO2	Demonstrate efficacy studies in the experimental techniques for any biological project.
CO 3	Enumerate the broad concept of molecular modeling, chirality & stereochemistry.

CO 4	Illustrate the molecular dynamics simulation, its major steps and various simulation models.

RPSZOO.E514	**Unit**	**Title: Bioinformatics and Molecular Modeling**	**Credits-2 Hours-30**
	I	***Bioinformatics*** • Specialized databases: EST, GSS, KEGG, OMIM Conserved regions in nucleotide and protein sequences • Gene finding and motif finding. System biology and Bioinformatics, Biological pathway analysis • System biology database and tools: Reactome, Pathway commons. Bioinformatics and functional genomics and proteomics • Introduction to Protein and DNA microarray • Data analysis in Microarray using bioinformatics. • GEO database: functional genomics data repository. • Bioinformatics and structural proteomics- Visualization and comparison of protein structure; Prediction of Secondary and tertiary structure of protein.	**1C/15 Hours**
	II	***Molecular Modeling & Molecular Dynamics simulations*** • Concept of molecular modeling, chirality & stereochemistry. • Theory and practice of energy minimization, Monte Carlo. Definition of the potential energy surface of a molecule, force field and generic form of a force field. Differences between molecular mechanics energy and the quantum mechanical energy of a system. • Differences between Class I, Class II and Class III force fields**.** Parametrization of a forcefield. • Molecular dynamics simulation: Major steps, simulation models such as coarse grained, bead rod and bead spring models, Ensembles- microanonical, canonical, isobaric-isothermal & grand canonical ensembles.	**1C/15 Hours**

References:

1**.** Bioinformatics: concepts skills and applications (2004). S.C. Rastogi, N. Mendiratta and P. Rastogi.
2. Bioinformatics: A modern approach. (2005) V.R. Srinivas.
3. Essential Bioinformatics (2006). J. Xiong.
4. Statistical methods in Bioinformatics: An introduction. (2005). W. Even and G. Grant
5. Bioinformatics: A Practical Approach 2007 Shui Qing (Chapman & Hall/CRC Mathematical and Computational Biology.
6. P. Clote and R. Backofen. 2000. Computational Molecular Biology: an Introduction. Wiley and Sons.

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10. A. K. Konopka and M. J. Crabb. 2004. Compact handbook of computational biology. Marcel Dekker, New York.

Course Code: RPSZOO.E515

Course Title: Research Project/ Field Projects

Academic year 2023-24

RPSZOO.E515	Research Project	Credits-4 Hours-60

Discipline Specific Elective

Course Code: RPSZOO.E516

Course Title: Wildlife Biology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION Upon successful completion of this course, learners will be able to;
CO 1	Explore the career opportunities in GIS.
CO 2	Summarize the concepts of GIS related technologies like Global Positioning System, Arial Photography, Remote Sensing, LiDAR.
CO 3	Explore and visualize Geo-database.
CO 4	Evaluate the broad concepts in wildlife photography.
CO 5	Enumerate the ethical aspects in the field of tourism.

RPSZOO.E516	Unit	Title: Wildlife Biology	Credits-3 Hours-45
	I	***Wildlife Management*** • On field computation and usage of portal computing devices. StillCameras for wild life tracking and path mapping. • Radio telemetry and Mobile Satellite systems, Multifrequency echosounders and acoustic tags for fishery.	1C/15 Hours

		• Sonogram and its analytics. e.g. (Bird songs, Insect calls, Habitatusage by Bats).	
	II	***GIS and its Interpretation*** • Definition: Datum and geographic, projected coordinate system and their types. • Introduction to various source for data and data acquisition terminologies in GIS. • Geographical Information Systems: Brief introduction, working of GIS, Geo referenced GIS data and its significance, GIS related domain. • Use of in decision support system and real-world applications. • Study of the topological relationship of spatial data. • Concepts of GIS related technologies like Global Positioning System, • Basic concepts of geography related to the use GIS technology. • Study of data display and cartographical methods. • Explore and visualize geo-database. • Arial Photography, Remote Sensing, LiDAR etc.	**1C/15 Hours**
	III	***Wild life Photography and Ecotourism*** • Introduction to wildlife photography: Scope, opportunity, best equipment for photography, Basics of DSLR camera. Macro and Micro Photography. Rules of Wildlife Photography. • Tourism and visitors' management: Nature and scope, Definition and concept. Types of Tourism: Responsible Tourism, Eco Tourism and Human tourism (Brief Introduction) • Wildlife Tourism. • Scope of Wildlife Tourism. • Stakeholders in Sustainable Tourism: Role of Government, Non- government bodies, Local communities and international organization (Global Sustainable Tourism Council) • Sustainable Development Goals (SDG): SDG 8, SDG12 and SDG 14	**1C/15 Hours**
RPSZOOP.E516	**Practical based on: Wildlife Biology**		**Credits 1**
	1. Perform the GIS operations like geo-database creation, visualization, digitization, map clean up, topology, geo-referencing, data linking, symbology, geo-processing, overlay analysis and map		

	composition in most popular GIS packages like QGIS. **2.** Using a hand-held GPS instrument locate coordinates of a demarcated field site (Eg. College campus). **3**.On campus visit and learning macro photography using DSLR camera/mobile camera. **4.**Make an audio recording of a song bird. e.g., bulbul, magpie robin, sunbird. Observe and note the activity of the bird while recording the call. Make a sonogram of the recording. Analyze the call and correlate with the behavioral observations. Classify the call as advertisement call, territorial call, alarm call, courtship call etc. **5**.Activity based learning: To communicate conservation and sustainable awareness amongst the youth & general public.	

References:

1. Wildlife management. Robert, G.H. W.H. Freeman and Co., San Francisco, U.S.A.1978.
2. Aerial Photography and Image Interpretation for Resource Management. Paine, D.P. John Wiley and Sons.
3. Remote Sensing: Principles and Applications Sabbins, F.E., Freeman.
4. Manual of wildlife techniques, for India. Sale, J.B. and Berkmuller, K. WII, FAO, Dehra Dun, India 1988.
5. A New Approach to Linear Programming Sharma, S.D. Kedarnath, Ramnath and Co. Meerut 1975.
6. Text Book of Wildlife Management. Singh, S.K. IBDC, Lucknow. 2005.
7. Guide for Planning Wildlife Management in Protected Areas and Managed Landscapes Vishwas Sawarkar Natraj Publisher. Dehradun

Modality of Assessment

Modality of Assessment-DSC/DSE

Theory Examination Pattern:

B) Internal Assessment- 40%- 30 Marks

Sr.No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	20
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**30**

B) External Examination (Semester End)- 60%- 45 Marks

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of two hours.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1	7/8 marks questions with option to any one	15	Unit-I
Q.2	7/8 marks questions with option to any one	15	Unit-II
Q.3	7/8 marks questions with option to any one	15	Unit-III
	TOTAL	**45**	

Practical Examination Pattern:

Sr No	Evaluation type	Marks
1	Journal	5
2	Viva & Practical Tasks	45
	TOTAL	**50**

Duration – The duration for these examinations shall be of **4 hours**.

Modality of Assessment-DSC – 2credit

Question	Unit	Options	Marks
Q.1	I	Any two out of three	20
Q.2	II	Any two out of three	20
Q.3	I & II	Short notes: Any two out of three	10
Total			**50**

Modality of Assessment-DSE

Theory Examination Pattern:

D) Internal Assessment- 40%- 20 Marks

Sr No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	10
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**20**