LEARNING OUTCOMES BASED CURRICULUM FRAME WORK (LOCF) FOR POSTGRADUATE PROGRAMMES

(With effect from 2022-23)

MSc Zoology

Department of Advanced Zoology and Biotechnology

LOYOLA COLLEGE (AUTONOMOUS)
CHENNAI 600034

PREFACE

A high priority task in the context of future education development agenda in India is fostering quality higher education. Improvement of quality of higher education is considered critical for enabling effective participation of young people in knowledge production, participation in the knowledge economy, improving national competitiveness in a globalized world and for equipping young people with skills relevant for global and national standards and enhancing the opportunities or social mobility. Sustained initiatives are required for institutionalizing an outcome-oriented higher education system and enhancing employability of graduates through curriculum reform based on a learning outcomes-based curriculum framework, improving/upgrading academic resources and learning environment, raising the quality of teaching and research across all higher education institutions; technology use and integration to improve teaching-learning processes and reach a larger body of students through alternative learning modes such as open and distance learning modes and use of MOOCs.

UGC, under its Quality Mandate, has resolved to revise the curriculum based on Learning Outcomes which is an endeavour towards fostering quality higher education in India. The Learning Outcomes-based Curriculum Framework (LOCF) works towards a more holistic experience for the students, while focusing not just on knowledge delivery in higher education but also on the application of knowledge through field and lab work and emphasises on application of knowledge to real life experiences. Besides this, students will attain various 21st century skills like critical thinking, problem solving, analytic reasoning, cognitive skills, self-directed learning etc (Excerpts of UGC document on LOCF, 16th January, 2020).

In response to the quality mandate of the UGC, the Department of Advanced Zoology and Biotechnology, Loyola College, Chennai has attempted to revamp the PG Zoology curriculum to cater to the growing needs of the students and the industry and to keep phase with the emerging trends in the field of Life Sciences. In the proposed curriculum, while the Major Core courses focus on the knowledge expansion of the subject discipline, the Subject elective, Inter-disciplinary, Cross Disciplinary and Value Added courses focus on the emerging trends in the field of applied biology aimed at skill enhancement and research output. We sincerely acknowledge the valuable inputs of the reviewers of the syllabi **Dr. B. Meena**, Associate Professor, Presidency College, Chennai, **Dr. J. J. Arockia Rita**, Assistant Professor, QMGC, Chennai and **Dr. S. Nandini**, Assistant Professor, QMGC, Chennai.

We acknowledge the contributions of the following members of the Board of Studies **Dr. S. Janarthanan** (University Nominee-PG Board), **Dr. S. Elumalai** (University Nominee-UG-Board), **Dr. S. Arivoli** (Subject Expert), **Dr. M. Akilan** (Subject Expert), **Dr. J. J. Arockia Rita** (Alumna), **Dr. Felix Paul Joe** (Industry Representative), **Ms. Monalisa Sahu** and **Mr. Pranjal Sharma** (Student representatives).

CONTENTS

VISION AND MISSION OF LOYOLA COLLEGE

VISION

Towards holistic formation of youth, grounded in excellence, through accompaniment to serve the humanity.

MISSION

- To provide inclusive education through an integral and holistic formative pedagogy.
- To promote skills that prepare them for the future.
- To kindle in young minds the spirit of social and environmental justice with a blendof academic excellence and empathy.
- To stimulate critical and conscientious scholarship leading to meaningful and innovative human capital.

CORE VALUES

- Cura Personalis
- Pursuit of Excellence
- Moral Rectitude
- Social Equity
- Fostering solidarity
- Global Vision
- Spiritual Quotient

VISION AND MISSION OF THE DEPARTMENT

VISION

To offer quality science education to inculcate respect for nature and human life and to promote scientific practices based on strong ethical principles.

MISSION

To introduce modern trends in life sciences emphasizing conservation.
To develop and hone skills of students to meet the local and global needs.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
(School of Life Sciences)

PEO1	**Academic Excellence, Core Competency and Lifelong learning** To achieve academic excellence through teaching and research by building core competencies in the realm of Life Sciences for lifelong learning.
PEO 2	**Globally Relevant Curriculum, Learning Environment** To provide a conducive learning environment to the stakeholders and consistently innovate and upgrade the curriculum by employing modern instructional methodologies to make Life Sciences teaching and learning relevant to the global context.
PEO3	**Effective Communication, Teamwork and Leadership skills** To demonstrate team-building skills and leadership qualities for effective communication and collaboration through scientific research and publications and enhance the spirit of teamwork and leadership skills.
PEO4	**Environmental sustainability, social responsibility and solidarity** To instil values in environmental sustainability and social responsibility to become socially responsible scientists.
PEO5	**Technical and professional skills, Entrepreneurship and Empowerment** To equip students with technical and professional skills in Life Sciences to be empowered citizens through entrepreneurial ventures and contribute toward national priorities.
PEO6	**Equity, Equality, Gender sensitization and Scientific temperament** To create a campus culture that prepares the students with a strong scientific temperament who are proactive to the needs of the disadvantaged sections of society and demonstrate the principles of equity, equality, and gender sensitization.

PROGRAMME OUTCOMES (POs)
(School of Life sciences)

PO1	**Disciplinary knowledge** Students will apply the knowledge acquired in the subject domain and become skilled professionals with a competency that matches global standards.
PO2	**Communication Skills, Teamwork and leadership qualities** Students will be able to pursue research in Life Sciences and offer solutions to environmental issues and conservation strategies through scientific practices, communication, teamwork and exemplary leadership.
PO3	**Critical thinking, problem-solving and analytical reasoning** Students will demonstrate skills in analytical reasoning, problem-solving, scientific understanding, and reflective thinking in the frontiers of life sciences.
PO4	**Research-related skills and Scientific reasoning** Students will acquire skills for scientific research to update and expand the existing knowledge and make conceptual contributions to theoretical biology and create workable prototypes for applied biology.
PO5	**Skill development, entrepreneurship and lifelong learning** Students will be able to apply the skills learned during the study for lifelong learning to be an entrepreneur, academics or industrialist.
PO6	**Environment and ethical awareness** Students will be ethically grounded individuals who will understand and contextualize environmental and ethical issues and contribute toward the betterment of the environment to achieve sustainable growth.
PO7	**Digital literacy and self-directed learning** Students will engage in self-paced and self-directed lifelong learning through digital literacy for personal development, professional accomplishment and the welfare of society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)
(Department of Advanced Zoology and Biotechnology)

PSO1	Students will be able to get exposed to emerging trends in the subject domain and acquire up to date knowledge on theoretical and applied biology.
PSO2	Students will be able to understand and enrich their knowledge of the diversity, systematic position, community ecology and intra and inter species interaction of Kingdom Animalia.
PSO3	Students will be able to apply the principles of biophysics, biochemistry and bioenergetics in the functioning of an ecosystem and appreciate the interaction of biotic and abiotic factors in the sustenance of life and life-supporting systems.
PSO4	Students will be able to expand their perception of the role of principles of genetics, evolution, embryology and behaviour in the stabilization, inheritance and acquisition of desirable traits in the lives of animals.
PSO5	Students will be able to broaden their understanding of the role of beneficial and harmful insects in areas concerning human welfare like health and hygiene, epidemiology, disease diagnosis and prevention, food production and economic prosperity.
PSO6	Students will be able to enrich their knowledge in the emerging multidisciplinary areas of life sciences like molecular biology, genetic engineering, computational biology, remote sensing, physiology, immunology, gene manipulation techniques, biotechnology, toxicology and drug discovery that offer ample scope for better career options.
PSO7	Students will be able to perform laboratory experiments, undertake research projects, and field and institutional visits to gain hands-on experience and industry exposure to hone their skills and enhance their expertise in emerging areas of life sciences and contribute toward national priorities as entrepreneurs.

Correlation Rubrics

High	Moderate	Low	No Correlation
3	2	1	0

Mapping of PEOs with Vision and Mission

	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
Vision	3	3	3	3	3	3
Mission	3	3	3	3	3	3

Mapping of POs with PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
PO1	3	2	3	3	3	2
PO2	3	3	3	3	3	2
PO3	3	3	3	3	3	3
PO4	3	3	3	3	3	3
PO5	3	3	3	3	3	3
PO6	3	3	2	3	3	2
PO7	3	3	3	3	3	3

Mapping of PSOs with PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
PSO1	3	3	3	3	3	3
PSO2	3	3	3	3	3	2
PSO3	3	3	3	3	3	3
PSO4	3	3	3	3	3	3
PSO5	3	3	3	3	3	3
PSO6	3	3	3	3	3	3
PSO7	3	3	3	3	3	3

Mapping of PSOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PSO1	3	3	3	3	3	3	3
PSO2	3	3	3	3	3	3	3
PSO3	3	3	3	3	3	3	3
PSO4	3	3	3	3	3	3	3
PSO5	3	3	3	3	3	3	3
PSO6	3	3	3	3	3	3	3
PSO7	3	3	3	3	3	3	3

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI
DEPARTMENT OF ADVANCED ZOOLOGY AND BIOTECHNOLOGY
(2021 - Restructured Curriculum)
OVERALL COURSE STRUCTURE (MSc Zoology)

Sem	Code	Course Title	T/L	Category	Hrs	Cr
I	PZO1MC01	Systematics and Diversity of Animals	T	MC	4	5
I	PZO1MC02	Advanced Developmental Biology	T	MC	5	5
I	PZO1MC03	Ethology and Evolutionary Biology	T	MC	5	5
I	PZO1MC04	Community and Population Ecology	T	MC	5	5
I	PZO1MC05	Entomology and Vector Biology	T	MC	5	5
I	PZO1MC06	Diversity of Animals, Embryology and Ecology Lab Course	L	MC	6	3
II	PZO2MC01	Biophysics, Biochemistry and Bioenergetics	T	MC	4	3
II	PZO2MC02	Research Methodology and Biostatistics	T	MC	4	3
II	PZO2MC03	Inheritance Biology	T	MC	5	5
II	PZO2MC04	Cellular Organization and Molecular Processes	T	MC	4	4
II	PZO2MC05	Biophysics, Biochemistry and Cytogenetics Lab Course	L	MC	6	3
II		Based on students' preference two courses will be offered	T	SE	4	2
II		MOOCs[#] (Outside class hours, additional credits)	T	MO	2	2
II		Life Skills[#]	T	LS	2	1
II		Cross Disciplinary (between schools, purely internal)	T	CD	3	1
II		Summer Internship (3 to 4 weeks) [#]	-	SI	-	1
III	PZO3MC01	Comparative Animal Physiology	T	MC	4	4
III	PZO3MC02	Immunology, Microbiology and Epidemiology	T	MC	4	4
III	PZO3MC03	Toxicology, Pharmacology and Bioethics	T	MC	3	4
III	PZO3MC04	Computational Biology	T	MC	3	3
III	PZO3MC05	Animal Physiology, Microbiology and Immunology Lab Course	L	MC	6	3
III		Based on students' preference two courses will be offered	T	SE	4	2
III		System Physiology - Plant	T	ID	6	3
III		Soft Skills[#]	T	SK	2	1
III		Value Added Courses (from other Institutions) [#]	T	VA	2	1
III		LEAP[#]	-	SL	2	1
IV	PZO4MC01	Methods in Biology	T	MC	5	5
IV	PZO4MC02	Genetic Engineering	T	MC	4	4
IV	PZO4MC03	Methods in Molecular Biology Lab Course	L	MC	6	6
IV	PZO4MC04	Project and Dissertation	-	PD	15	5
					130[*]	**99**

[*] 120 Contact hours and 10 Outside Class [#]Outside Class

Major Elective (ME)

Sem	Code	Course Title	T/L	Category	Hrs	Cr
II	PZO2SE01	Remote Sensing and Bioresource Management	T	SE	4	2
II	PZO2SE02	Endocrinology and Neuroscience	T	SE	4	2
II	PZO2SE03	Breeding in Plants and Animals	T	SE	4	2
II	PZO2SE04	Nanotechnology and Synthetic Biology	T	SE	4	2
II	PZO2SE05	Wildlife Conservation and Management	T	SE	4	2
III	PZO3SE01	Bioremediation, Phytoremediation and Biosensors	T	SE	4	2
III	PZO3SE02	Fishery Science	T	SE	4	2
III	PZO3SE03	Environmental Impact analysis	T	SE	4	2
III	PZO3SE04	Intellectual Property Rights	T	SE	4	2
III	PZO3SE05	Histochemistry and Clinical Lab Technology Lab Course	T	SE	4	2

Courses offered to other Departments

Sem	Code	Course title	T/L	Category	Hrs	Cr
II	PZO2CD01	Biogeography and Conservation Biology	T	CD	3	1
II	PZO2CD02	Forensic Biology	T	CD	3	1
III	PZO3VA01	Apiculture, Sericulture and Lac culture	T	VA	2	1
III	PZO3VA02	Freshwater and Brackish water Aquaculture	T	VA	2	1

MC – Major Core; **ME**-Major Elective; **ID**-Inter-Disciplinary; **MO**-MOOC; **LS**-Life Skills; **SK**- Soft Skills;
CD-Cross Disciplinary; **VA**- Value Added; **SI**-Summer Internship; **SL**-Service Learning; **PJ**-Project

M. Sc Zoology Restructured LOCF Curriculum (effective from June, 2022)

PART	SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV
MC	Systematics and Diversity of Animals (4h/5c)	Biophysics, Biochemistry and Bioenergetics (4h/3c)	Comparative Animal Physiology (4h/4c)	Methods in Biology (5h/5c)
	Advanced Developmental Biology (5h/5c)	Research Methodology and Biostatistics (4h/3c)	Immunology, Microbiology and Epidemiology (4h/4c)	Genetic Engineering (4h/4c)
	Ethology and Evolutionary Biology (5h/5c)	Inheritance Biology (5h/5c)	Toxicology, Pharmacology and Bioethics (3h/4c)	Methods in Molecular Biology Lab Course (6h/6c)
	Community and Population Ecology (5h/5c)	Cellular Organization and Molecular Processes (4h/4c)	Computational Biology (3h/3c)	
	Entomology and Vector Biology (5h/5c)	Biophysics, Biochemistry and Cytogenetics Lab Course (6h/3c)	Animal Physiology, Microbiology and Immunology Lab Course (6h/3c)	
	Diversity of Animals, Embryology and Ecology Lab Course (6h/3c)			
ME		(4h/2c)*****	(4h/2c) *****	
ID			System Physiology - Plant (6h/3c) (within school)	
MOOCs		2h(2c) (Outside Class Hours, additional Credits)		
LS		2h(1c) (Outside Class Hours)		
SK			2h/1c (Outside Class Hours)	
CD		3h(1c) (Between schools, purely internal)		
VA			2h(1c) (Outside Class Hours)	
SI		3 to 4 weeks (1c) (Outside Class Hours)		
SL			LEAP (2h/1c) (Outside Class Hours)	
PJ				(15h/5c)
Hr/c	**30h (28c)**	**30h (23c+2c)**	**30h (26c)**	**30h (20c)**

MC – Major Core; **ME**-Major Elective; **ID**-Inter-Disciplinary; **MO**-MOOC; **LS**-Life Skills; **SK**- Soft Skills; **CD**-Cross Disciplinary;
VA- Value Added; **SI**-Summer Internship; **SL**-Service Learning; **PJ**-Project

***** Based on students' preference two courses will be offered from the pool of 10.

Course Code	PZO1MC01
Course Title	Systematics and Diversity of Animals
Credits	05
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	I
Regulation	2022

Course Overview

1. The course highlights on a variety of biodiversity ranging from protozoans to metazoans and different kinds of taxonomic keys, their merits.
2. This course will challenge students to impart, analyze and apply skills to their readings in Basic concept of Biosystematics and animal taxonomy.
3. This course gives a broad overview of the foundations and Modern concepts and recent trend.
4. Course module is designed to learn diversity and relationships in animal world for biodiversity management.
5. After successful completion of the course the candidate should be able to design and comprehend different variety of organisms.

Course Objectives

1. To learn and understand the concepts regarding animal diversity to appreciate the variability in relation to their morphology, anatomy and behaviour among different animals.
2. To give a thorough understanding in the principles and practice of systematics, This will provide them ample opportunities to explore different career avenues
3. To help students acquire an in-depth knowledge on the diversity and relationships in animal world.
4. To develop an holistic appreciation on the phylogeny and adaptations in animals
5. The course has been designed to provide in-depth knowledge of animal systematics and diversity ensuring the inculcation of employment skills so that students can make a career and become an entrepreneur in diverse fields of aquatic biology.

Prerequisites	Basic knowledge on Molecular Biology, Cell Biology and Biotechnology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Biological Classification** Hierarchy, Binomial nomenclature, Trinomial nomenclature, Rules of nomenclature, Concept of Five kingdom Basis of Classification- Grade of organization, Symmetry, Coelom, Embryogeny, segmentation. Three Domain Concept in Systematics, two, five and six kingdom classification. Concept of species-taxonomic diversity within species. Molecular Phylogeny – specific Proteins, DNA barcoding and 16S RNA, Phylogenetic trees, Concepts and Techniques in Systematics.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Taxonomy and Classification** Microtaxonomy: species concepts; typological species concept, nominalistic species concept, biological species concept and evolutionary species concept. Polytypic and monotypic species; species category; subspecies, other infra-specific categories and intra-population variants. Theories and practice of biological classification: basic principles of classification: The three schools of macro taxonomy: Phenetics, cladistics and phylogenetics and their comparison. Modern concepts and recent trends: chemotaxonomy, cytotaxonomy, serotaxonomy and molecular taxonomy, Importance of application of Systematics in biology, Taxonomy vis-a-vis biodiversity conservation.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Lower Metazoans** Porifera, Cnidaria-Polymorphism, Ctenophora, Acoelomata, Placozoa, Mesozoa and Pseudocoelomata evolutionary relationships and adaptive modifications only. Phylogenetic position of Molluscs, Adaptive Radiation in Molluscs and Annelids. Phylogeny of Arthropod-Monophyly and Polyphyly, Reasons for the success of Arthropods. Major classes under Arthropoda and adaptive radiation. Sipuncula, Echiura, Phoronida,	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Brachipoda, Onychophora and Chaetognatha- Phylogeny only. Echinoderms: Classification and adaptive radiation.			
IV	**Ancestry of Chordates** Theories and origin of chordates, Hemichordates: Position in the animal kingdom, phylogeny and evolutionary significance, Cephalochordates and Urochordates. Vertebrate Phylogeny-Agnatha, Ostracoderms and Gnathostomes-Placoderms, Acanthodians, Chondrichthyes and Osteichthyes. Structural and Functional adaptations of fishes.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Terrestrial Vertebrates, Birds and Mammals** Tetrapod phylogeny - modern Amphibians, diversity, distribution, status and threats. Reptiles – origin and adaptive radiation. Skull of reptiles and its importance in biosystematics. Mesozoic world of reptiles and extinction. Origin of birds and mammals, Structural and functional modifications for aerial life. Orders under class Aves. Class Mammalia: Prototheria, Metatheria and Eutheria. Phylogeny of Mammalian orders. Adaptive radiation in mammals.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Alfred, J. R. B., & Ramakrishna. (2004). Collection, preservation and identification of animals. Zoological Survey of India Publications.
2. Anderson, T. A. (2001). Invertebrate zoology (2nd ed). Oxford University Press.
3. Barnes, R. D. (1982). Invertebrate zoology (6th ed).
4. Barrington, E. J. W. (1979). Invertebrate structure and functions (2nd ed). E.L.B.S. and Nelson, Boradale, L. A., & Potts, E. A. (1961). Invertebrates: A manual for the use of students. Asia publishing home.
5. Benton, M. J. (2005). Vertebrate paleontology (3rd ed). Blackwell Publishing Com.Oxford,UK.
6. Boolootian, R. A., & Stiles, K. A. (1981). College zoology (10th ed) p. 2. Macmillan Publishing, Co., Inc. New York.
7. David, M. H., Moritz, C., & Barbara, K. M. (1996). Molecular systematics. Sinauer Associates, Inc.
8. Edward, R. E., Fox, R. S., & Barnes, R. D. (2006). Invertebrate zoology: A functional evolutionary approach. Cole. Singapore.

9. Hickman, C., Roberts, L. S., Keen, S. L., Larson, A., & Eisenhour, D. (2018). Animal diversity. McGraw-Hill.
10. Holland, P. (2011). The animal kingdom: A very short introduction. Oxford University Press.
11. Hyman, L. H. (1992). The Invertebrates: Protozoa Through Ctenophora. India: International Books & Periodicals Supply Service.
12. Hyman, L. H. (1940). The Invertebrates: Platyhelminthes and Rhynchocolea -- The Acoelomate Bilateria. United Kingdom: McGraw-Hill.
13. Kapoor, V. C. Theory and practice of animal taxonomy. Oxford & IBH Publishing, Co.
14. Kardong, K. V. (2006). Vertebrates: Comparative anatomy, function, evolution (4th ed). McGraw-Hill.
15. Margulis, L., & Chapman, M. J. (2001). Kingdoms and domains: An illustrated guide to the phyla of life on earth (4th ed). W. H. Freeman and Company.
16. Mayr, E. (1997). This is Biology: The Science of Living world. Harvard University PressLtd.
17. Mayr, E., & Ashlock, P. D. (1991). Principles of systematic zoology (2nd ed). McGraw-Hill Int.
18. Parker, T. J., & Haswell, W. A. Text book of Zoology. Macmillan Company.
19. Romer, A. S., & Parsons, T. S. (1985). The vertebrate body (6th ed). Saunders.
20. Simpson, G. G. (1961). Principles of Animal Taxonomy. United Kingdom: Columbia University Press.
21. Hall, B., Hallgrimsson, B. (2011). Strickberger's Evolution. (n.p.): Jones & Bartlett Learning.
22. Winston, J. E. (2000). Describing species: Practical Taxonomic Procedures for Biologists. Columbia University Press.

Web Resources

1. https://www.zsi.gov.in/App/index.aspx
2. https://moef.gov.in/en/
3. http://nbaindia.org/
4. https://www.mapress.com/zt/
5. https://www.bnhs.org/
6. https://wwf.panda.org/
7. https://cites.org/eng
8. https://indiabiodiversity.org/

Prepared by : Dr. K. Thresia Mathews

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the concepts of taxonomy and biodiversity.	**K1, K2**
CO2	To compare the morphology, anatomy and behaviour of animals belonging to different levels in taxonomical hierarchy.	**K3**
CO3	To analyze and categorize organisms using advanced molecular taxonomical techniques.	**K4**
CO4	To explain structural and functional adaptations of animals belonging to different categories.	**K5**
CO5	To design research plans to monitor biodiversity and formulate keys for taxonomical identification of animals.	**K6**

Course Code	PZO1MC02
Course Title	Advanced Developmental Biology
Credits	05
Hours/Week	05
Category	Major core (MC) – Theory
Semester	I
Regulation	2022

Course Overview

1. Developmental biology is an expanding field that integrates molecular biology, genetics, cell biology, ecology and evolution.
2. This course concentrates on the development and growth of complex organisms. In which major events in early developmental stages are examined with basic genetics and molecular approach.
3. This course aims to provide a broad aspect of embryology with special emphasis on both classical experiments and modern molecular and genetic techniques. And that can be examined and compared with several model organisms.
4. This course explores the expression of genes and proteins in controlling the behaviour of cells in the processes of differentiation, cell interaction, morphogenesis and growth and also provides a better understanding of early embryonic defects.
5. The techniques in experimental embryology include stem cells, transgenic cells in-vitro fertilization and cryopreservation, etc., highlighting the relevance of human embryology to stem cell therapy, gene therapy, transgenic animals, and fertility studies.

Course Objectives

1. To understand the basic concepts of communication of cells in promoting the development of multicellular organisms.
2. To understand the interaction of biomolecules in cell differentiation and morphogenesis.
3. To understand how the expression of genes and proteins involved in normal development and its errors leads to congenital defects.
4. To understand the importance of techniques in experimental embryology for diagnosis and treatment.

Prerequisites	Basic knowledge in cell biology, genetics and embryology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Basic Concepts of Development** Principles and terms in developmental biology; Potency, specification; determination and differentiation; morphogen and morphogenetic gradients; induction, competence; Cell fate and cell lineages, mechanisms of developmental commitment; genomic equivalence and the cytoplasmic determinants; maintenance of differentiation pattern formation, compartments and segmentation; model organisms. cellular and microsurgical techniques.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5. K6
II	**Early Embryonic Development** Early animal development by single-cell specification; Gametogenesis; Gamete recognition, contact, polyspermy prevention and Fertilization in animals; Cleavage, blastula and Gastrulation and formation of germ layers. General principles of cell-cell communication in development; Genes in development; Role of maternal genes, patterning of early embryo by zygotic genes; Epigenetic regulation of development; Chromatin and DNA Methylation; Histone modification; dosage compensation; imprinting; Developmental genetic defects.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Morphogenesis and Organogenesis** Neural tube formation and cell migration; Axis and pattern formation in *Caenorhabditis elegans*, *Drosophila*, Amphibia and chick; Genetics of axis formation in *Drosophila;* homeobox genes in patterning; Vulva formation in *C. elegans*; Hox genes in vertebrates; epithelial - mesenchyme interaction. Pattern formation and morphogenesis in Vertebrate Limb development. Development of vertebrate eye; Differentiation of neurons;	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Prenatal diagnosis; stem cell biology and applications			
IV	**Post Embryonic Development** Growth, cell proliferation, growth hormones; aging: genes involved in alteration in the timing of senescence; Role of cell death in development; Metamorphosis in insects and amphibians; Regeneration in invertebrates and vertebrates; Medical advances in tissue regeneration; Differential RNA processing, inborn errors of translation; Environmental regulation of normal development; Teratogenesis.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6
V	**Human Embryonic Development and Experimental Embryology** Differentiation of sex and development of male and female reproductive systems; Regulation of hormones in ovulation and pregnancy; Disorders of Folliculogenesis and ovulation: Polycystic Ovary Syndrome; Abnormal spermatogenesis. Embryonic adaptation and the development; Foetal and maternal relationship; Common causes of male and female infertility – anatomical, hormonal, genetic. Assisted Reproductive Technology in humans; ethical implications of cloning and cryopreservation; Recent advances in developmental biology.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Balinsky, B. I., (2012). Introduction to Embryology (5th ed). CBS College Publishers, New York, 782pp.
2. Berrill, N.J., (1980). Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, 535pp.
3. Gilbert. S. F., (2017). Developmental Biology (11th ed.). INC Publishers, USA, 810pp.
4. Gerhart, J. & Marc Kirschner (1997). Cells, Embryos and Evolution. Whiley Blackwell Science. 656pp.
5. Hopper, A.F. & Hart, N.H. (2016). Foundations of Animal Development. Oxford University Press, Oxford.
6. Kalthoff, (2000). Analysis of Biological Development, (2nd ed.). McGraw-Hill Science, New Delhi, India. 816pp.
7. Lewis Wolpert, (2012). Principles of Development. Oxford University Press, oxford. 656pp.
8. Mari-Beffa, M., & Knight, J. (2005). Key Experiments in Practical Developmental Biology. Cambridge University Press, UK, 404pp.
9. Saunders, J.W. (1982). Developmental Biology-Patterns, Principles and Problems. Macmillan Publishing Co., New York. 640pp.
10. Slack, J.M.W. (2012). Essential Developmental Biology (3rd ed.).Wily-Blackwell Publications, USA, 496pp.
11. Subramoniam, T. (2011). Molecular Developmental Biology (2nd ed.). Narosa Publishers, India, 364pp.
12. Twyman, R. M. (2003). Developmental biology (1st ed). Viva Books publisher, New Delhi. 452pp.
13. Tyler, M.S. (2000). Developmental Biology - A Guide for Experimental Study, Sunderland, MA, 208pp.
14. Werner A. Muller, (2005). Developmental Biology. Springer – Verlag, New yok. 382pp.
15. Wilt, F.H. & Wessel, N.K. (1967). Methods in Developmental Biology, Thomas Y Crowell, New York.

Web Resources:

1. https://courses.lumenlearning.com/suny-wmopen-biology2/
2. https://thebiologynotes.com/introduction-to-embryology/
3. https://bit.ly/37Lfpkn
4. https://medlineplus.gov/assistedreproductivetechnology.htmll
5. https://www.sdbonline.org
6. https://www.easybiologyclass.com/

7. https://www.ccmb.res.in/
8. https://virtualhumanembryo.lsuhsc.edu/
9. https://www.3dembryoatlas.com/
10. https://www.museumfuernaturkunde.berlin/en/science/embryology-collection

Prepared by : Dr. V. Jelin

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the concepts, developmental stages, expression of genes and environmental influence in development.	**K1, K2**
CO2	To determine the mechanism of genes in development and apply experimental techniques to examine the normal and abnormal embryonic development.	**K3**
CO3	To differentiate and compare the developmental stages of animals and analyse them with appropriate biomolecular techniques.	**K4**
CO4	To assess the regulation and coordination of biomolecules for the normal developmental process.	**K5**
CO5	To collate, discuss and design a broad perspective study on suitable techniques to erase infertility and other developmental genetic disorders.	**K6**

Course Code	PZO1MC03
Course Title	Ethology and Evolutionary Biology
Credits	05
Hours/Week	05
Category	Major core (MC) - Theory
Semester	I
Regulation	2022

Course Overview

1. The course familiarizes the learners with the nature of animal behaviour and the key principles of evolution.
2. It facilitates a higher and deeper understanding of the underlying causes for behavioural patterns.
3. The course uncovers evolutionary approaches to the study of biological and genetic processes. The course is designed to stimulate learners to critically analyze and devise research questions on behavioural and evolutionary principles.

Course Objectives

1. To understand the main principles and concepts in behavioural and evolutionary biology.
2. To explore the behavioural patterns in animals and understand behavioural strategies in the light of evolutionary theories.
3. To understand the behavioural and evolutionary changes in organisms.
4. To inculcate scientific thinking and design experiments based on theories studied in the course.

Prerequisites	Basic knowledge in Biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Mechanisms underlying behaviour and habitat selection** Neural basis of learning, memory, cognition, sleep and arousal. Development of behaviour. Approaches and methods in study of behaviour. Proximate and ultimate causation. Adaptive mechanisms of human perception. Habitat selection and preferences, dispersal, migration, orientation and navigation, territoriality and territorial	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	contests. Optimal foraging behaviour and complex behaviour related to feeding.			
II	**Social and reproductive behaviour** Mating tactics and strategies, sperm competition, mate choice, sexual conflict, parental investment and reproductive success, parental care, parental favouritism, monogamy, polyandry, polygyny, interspecific brood parasitism, siblicide. Mutualism, altruism and evolution - group selection, kin selection, reciprocal altruism. Antipredator behaviour – camouflage, warning colouration, Batesian mimicry, diverting colouration, structures and behaviour, intimidation and fighting back behaviour, group defense mechanisms. Communication signals. Behavioural changes on domestication.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Evolution theories and timescales** Theories of evolution and origin of life – Lamarck and Darwin – concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, spontaneity of mutations, evolutionary synthesis, origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane, Urey-Miller experiment, the first cell. Anaerobic metabolism, photosynthesis and aerobic metabolism. Evolution of prokaryotes and eukaryotes. Evolutionary timescale, eras, epochs and periods. Major events in the evolution of plants, animals and humans.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Concepts of molecular evolution** Molecular divergence, molecular clock and neutral evolution. Origin of new genes and proteins. Genome evolution – genome expansion and restructuring during evolution, gene duplication and divergence. Migration and random genetic drift, adaptive radiation, speciation and natural selection, speciation and sexual selection, allopatricity, sympatricity, convergent evolution and co-evolution. Molecular phylogeny using protein and DNA sequence analysis. Use of ancient DNA for evolutionary investigation and phylogeography.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

V	**Population genetics and evolutionary approach to behaviour and medicine** Population genetics – populations, gene pool, gene frequency, Hardy-Weinberg law, concepts and rate of change in gene frequency through natural selection. Evolution of the brain and intelligence in animals. Evolution of diet and language in humans. Continuing evolution of humans in the modern world. Core principles of evolutionary medicine.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Alcock, J. (2009). *Animal behaviour: An evolutionary approach* (9th ed). Sinauer Associates, Inc.
2. Barnard, C. J. (2012). *Animal behaviour: Ecology and evolution*. Springer Science & Business Media.
3. Darwin, C. (2020). *On the origin of species: The science classic*. United Kingdom: Wiley.
4. Dobzhansky, T. (2013). *Genetics and the origin of species*. United States: Columbia University Press.
5. Ferrell, V. (2006). *The evolution handbook*. Evolution Facts, Incorporated.
6. Grunspan, D. Z., Nesse, R. M., Barnes, M. E., & Brownell, S. E., (2018). Core principles of evolutionary medicine: A Delphi study. *Evolution, Medicine, and Public Health, 1*(1), 13–23. https://doi.org/10.1093/emph/eox025
7. Hall, B. K., Hallgrímsson, B., & Strickberger, M. W. (2014). *Strickberger's evolution*. Jones and Bartlett Publishers Learning.
8. Hauser, M. D., Yang, C., Berwick, R. C., Tattersall, I., Ryan, M. J., Watumull, J., Chomsky, N., & Lewontin, R. C. (2014). The mystery of language evolution. *Frontiers in Psychology, 5*, 401. https://doi.org/10.3389/fpsyg.2014.00401
9. Levinson, G. (2019). *Rethinking evolution: The revolution that's hiding in plain sight*. World Scientific Publishing.
10. Losos, J. B. (2017). *The Princeton University guide to evolution*. Princeton University Press.
11. Lull, R. S. (1922). *Organic evolution*. Macmillan.
12. Mandal, F. B. (2015). *Textbook of animal behaviour*. Public Health Institute Learning Pvt, Ltd.
13. Manning, A., & Dawkins, M. S. (2012). *An introduction to animal behaviour*. Cambridge University Press.
14. Rastogi, V. B. (2018). *Organic evolution, Medtech*.

15. Rius, M., & Turon, X. (2020). Phylogeography and the description of geographic patterns in invasion genomics. *Frontiers in Ecology and Evolution*, *8*, 439. https://doi.org/10.3389/fevo.2020.595711
16. Valone, T. J., & Nordell, S. E. (2021). *Animal behavior: Concepts, methods, and applications*. Oxford University Press.

Web Resources

1. https://www.frontiersin.org/journals/ecology-and-evolution
2. https://www.onezoom.org/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5822696/
4. https://courses.lumenlearning.com/wm-biology1/
5. https://onlinelibrary.wiley.com
6. https://www.youtube.com/watch?v=ELr9QgiGB6U
7. https://www.youtube.com/watch?v=w7Kwei1vuAE

Prepared by : Dr. M. D. Anitha Sebastian

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To define and describe the main principles and concepts in behavioural and evolutionary biology.	**K1, K2**
CO2	To interpret behavioural patterns in animals and establish the evolutionary relationships between organisms.	**K3**
CO3	To explain and infer behavioural strategies in the light of evolutionary theories.	**K4**
CO4	To appraise and assess animal biodiversity from behavioural and evolutionary viewpoints.	**K5**
CO5	To formulate scientific questions and to design experiments based on theories studied in the course.	**K6**

Course Code	PZO1MC04
Course Title	Community and Population Ecology
Credits	05
Hours/Week	05
Category	Major Core (MC) - Theory
Semester	I
Regulation	2022

Course Overview

1. The course presents an understanding of the abiotic and biotic ecological mechanisms that determine the distribution and abundances of populations in nature.
2. The course introduces central theories within population ecology which include the importance of abiotic factors, competition, predation, herbivory, dispersal, diseases and harvesting strategies for fluctuations in population sizes.
3. Community ecology is the study of biotic interactions in plant and animal assemblages.
4. This course begins with a description of community types, competition and ecological niche, predator-prey interactions, food webs, habitat selection, and diversity. The material is supported by numerous examples from models and experimental studies.

Course Objectives

1. To understand the interaction of biotic and abiotic factors in an environment.
2. To explain and reflect about central ecological theories and ecological mechanisms which influence the distribution and abundance of individual in populations.
3. To apply different mathematical models that describe demographic properties in populations and estimate essential population parameters.

Prerequisites	Basics of Environmental Biology and Bio-resource Management.

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Structure of the community** Physical Structure: Growth forms and Life forms. Stratification: Horizontal Zonation and Vertical Stratification. Biological Structure: Dominance, Diversity, Periodicity, Stratification, Eco-tone and Edge-effect, Ecological Niche, Community Productivity, Biotic Stability, Key stone species. Species richness and species diversity, Diversity Indices: Shannon-Weiner Index, Simpson Index (Ds), Gini–Simpson index.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Density-dependent and Density-independent growth** Fundamentals of population growth, Types of models, Density-independent versus density-dependent growth: discrete generations, overlapping generations, Nonlinear density, birth and death rates, Allee effect. Tests of density dependence. Exponential growth in an invasive species, The finite rate of increase (λ) and the intrinsic rate of increase (r). Stochastic models of population growth and population viability analysis.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Population regulation and Metapopulation ecology** Populations with age structures, Survivorship, Fertility, Mortality curves, Expectation of life, Net reproductive rate, generation time, and the intrinsic rate of increase, Age structure and the stable age distribution. Reproductive value. Metapopulations and spatial ecology. MacArthur and Wilson and the equilibrium theory. Metapopulation dynamics, Non-equilibrium and patchy metapopulations, Assumptions and evidence for the existence of metapopulations in nature.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Life-history strategies** Power laws, The metabolic theory of ecology, Relative importance of life history - Cole and Lewontin. The theory of r- and K-selection, Cost of reproduction and allocation of energy, Clutch size, Latitudinal gradients in clutch size,	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Predation and its effects on life-history characteristics, Bet hedging.			
V	**Intra and Interspecific competition** The nature and characteristics of intraspecific competition, Density-dependence, Scramble and contest, Individual variability, Competition in the fruit fly, Negative competition. Interspecific competition: early experiments and the competitive-exclusion principle, The Lotka–Volterra competition equations, Laboratory experiments and competition, Resource-based competition theory. Modelling mutualism, Host–parasite interactions. Predator–prey interactions, Nicholson–Bailey models.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Begon, M., Thompson, D. J., Mortimer, M. (2009). Population Ecology: A Unified Study of Animals and Plants. Germany: Wiley.
2. Bossert, W. H. (1971). *A primer of population biology*. Harvard University.
3. Diamond, P. o. G. J. (1986). Community Ecology. United Kingdom: Harper & Row.
4. Hutto, R. L., & Young, J. S. (2002). *Regional land bird monitoring: Perspectives from the northern Rocky Mountains.* Wildlife Society bulletin (pp. 738–750).
5. Krebs, C. J. (1989). *Ecological methodology*. Harper & Row.
6. McGill, B. J., Mittelbach, G. G. (2019). Community Ecology. United Kingdom: OUP Oxford.
7. Mittelbach, G. G., & McGill, B. J. (2019). *Community ecology* (2nd ed). Oxford University Press.
8. Morgan, B., Brooks, S., Gimenez, O., King, R. (2009). Bayesian Analysis for Population Ecology. United States: CRC Press.
9. Rockwood, L. L. (2015). Introduction to Population Ecology. Germany: Wiley.
10. Royama, T. (2021). Animal Population Ecology: An Analytical Approach. United Kingdom: Cambridge University Press.
11. Southwood, T. R. E., & Henderson, P. A. (2000). *Ecological methods* (3rd ed). Methuen, and Co., Ltd.
12. Speight, M. R., Hunta, M. D., & Watt, A. D. (2006). *Ecology of insects: Concepts and application*. Elsevier Science Publishing. Wilson EO & William H.
13. Vandermeer, J. H., Goldberg, D. E. (2013). Population Ecology: First Principles - Second Edition. United States: Princeton University Press.

14. Wratten, S. D., & Fry, G. L. A. (1980). Field and laboratory exercises in ecology. Arnold, London. *Entomologist*, *505*.

Web Resources

1. https://www.zsi.gov.in/App/index.aspx
2. https://moef.gov.in/en/
3. http://nbaindia.org/
4. https://www.mapress.com/zt/
5. https://www.bnhs.org/
6. https://wwf.panda.org/
7. https://cites.org/eng
8. https://indiabiodiversity.org/
9. https://www.esa.org/
10. http://indianecologicalsociety.com/society/
11. https://www.fes.org.in/

Prepared by : Dr. M. C. John Milton

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand, recognize and examine the difference between ecological populations from ecological communities and articulate the underlying processes that maintain these communities.	**K1, K2**
CO2	To compare, modify, apply and demonstrate the knowledge of the biogeography of species diversity.	**K3**
CO3	To survey, categorize and prioritize the controlling factors and cascading effects associated with food chain and food web.	**K4**
CO4	To compare, evaluate and assess the relations ship between patchy environments and meta-populations and metacommunities.	**K5**
CO5	To construct and organize ecological and evolutionary responses of species to changing environments.	**K6**

Course Code	PZO1MC05
Course Title	Entomology and Vector Biology
Credits	05
Hours/Week	05
Category	Major Core (MC)- Theory
Semester	I
Regulation	2022

Course Overview

The course provides an insight into the classification of insect vectors, their anatomy, physiology and adaptations and illustrates their role in the spread of vector borne diseases.

Course Objectives

- To learn the systematic position of Class: Insecta, its sub classes and orders within.
- To learn the types vectors and vector borne diseases.
- To understand the approaches in the management of vectors and vector borne diseases.
- To understand the role of insects as biocontrol agents in the control of pests.
- To learn and understand legislations and mitigation measures practiced in the control vectors and insect pests.

Prerequisites	Basic knowledge in invertebrate classification

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Insect Classification, Anatomy and Physiology** Brief evolutionary history of Insects. Introduction to phylogeny of insects and classification of Class Insecta. Structure, modification and physiology of different systems : digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands. physiology of integument, moulting; growth, metamorphosis and diapause.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Insect Vectors and Vector Borne Diseases** Insect Vectors: Order : Diptera (Mosquitoes and flies), Order : Heteroptera (Bugs), Order : Anoplura (Lice), Order : Siphonaptera (Fleas), Order : Dictyoptera (Cockroaches), Class : Arachnida, Order : Acarina (Mites	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	and Ticks), Order : Araneida (Spiders), Order : Scorpionida (Scorpions). Vector Borne Diseases: *Aedes* : Chikungunya, Dengue, Lymphatic filariasis, Rift Valley fever, Yellow Fever and Zika. *Anopheles* :Lymphatic filariasis, Malaria. *Culex*: Japanese encephalitis, Lymphatic filariasis, West Nile fever . Blackflies: Onchocerciasis (river blindness). Fleas: Plague (transmitted from rats to humans). Tungiasis. Lice: Typhus, Louse-borne relapsing fever. Sandflies: Leishmaniasis, Sand fly fever (phlebotomus fever): Ticks Crimean-Congo haemorrhagic fever, Lyme disease, Relapsing fever (borreliosis), Rickettsial diseases (eg: spotted fever and Q fever), Tick-borne encephalitis, Tularaemia. Triatome bugs: Chagas disease (American trypanosomiasis). Tsetse flies: Sleeping sickness (African trypanosomiasis)			
III	**Approaches to Insect Pest and Vector Management** Insecticides. Types of insecticides, Formulation; Toxicity and safety. Application of insecticides: Problems associated with using insecticides. Environmental and cultural control (Irrigation, Fertilizer, Sanitation. Alternate hosts, Multiple and intercropping, Separation in time and space, Crop geometry). Host resistance: Basis for resistance, mechanisms of resistance.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Biocontrol agents** Predators, Parasitoids, Parasites. Pathogens: fungi, viruses, bacteria, microsporidia, nematodes, arthropods. Transmission of pathogens. Area-wise management. Techniques of biocontrol: constraints and reasons for failure of biocontrol. Use of pheromones/ allelochemicals in pest management; Mating disruption/confusion, Alarm pheromones and oviposition deterrents; repellents. Exclusion and barriers, Traps. Physical disturbance. Use of Larvivorous Fish and plants in vector control. Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	natural enemies, quarantine regulations, biotechnology in biological control.			
V	**Legislation and other alternatives** Exclusion and routes of entry. Risk assessment; Damage thresholds Forecasting; Increasing agroecosystem resistance Legislation for Pesticide use; Effects of regulation; Genetically modified organisms. New concepts and practices. Integrated vector management. The integrated control/ IPM; Constraints towards IPM adoption. Eradication versus management concept.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Blum, M.S. 1996. Fundamentals of Insect Physiology John Willey & Sons. New York.
2. Cameron, M. & Lorenz, L. (2013) Biological and Environmental Control of Disease Vectors. CABI, UK .
3. Chapman J. L & Reiss M. J. (2006). Ecology: Principles & Applications. 2nd Ed. Cambridge Univ. Press, Cambridge.
4. CSIRO (1990). The Insects of Australia: A Text Book for Students and Researchers. 2nd Ed. Vols. I & II, CSIRO. Cornell Univ. Press, Ithaca.
5. Daly, H.V. Doyen, J.T. an Ehrlich, P.R. (1988). Introduction to insect Biology and Diversity. McGraw Hill Ltd. London.
6. David B. V & Ananthkrishnan T. N. (2004). General and Applied Entomology. Tata-McGraw Hill, New Delhi.
7. Dent, D. (2000) Insect pest management (2nd edition) CAB International.
8. Dhaliwal & Arora (2001). Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.
9. Duntson P. A. (2004). The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
10. Evans J. W. (2004). Outlines of Agricultural Entomology. Asiatic Publ., New Delhi.
11. Gerson H & Smiley RL. (1990). Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman & Hall, New York.
12. Ignacimuthu & Jayaraj (2003). Biological Control of Insect Pests. Phoenix Publ., New Delhi.
13. Imms, A.D. (1992). A. General Text book of entomology. Chapman & Hall, London.
14. Mani, M.S. (1997). General Entomology Oxford & IBH Publishing Co., New Delhi
15. Mullen & Durden (2009). Medical and veterinary entomology, Academic press, London.

16. Nayar, K. R. Anantha krishnan, T.N. & David, B.V. (1998) General and Applied Entomoloty. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
17. Pedigo, L.P. (1996) Entomology and pest management, Prentice Hall, N. Delhi.
18. Snodgrass. R.E. (1989). Principles of Insect Morphology. Mc Graw Hill, New York.
19. Srivastva, K. P. (1998). A Text Book of Applied Entomology (Vol. I & II) Kalyani Publihshers, New Delhi.
20. Van Emden, H.F. & M.W. Service. (2004) Pest and Vector Control. Cambridge University Press.
21. Wigglesworth, V.B. (1992). Principles of Insect Physiology ELBS edition.

Web Resources

1. https://icar.org.in//
2. https://www.icmr.gov.in//
3. https://vcrc.icmr.org.in//
4. https://dbtindia.gov.in//
5. https://www.who.int//
6. https://nimr.org.in//
7. https://www.monash.edu/ivbd

Prepared by : Dr. M.C. John Milton

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To identify, describe and explain the systematics position of Class: Insecta and enumerate details on vectors of human importance, their control and management.	**K1, K2**
CO2	To illustrate and demonstrate the anatomical, physiological adaptation of vectors and interpret their role in human health and pest control.	**K3**
CO3	To analyse, compare and categorise the systematics of insects and appraise their role as vectors and biocontrol agents.	**K4**
CO4	To evaluate, compare and summarise the biology, reproduction, and adaptations of vectors and assess and recommend measures for control and management.	**K5**
CO5	To design, and formulate diagnostic methods, control and management measures to eradicate vector borne diseases.	**K6**

Course Code	PZO1MC06
Course Title	Diversity of Animals, Embryology and Ecology Lab Course
Credits	03
Hours/Week	06
Category	Major Core (MC) - Lab
Semester	I
Regulation	2022

Course Overview

1. Inculcate in the student a fascination for nature and learn the bionomics of vertebrates.
2. Learn the principles, applications and management of environmental science.
3. Describe the diversity in form, structure and habits of vertebrates and invertebrates.
4. Able to identify the invertebrates and classify them up to the class level with the basis of systematic.
5. Familiar with various stages involved in the developing embryo.
6. Understand the basis of life processes in the non-chordates and recognize the economically important invertebrate fauna.
7. Realise the fundamental characteristics of diversity of animals, embryology and ecological methods.

Course Objectives

1. To provide a hands-on training experience in anatomy through dissections.
2. To obtain an overview of economically important invertebrate fauna.
3. To learn the basics of systematic and understand the hierarchy of different categories.
4. To familiarize students with organ system in common, easily available animals.
5. To apply scientific methods in day-to-day life.
6. To emphasize the 'seeing is believing' typical examples and economically important specimen preserved to be studied.
7. To develop positive attitude towards sustainable development.

Pre-requisites	Knowledge in Biology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Major Dissection** Nervous System: Cockroach, Prawn, Apple Snail, Sepia, Crab, Shark: Arterial system: Frog. Cranial Nerves: Frog/ Shark. **Minor Dissection** Cockroach: Salivary Glands, Digestive System, Reproductive System. Prawn – Appendages. Red Snapper –Digestive System. **Mounting:** Mouth parts: Cockroach, Honey bee, Sting apparatus of honeybee. Body setae of earthworm, Fish scales: Cycloid, Ctenoid. Radula of *Pila*.	30	CO1 CO2 CO3 CO4 CO5	K1,K2, K3, K4, K5, K6
II	**Embryology** **Mounting of chick embryo** - whole mount 24hrs, 32hrs, 72hrs, 96hrs of incubation period embryo. **Metamorphosis:** Moth/Butterfly.	20	CO1 CO2 CO3 CO4 CO5	K1,K2, K3, K4, K5, K6
III	**Study of pond/ wetland/ river ecosystem. Ecological analysis** Determination of, acidity, total hardness, calcium hardness, residual chlorine, turbidity from the given samples. Identification of soil arthropod. Study of marine and fresh water planktons, study of rocky and sandy shore fauna.	10	CO1 CO2 CO3 CO4 CO5	K1,K2, K3, K4, K5, K6
IV	**Study of the following specimens with special reference to their salient features and their modes of life (Spotters)** **Invertebrates:** Gorgonia, Brain Coral, Murex, Nautilus, Chiton, Sea star, Holothuria, Balanus, Neries, Physalia, Peripatus, Scorpion, Limulus, Mytilus, Arenicola. **Chordates:** Amphioxus, Asidian, Balanglosus, Sea horse, Chameleon, Exocetus, Syngnathus, Flatfish, Naja naja, Russle viper, Krait, Poisonous apparatus of snake, Rachophorus, Wood pecker.	15	CO1 CO2 CO3 CO4 CO5	K1,K2, K3, K4, K5, K6

	Embryology: Observation of chick embryo at various stages of development. Developmental stages of frog, Goat embryo, Human embryo, Shark yolk sack placenta. **Osteology**: Turtle - Carapace and plastron. Synsacrum of bird, Typical; vertebra, thoracic and lumbar vertebrae of dog/bird, Skull of bird, Skeletal system of frog. **Animal Association:** Sacculina on Crab, Cymothoa in Fish Gills, Ascaris, Taenia Solium, Hermit crab on sea anemone, Sucker fish. **Taxonomy** **Identification, classification up to the order and brief note of the following specimens**. **Prochordates** –Amphioxus (entire). **Pisces** - 2 cartilaginous fishes, 2 fishes with accessory respiratory organs, 2 edible fishes,2 culture fishes and 2 Cat fishes. **Amphibia** - Any 3 (representing the three orders). **Reptilia** - Poisonous and non -poisonous snakes, Draco, Chamaelon. **Aves** - Different feathers, Pigeon. **Mammals** – Bat			
V	**Field and Institutional Visit** Industrial / institutional visit, shore fauna for collecting specimen, identification of new species and preparing catalogue. **Assignment** Submit a detailed survey and inventory report on select invertebrate or vertebrate specimen with taxonomic key.	15	CO1 CO2 CO3 CO4 CO5	K1,K2, K3, K4, K5, K6

Suggested Readings

1. Beck, W. S., Karel, F., Liem, & Simpson, G. G.(2000). Life: An introduction to biology. HarperCollins Publishers.
2. Bhaskaran, K.K. & Biju Kumar, A.(2003). Chordate Zoology. Manjusha Publications.
3. Colinvaux, P. A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.
4. Hegner, P.R. W. (2015). Practical Zoology, BiblioLife, 522pp.
5. Kendegh, F.C. (1984). Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
6. Krebs, C. J. (2001). Ecology (6th edition) Benjamin Cummings. 57
7. Lal, S.S. (2005). A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut.
8. Odum, E.P.,(2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole.

9. Ricklefs, R.E. (2000). Ecology (5th edition) Chiron Press.
10. Southwood, T.R.E. & Henderson, P.A. (2000).Ecological Methods (3rd edition) Blackwell Sci.
11. Stiling, P. D. (2012). Ecology Companion Site: Global Insights and Investigations. McGraw Hill Education.
12. Young, J. Z. (2006). The life of Vertebrates. Oxford University Press.

Web Resources

1. https://animaldiversity.org/
2. https://vlab.amrita.edu/index.php?sub=3&brch=272
3. http://rms.rsccd.edu/faculty/kimomorris/bio212/oer/oerbio_ch28.pdf
4. https://bit.ly/3FNRrln
5. https://libguides.humboldt.edu

Prepared by : Dr. V. Pushpa Rani

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To identify and classify invertebrates and vertebrates and to understand the types of association between animals.	**K1, K2**
CO2	To perform directed dissections of animals representing different phyla.	**K3**
CO3	To analyze the different ecological parameters to compare physical conditions of different ecosystems.	**K4**
CO4	To compile the changes in different developmental stages of vertebrates.	**K5**
CO5	To prepare catalogue of collected and identified species and to compile detailed survey data of field study.	**K6**

Course Code	PZO2MC01
Course Title	Biophysics, Biochemistry and Bioenergetics
Credits	03
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	II
Regulation	2022

Course Overview

1. Course module is designed to develop a clear understanding of the biophysics, biochemistry and bioenergetics with an emphasis on structure and physico - chemical properties of biomolecules.
2. This course gives a broad overview of the foundations, modern concepts and recent trends in the metabolism of carbohydrates, proteins, Lipids and nucleic acids.
3. To understand everything that is there to know and understand about biomolecules, their classification and their metabolism.
4. This course gives a broad overview of the foundations, modern concepts and recent trends in Bioenergetic processes, such as cellular respiration or photosynthesis, are essential to most aspects of cellular metabolism, therefore to life itself.
5. After successful completion of the course the candidate should be able to design and comprehend different variety of biomolecules and their dynamics for modern research.

Course Objectives

1. The course entails giving in-depth theoretical knowledge about the field of biochemistry, biophysics and bioenergetics.
2. Make the Students capable to design research and industrial projects to solve the problems of biological complexity and resolve various health & environmental issues.
3. To get knowledge and understanding of the fundamental of biophysical aspects of biology and application of instruments in biological laboratory.
4. To develop the Human Resource with the interdisciplinary approach in the field of Science & Technology.
5. To highlights the various applications of physical sciences to biology and bridges physical sciences (physics, chemistry, mathematics) and biological sciences (Botany, Zoology, Microbiology etc)

Prerequisites	Basic knowledge on Biology, Chemistry and Physics

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Energies, Forces and Bonds** Elementary composition of living matter, Structure of an atom, Ionization energy, electron affinity and chemical binding. Interatomic potentials for strong bonds and weak bonds, Non – central forces and bond energies. Rates of reaction: Free energy, Internal energy, Radiation energy, thermodynamics, reaction kinetics, water - acids - bases and aqueous reactions. Transport processes: Membrane physics and structure, Diffusion, viscosity and thermal conduction.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Biochemistry of Carbohydrate** Overview of carbohydrate metabolism and metabolic reactions, Aerobic and Anaerobic production of ATP, TCA cycle, regulation of glycogen metabolism: Glycogenesis and glycogenolysis - glycogen storage diseases. Glycolysis, regulation and utilization of sugars other than glucose. Signaling pathways - Hormonal regulation of carbohydrate metabolism.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Metabolism of protein and amino acids** Amino acid metabolism: Biosynthesis of amino acids and its regulation, Role of essential and non-essential amino acids in growth and development, Formation and disposal of ammonia, Urea cycle and its regulation. Disorders of amino acids metabolism, Introduction to Protein structures and Protein folding; Conjugated proteins, Metalloproteins, Structure-function and classification of proteins.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Lipid and Nucleic acid Metabolism** Absorption, transport and storage of lipids and TAGs, Lipid metabolism and regulation, Biosynthesis and degradation of TAGs and phospholipids, cholesterol, lipoprotein, fatty acid oxidation and ketoacidosis. Structure, composition and properties of nucleic acids,	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	purine and pyrimidine nucleotides and its regulation. De-Novo and salvage pathways of nucleotides synthesis.			
V	**Bioenergetics** High energy compounds. ATP as Universal currency of free energy, oxidation-reduction reactions. Organization of electron carriers and Classes of electron-transferring enzymes, inhibiters of electron transport. Mitochondrial electron transporters and shuttle systems, microsomal electron transport chain. Mechanism of oxidative phosphorylation, Role of electron transport energy, Functions of ATP, substrate level phosphorylation, uncouplers and inhibitors of oxidative phosphorylation.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Ambika Shanmugam & Ramadevi. K., (2016). *Fundamentals of Biochemistry for Medical Students.* (8th ed). Lippincott Williams & Wilkins.
2. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2012). *Biochemistry*. (7th ed).W. H. *Freeman.*
3. Conn, E. E., Stumpf, P. K., Bruening, G., & Doi, R. H. (2007). *Principles of biochemistry* (5th ed). Wiley & Sons, Inc.
4. David L. Nelson & Michael M. Cox (2017). Lehninger *principles of biochemistry* (7th.ed). W. H. Freeman and Company· New York.
5. Elliott, W. H., & Elliot, C. (2003). *Biochemistry and molecular biology*. Oxford University Press.
6. Garret, R. H., & Grisham, C. M. (1995). *Biochemistry*. (5 thedn).CBS publishers & distributors,Delhi
7. Hames, D.,& Hooper, N.,(2005). Instant notes in Biochemistry (3rd.ed). Taylor & Francis, London.
8. Horton, H. R., Morson, L. A., Scrimgeour, K. G., Perry, M. D., & Rawn, J. D. (2006). *Principles of biochemistry.* Pearson *educations, international, NewDelhi*.
9. Murray, R. K., & Granner, D. K., Mayes & P.A., Rodwell, V.W. (2012). Harper's. *Biochemistry* (29th ed). Lange Medical Books/McGraw-Hill. ISBN: 978-0-07-176-576-3.
10. Nicholls, D. G., & Ferguson, S. J. (1992). *Bioenergetics*. Academic Press.
11. Tymoczko, J. L., & Stryer, L. (2011). *Biochemistry* (7th.ed). W. H. Freeman and Company· New York.
12. Voet, D., & Voet, J. G. (2011). *Biochemistry (4th ed)*. John Wiley & Sons.
13. Zubay, G. (2017). *Biochemistry* (4th ed) . McGraw-Hill.

Web Resources

1. https://courses.lumenlearning.com/wm-biology1/
2. https://blanco.biomol.uci.edu/WWWResources.html
3. https://bit.ly/3Lkr9s6
4. https://bit.ly/3wqMdI5
5. https://bit.ly/3Lf2W6E
6. https://www.easybiologyclass.com/

Prepared by : Dr. K. Thresia Mathews

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the basics of biochemistry, biophysics and bioenergetics.	**K1, K2**
CO2	To correlate the biophysical aspects of biology and the important metabolic pathways.	**K3**
CO3	To analyze and compare the role of different biomolecules in cellular processes.	**K4**
CO4	To summarize the various stages to produce different energy rich molecules in cells.	**K5**
CO5	To collate work plans and design projects to understand biological complexity.	**K6**

Course Code	PZO2MC02
Course Title	Research Methodology and Biostatistics
Credits	03
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	II
Regulation	2022

Course Overview

To provide knowledge on research methods, techniques and the process, and to develop skills in the application of research methods and biostatistics for biological data analysis. Solve the statistical problems based on Central Tendency, Dispersion, Correlation and regression and ANOVA. Solve numerical problems on test of hypothesis using biological data and interpreted in the dissertation/ research article.

Course Objectives

1. To understand and define the basic knowledge about the research problem demonstrate knowledge of research processes (reading, evaluating, and developing);
2. To compute, construct and prepare the key elements of a good research proposal/report.
3. To develop and formulate a possible novel research interest area using specific research designs with statistical tools.
4. To organize and conduct research (advanced project) in a more appropriate manner.
5. To describe, compare, and contrast descriptive and inferential statistics, and provide examples of their use in novelty research.

Prerequisites	Basic knowledge about Mathematics and Computer

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Introduction to research** Definition, need for research, stages of research, research methods and methodology, Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, characteristics of good research.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	**Research process and Research Design** Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, Title Formulation, literature review-primary and secondary sources, reviews, monograph, patents, research database, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis and Research Design. Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of Good Sample Design.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Data Collection and Data Management** Meaning and importance of Data, Sources of data, Type of data – Primary and Secondary / Qualitative and Quantitative data, Variables and Attributes, Data Editing / Reduction / Summerization, Construction of Questionnaire. Collection data, Methods of Data Preparation – Univariate and Bivariate analysis (Frequency table & cross tabulation), Classification & tabulation of data.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Data Analysis and Outcome Assessment** Measures of Dispersion: range, Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of Variation Probability – Frequency distribution, Poisson and Binomial distribution, Cumulative frequency, Graphical representation of data: Histogram, Pie-Diagram, Pictogram, Ogive Curve. Hypothesis testing for significance, types of hypothesis, Chi square and goodness of fit, Type I & Type II errors. Confidence Interval, Level of Significance. Linear Regression and Correlation- Types of Correlation, Karl Pearson's coefficient of correlation and its properties, Spearman's rank correlation. ANOVA: One way and two way classified data – 'F'-test. Biodiversity index: Simson and Shannon index. Interpretation of statistical test results.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

V	**Statistical software and Report writing** Introduction about Excel, SPSS, SAS, R language and Python. Report writing -target audience -types of reports -contents of reports - styles and conventions in reporting -steps in drafting a report. Paper writing/ thesis writing, Different parts of the Research paper/Thesis Presentation oral/poster presentation. Principles of scientific writing and components of Dissertation, Plagiarism.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Gupta, M., & Gupta, D. (2011). *Research methodology*. Public Health Institute Learning Private Ltd.
3. Gurumani, N. (2011), *Research methodology for Biological Sciences*—MJP Publishers.
4. Kothari, C. R. (1990). Research methodology: Methods and techniques. New. *Ageing International*, 418p.
5. Pagano M & Gauvreau, K. (2000). *Principles of biostatistics*, Duxbury Press.
6. Kothari, C. R. (2009), Research methodology. *New Age International*.
7. Ruzin, S. E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.
8. Stapleton, P., Yondeowei, A., Mukanyange, J & Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
9. Triola, M. M., Triola, M. F., & Roy, J. (2018). *Biostatistics for the biological and health sciences* (2nd ed). Pearson.
10. Woolson. (1987), Statistical Methods for the Analysis of Biomedical Data. John Wiley & Sons, Inc, New York.

Web Resources

1. https://bit.ly/3Liq1Fg
2. https://bit.ly/3l8Zb8a
3. https://research-methodology.net/
4. https://datatab.net/statistics-calculator/hypothesis-test
5. https://www.statskingdom.com/
6. https://library.famu.edu/c.php?g=276373&p=1841937

Prepared by : Dr. M. Raja

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the basics of research methodology and biostatistics.	**K1, K2**
CO2	To explore different statistical tools and to incorporate them in interpreting experimental results.	**K3**
CO3	To analyze new research articles and to compare experimental designs and statistical tools used in different fields of study.	**K4**
CO4	To summarize, criticize and justify experimental results for compilation of research data.	**K5**
CO5	To formulate hypothesis and compute, construct and prepare the key elements of a good research proposal.	**K6**

Course Code	PZO2MC03
Course Title	Inheritance Biology
Credits	05
Hours/Week	05
Category	Major Core (MC) - Theory
Semester	II
Regulation	2022

Course Overview

1. This course describe the nature and structure of genetic material and the role of genes in determining the characteristics of organisms and also the relationship between the various mechanisms of genetic inheritance.
2. Topics will include the Principles of inheritance biology with an emphasis on cellular metabolism, molecular genetics, population allele and genotype frequencies and chromosome spreads.
3. Course module is designed to develop a clear understanding of the underlying concepts of chromosome structure, genome organization, advanced aspects of chromosome biology and genetics of cell cycle regulation.
4. Course emphasis on a knowledge of Mendel's Laws of inheritance, genetic crosses, types of modes of inheritance, genetic linkage, genetic mapping, gene expression and regulation.

Course Objectives

1. To understand the structure and function of the DNA molecule to its functional role in encoding genetic material.
2. To distinguish between dominant, recessive, autosomal, X-linked and cytoplasmic modes of inheritance.
3. To analyze gene expression and relationships between species based on the principles of inheritance as formulated by Mendel.
4. To describe normal chromosome number, structure, and behaviour in human cells and understand extra nuclear inheritance, linkage & crossing over.
5. To apply the Hardy-Weinberg Law in analyzing population genetics for gene frequency, sex linkage, equilibrium, and heterozygote frequency.

Prerequisites	Basic knowledge on Molecular Biology, Cell Biology and Biochemistry

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Concept of gene** Gene concept and organization, Heterochromatin and Euchromatin; DNA as genetic material, DNA structure and replication. RNA as genetic material, types of RNA. Allelic and non-allelic interactions, pseudo allele, lethal alleles, multiple alleles, test of allelism, complementation tests. Fine structure of gene; Prokaryotic and eukaryotic gene regulation.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Mendelian and non Mendelian inheritance** Dominance, segregation, independent assortment. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy. Sex Chromosomes and sex determination in animals; Dosage Compensation of X-Linked Genes; sex limited and sex influenced characters. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Linkage, crossing over and genetic maps of chromosomes** Linkage groups and chromosomes; Stern's hypothesis, Creighton and McClintock's experiments, single cross over, multiple cross over, two-point cross, three-point cross, map distances, gene order, interference and co-efficient of coincidence. Haploid mapping (Neurospora), Mapping in bacteria and bacteriophages**.** recombination, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids.	16	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Microbial genetics** Fundamentals of Bacterial and Viral Genetics; Methods of genetic transfers – transformation, conjugation, mapping genes by interrupted mating, transduction and sexduction, Genetics of Temperate and Intemperate Bacteriophages,	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	T4 Bacteriophage; Retrovirus and transposable elements in prokaryotes and eukaryotes.			
V	**Human Genetics** Human chromosomes and karyotyping; Techniques in human chromosome analysis; Pedigree analysis, Numerical and structural abnormalities of chromosomes and genetic disorders. Mendelian based heritable diseases in man; Quantitative genetics: Polygenic inheritance, heritability and its measurements. Effect of environmental factors and artificial selection on polygenic inheritance. Statistics of Quantitative Genetics; Analysis of quantitative traits in human: IQ, QTL. Mutation, mutagenic agents and humans; Future of human genetics.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K & Walter P. (2014). Molecular Biology of the Cell. 7th Ed. *Garl& Science.*
2. Carroll S.B., Doebley J., Griffiths, A.J.F. & Wessler, S.R. (2018). An Introduction to Genetic Analysis. W. H. Freeman & Co. Ltd.
3. De Robertis, E.D.P. & De Robertis, E.M.F., (2006). Cell & Molecular Biology. (8th Edition). New York : Lippincott William & Wilkins.
4. Gardner, E.J., Simmons, M.J & Snustad, D.P. (2008). Principles of Genetics. (8th edition) Wiley & Sons. Inc.
5. Hartl D L & Ruvolo M. (2011). Genetics – Analysis of Genes & Genomes. (8th Student Edition). *Jones & Bartlett*.
6. Harvey F Lodish, Arnold Berk, Chris Kaiser, Monty Krieger, Matthew P Scott, Anthony Bretscher, Hidde L Ploegh, Paul T Matsudaira. (2007). Molecular Cell BiologyW.H. Freeman & Company.
7. Klug, W.S., Cummings, M.R. & Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
8. Primrose, S. B. & Twyman, R. M., (2006). Principles of Gene Manipulation & Genomics. (7th Edition). Blackwell Publishing, West Sussex.
9. Snustad, Russell, P.J. (2010). Genetics. Benjamin Cummings.
10. Walker & Ginglod (1992). Molecular Biology & Biotechnology, Royal Society of Chemistry Cambridge.
11. Watson JD, Baker TA, Bell SP, Gann A, Levine M & Losick R. (2014). Molecular Biology of the Gene. (7th Ed). *Pearson*.

12. Wessler SR, Lewontin RC, Gelbart WM, Suzuki DT & Miller JH (2004). Introduction to Genetic analysis. (8th Edition). *W.H Freeman & Company*.

Web Resources

1. https://www.ciando.com
2. https://www.nigms.nih.gov
3. https://www.genome.gov
4. https://www.researchgate.net
5. https://pages.jh.edu
6. https://le.ac.uk
7. https://learn.genetics.utah.edu

Prepared by : Dr D. Robert Selvam

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To define and recall the basic concepts of Classical Genetics.	**K1, K2**
CO2	To demonstrate the principles of inheritance and examine the interactions of gene related to Mendel's laws of segregation and independent assortment.	**K3**
CO3	To outline gene linkage and to differentiate mapping with molecular markers.	**K4**
CO4	To select and test the methods of genetic transfers and gene interaction, justify the process of restriction mapping and value Pedigree analysis.	**K5**
CO5	To develop experimental models for quantitative and qualitative genetics.	**K6**

Course Code	PZO2MC04
Course Title	Cellular Organization and Molecular Processes
Credits	04
Hours/Week	04
Category	MC
Semester	II
Regulation	2022

Course Overview

This course will provide knowledge about the complex organization in the eukaryotic cell and prokaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types.

Course Objectives

1. To understand the basic structure and functions of cellular components.
2. To describe the molecular processes of DNA replication, transcription, and translation, and Explain how they are managed in cells.
3. To illustrate the protein and nucleic acid structure and function, and the relationship between them.
4. To compare the principles of gene expression and its regulation in prokaryotes and eukaryotes.
5. To formulate principles and application of gene cloning in industry and medicine for cancer cells.

Prerequisites	Basic knowledge about cell biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Cellular organization** Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles,	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	chloroplast, structure & function of cytoskeleton and its role in motility.			
II	**Organization of genes, chromosomes and cell cycle** Organization of genes and chromosomes: Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**DNA and RNA processing** DNA replication in prokaryotes and eukaryotes, enzymes involved, replication origin and replication fork, types of replication, extrachromosomal replicons, DNA damage and repair mechanisms, RNA synthesis and processing: transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, Different types of RNA, RNA transport. Mobile DNA elements: Transposable elements in bacteria, IS elements, composite transposons, replicative, non-replicative transposons, Mu transposition, SINES and LINES. Retroviruses and retrotransposon.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Protein synthesis and molecular processing** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins. Lac operon. Regulation of gene expression at transcription and translation level: regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

V	**Cell signalling, communication** Host parasite interaction, Cell signalling, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, Cellular communication, principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular biology of the cell* (7th ed). Garland Science.
2. Becker, W. M., Kleinsmith, L. J., Hardin, J., & Bertoni, G. P. (2009). *The world of the cell* (7th ed). Benjamin-Cummings Publishing. San Francisco.
3. Cooper, G. M., & Hausman, R. E. (2009). *The cell: A molecular approach* (5th ed). ASM Press and Sinauer Associates. MA.
4. De Robertis, E. D. P., & De Robertis, E. M. F. (2006). *Cell and molecular biology* (8th ed). Lippincott Williams & Wilkins.
5. Green, M. R & Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.
6. Hancock, J. T. (2006). *Cell signaling* (2nd ed). Oxford University Press.
7. Karp, G. (2010). *Cell and molecular biology: Concepts and experiments* (6th ed). John Wiley & Sons, Inc.
8. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., & Bretscher, A. (2016). *Molecular and Cellular Biology*. W H Freeman
9. Malacinski, G. M. (2010). *Essential of molecular biology* (4th ed). Narosa Publication.
10. Paul, A. (2011). *Text books of cell and molecular biology* (3rd ed), Books & allied (P) Ltd. Kolkata, India.
11. Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
12. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular biology of the gene* (7th ed). Pearson.

Web Resources

1. https://plato.stanford.edu/entries/molecular-biology/
2. https://www.sciencedaily.com/terms/molecular_biology.htm
3. https://en.wikipedia.org/wiki/Cell_(biology)
4. https://www.genetics.org/
5. https://www.cancer.gov/research/areas/biology
6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html
7. http://isca.co.in/BIO_SCI/lab_manual/IeP-BS-LM-2013-001.pdf

Prepared by : Dr. M. Raja

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the basic structure and functions of cellular components.	**K1, K2**
CO2	To compare the principle and regulation of gene expression in prokaryotes and eukaryotes.	**K3**
CO3	To analyze the relationship between the morphology and functions of proteins and nucleic acids.	**K4**
CO4	Evaluate the role of biomolecules in the functioning of cells.	**K5**
CO5	To summarize the molecular processes of gene expression, cell signalling, cell communication and their abnormalities.	**K6**

Course Code	PZO2MC05
Course Title	Biophysics, Biochemistry and Cytogenetics Lab Course
Credits	03
Hours/Week	06
Category	Major Core (MC) - Lab
Semester	II
Regulation	2022

Course Overview

1. The aim of the course is to give hands-on experience on tools and techniques used in molecular biology, genetics and biochemistry.
2. In this course, we will perform different methods of isolation and purification of cell organelles, nucleic acids, biomolecules etc.
3. We will demonstrate various experiments to understand various biological processes and structures.
4. In this course, we will perform experiments to study enzyme kinetics.

Course Objectives

1. To understand the properties and characteristics of biological compounds.
2. To know how to use different techniques to quantify and characterize biomolecules.
3. To apply the knowledge of genetics to predict the inheritance pattern.
4. To isolate chromosomes and study various stages of meiosis.

Prerequisites	Basic knowledge of physics, chemistry and Biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Biophysics** Separation Techniques: Permeability test using erythrocytes, Analysis of erythrocyte membrane lipids using Thin Layer Chromatography. Differential centrifugation of cell organelles and identification of mitochondrial fractions: Isolation and partialpurification of DNA/ RNA/Plasmid.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Biochemistry (Quantification of biomolecules)** Spectrophotometry - Beer's and Lambert's laws. Buffer preparation and determination of pH. Isolation and Estimation of Glycogen from liver	18	CO1 CO2 CO3 CO4	K1, K2, K3, K4, K5, K6

	Quantitative estimation of glucose, protein, cholestoerol and triglycerides. Urea and creatinine in the serum of goat.		CO5	
III	**Biochemistry (Enzyme analysis)** Isolation, Purification and enzyme kinetic studies of Amylase, Acid phosphatase and Alkaline phosphatase of rat kidney or liver. Urease from plant seeds. Separation of amino acids and sugars by paper Chromatography. Separation of lipids by TLC. Separation of plant pigments by column chromatography.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Cytogenetics** Chromosome Preparation: Metaphase chromosome preparation from mouse bone marrow cells/ fish gill cells – Karyotyping – Squash preparation of cockroach/ grasshopper testis/ mouse and observation of meiotic stages using plant/animal serum. Allele frequency and gene mapping. Study of Mendelian traits in man. Demonstrate Mendelian laws of segregation and independent assortment using chi square and ANOVA.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Morphology and sex identification, mutants in *Drosophila*. Mounting of salivary glands of *Drosophila/Chironomous* larva for observing giant chromosomes with banding and balbiani rings. Demonstration of bacterial conjugation and mutation using mutagens.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Ambika Shanmugam. (1974). Fundamentals of Biochemistry for Medical Studies. Second Edition, Aries Agencies, Chennai.
2. Durairaj, G. (1998). A Laboratory Manual in Genetics. Emerald, Chennai.
3. Gasque, E. (1992). A Manual of Laboratoryexperiments in Cell Biology. University of Wisconsin, Brown.
4. Geddes, L.A. (1972). Electrodesand the measurement of bioelectric events, John Wiley & Sons Ltd. New York.
5. Hall, D & S. Kawkins (1975). A Laboratory Manual of Molecular Cell Biology, English University,London.
6. Jay L. Nadeau (2011). Introduction to experimental biophysics. Biological methods for physical scientists, 2nd Ed. CRC Press, USA.

7. Lehninger, A. L.(2006). Biochemistry, Freeman, New York.
8. Rajan, S. & Selvi Christy, R., (2001). Experimental procedure in Life sciences, 1st edition, Anjanaa book house, Chennai.
9. West Edward Staunton, Todd Wilbert R. Mason Howard, S. & Bruggen John T. Van. (1974). Textbook of biochemistry Amerind Publishing Co. Pvt. Ltd, New Delhi.

Web Resources

1. https://www.vlab.co.in/
2. https://bit.ly/3rUz0pQ
3. https://bit.ly/3GWuVFX
4. http://www.pathology.washington.edu/research/cytopages/

Prepared by : Dr. Renilda Sophy A. J

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the separation techniques of biomolecules.	**K1, K2**
CO2	To correlate the quantity and functions of different biomolecules.	**K3**
CO3	To analyze the characteristics of cellular organelles and cellular compounds.	**K4**
CO4	To explain the principle of tools and techniques used to study cell and cellular organelles	**K5**
CO5	To demonstrate the functions of biomolecules and display cellular organelles.	**K6**

Course Code	PZO3MC01
Course Title	Comparative Animal Physiology
Credits	04
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	III
Regulation	2022

Course Overview

To understand how invertebrate and vertebrate animals work and how these animals' biology is influenced by the different environments of their niches. The students will be able to explore an original query in animal physiology and evolutionary changes and environmental adaptations in different taxa of invertebrates and vertebrates.

Course Objectives

1. Comparative Animal Physiology' helps understand how animals work at all levels, ranging from individual cells to the whole integrated organism.
2. The scope of physiology includes elucidation of the structure and function of all cells in all organs.
3. To classify and organize the all animals related to nervous, respiratory, circulatory and other physiological systems.
4. This course analyze and differentiate the modifications/adaptations found in different physiological systems of various organisms across the animal kingdom.
5. To integrate and prescribe the animal physiology and environment adaptation for lower and higher animals.

Prerequisites	Basic knowledge about invertebrate and vertebrate animals.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Nutrition and Excretion** Nutrition - nutrients - digestion in different organisms. adsorption of proteins, carbohydrates and lipids. Role of digestive gland and gastrointestinal hormones in digestion. Effect of starvation. Excretion - Excretion in different organisms, excretory product in relation to the environment - physiology of excretion in Man, Kidney, structure of Nephron, Urine formation and	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	concentration in Henle's loop, regulation of water balance.			
II	**Internal Transport and Gas Exchange** Comparative anatomy of heart, myogenic and neurogenic heart, cardiac cycle, heart as a pump, neural and chemical regulation. Systems of circulation, Peripheral circulation, Regulation of heart beat and blood pressure, Transport and exchange of gases, Composition of blood, plasma function, blood volume and regulation, blood groups, haemoglobin, haemostasis. Comparison of respiration in different species, Neural and chemical regulation of respiration, Gas transfer in air and water, Gas exchangers, respiratory pigments, Circulatory and respiratory responses to extreme conditions, Acid –base balance.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Thermoregulation and Adaptations to Stress** Basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones. Osmoregulation- Osmoregulation in aquatic and terrestrial environments, Extra-renal osmoregulatory organs. Thermoregulation- thermoregulatory centre of the brain, Heat balance in animals, Adaptations to temperature extremes, torpor, Aestivation and hibernation, Counter current heat exchangers.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Sensing the Environment & Coordination** Neuroanatomy and integrated function of the nervous system; Photoreception, Chemoreception, Mechanoreception; Echolocation, Endogenous and exogenous biological rhythms; Chromatophores- Types and Functional Modifications vis-a-via different animals (Invertebrates & Vertebrates) & control; Bioluminescence- Phenomenon dynamics (Luciferin-Luciferase reaction); Occurrence in different groups of animal kingdom, Types (Blue & Red), functional significance and its application in mankind.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

V	**Muscle physiology** Types of muscle, structure, properties, muscle contraction function & control, Muscle proteins, Muscle adaptations in invertebrates and vertebrates; Insect muscle, Flight muscle. Electric organs (myogenic lineage) - Electroplaxes, Electric discharge, Electroception, functional significance in animals.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Anderson, M., Hill, R. W & Wyse, G. A. (2017). Animal Physiology. United Kingdom: Oxford University Press.
2. Barnes, R. D. (1968) Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & Spicer, J.I. (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
4. Barrington, E J W. (1967) Invertebrate structure and function, Nelson, London. 39
5. Boradale, L.A. & Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Goldstein, L. (1977). *Introduction to comparative physiology*. Rinehart & Winston. New York.
7. Hall, J. E & Hall, M. E. (2020). Guyton and Hall Textbook of Medical Physiology E-Book. Netherlands: Elsevier Health Sciences.
8. Herkat, P. C., & Mathur, P. N. (1976). *Text book of animal physiology.S. Chand Co*. Pvt, Ltd.
9. Hoar, W. S. (1991). *General and comparative physiology. Prentice hall of India, New Delhi*.
10. Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.
11. Jordan, E. L. & Verma, P. S. (2013) Chordate Zoology (14th edition).
12. Marshall, A.J & Williams, W.D. (1995) Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers.
13. Saxena, R. K. & Sumitra Saxena, S. (2015) Comparative Anatomy of Vertebrates (2nd edition), Viva Books Pvt. Ltd.
14. Vander, A.; Sherman, J. & Luciano, D.(2003) Human Physiology (9th edition).
15. Verma, P. S., Tyagi, B. S., & Agarwal, U. V. (2005). *Animal physiology. S*. Chand and company Ltd, New Delhi.
16. Weichert, C.K. (1970) Anatomy of Chordates (4th edition). Mc Graw Hill.
17. Wilson, A. (1979). *Principles of animal physiology*. Macmillan Publishing, Co., Inc.

Web Resources

1. https://www.wiley.com
2. https://www.wiley.com
3. https://archive.org
4. https://www.worldcat.org
5. https://www.researchgate.net
6. https://open.umn.edu
7. https://www.sanfoundry.com
8. https://guides.library.illinois.edu

Prepared by : Dr. M. Raja

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand how animals work at all levels, ranging from individual cells to the whole integrated organism.	**K1, K2**
CO2	To classify and organize animals based on nervous, respiratory, circulatory and other physiological systems (old CO3),	**K3**
CO3	To analyze and differentiate the modifications/ adaptations found in different physiological systems of various organisms across the animal kingdom (old CO4).	**K4**
CO4	To integrate and explain the relationship between the animal physiology and environmental adaptations of lower and higher animals.	**K5**
CO5	To design research plans to elucidate the structure and functions of cells in various organs.	**K6**

Course Code	PZO3MC02
Course Title	Immunology, Microbiology and Epidemiology
Credits	04
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	III
Regulation	2022

Course Overview

1. This course will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted.
2. To provide training in basic laboratory exercises: Microbiology: Basic aseptic techniques and media preparation, spread plate, streak plate gram staining, microbial culture, antibiotic susceptibility testing.
3. This course emphasizes interaction of microorganisms in environment and biological systems to various conditions.
4. To understand the immunological methods: Serological tests, Basic methods in immunology, routine tests, Western blotting.
5. Explain the role of epidemiology in the field of public health.
6. To train students in the method of analysis of data and report writing. The information from this course will be subsequently used for planning health interventions.

Course Objectives

1. To develop the ability to analyse and understand the public health issues and undertake research to enhance evidence-based decision making.
2. To apply the knowledge to understand the microbial physiology and to identify the microorganisms.
3. To understand the basic epidemiological methods and study designs.
4. To understand the status of health and disease at global and national levels.
5. To provide a basic knowledge of the immune response, cytokines and immunomodulation, hypersensitivity and allergy and its involvement in health and disease.
6. To impart knowledge on ethics of research, including bioethics, ethical use of animals and to developing a research proposal and scientific writing.
7. To train the students in community diagnosis.

Pre-requisite:	Basic knowledge in Biology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Immunology basics and advances** Antigen, antibody: hapten structure, functions and types, immunogens .antigenicity, immunogenicity. Innate and adaptive immunity. Cells, organs and molecules involved in immunity. Types of immunity and immune response. Humoral and cell mediated immune response. Antibodies – types generation of antibody diversity, antibody engineering. Antigen processing and presentation. MHC molecules, complement system, toll like receptors, cell mediated effector function. T and B cells- development, maturation and activation. T and B cell epitopes, cytokines.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Immune response and immunotechniques** Immune system disorders: Inflammation, hypersensitivity, autoimmune disease. congenital and acquired immunodeficiencies. Immune response during bacteria(tuberculosis), parasite (malaria), viral (HIV/COVID), malignancy (tumors). Primary and secondary immunodeficiency's with related diseases. Hybridoma technology- production of monoclonal antibodies and its applications. Vaccines – types and various methods in vaccine preparation. Immunization schedule in India. Immunotechniques-ELISA, RIA, Immunoblotting, immunofluorescence, microscopy,immunosensor, immunoprecipitation, flowcytometer.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Microbial world** Microbes around us, History and scope of microbiology, Whittaker's five kingdom classification. Microbial anatomy: cell membrane, cell wall, glycocalyx, flagella, fimbriae, inclusion, endospore. Microbial nutrition's and factors affecting the growth of microbes, growth curve, role of microbial metabolism in biosynthesis and growth: primary and secondary	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	metabolites. Microbial mutations. Bergey's manual of systemic bacteriology.			
IV	**Study of Microbes** General methods and tools used for studying – bacteria, virus, fungus. Safety measures while handling pathogens. Different culture media for microbial growth/ bacteria, virus, fungus. Applications: Bioremediation, pharmaceutics, probiotics, food science, pathology etc. Genetically modified microbes, microorganisms and their impact on humans.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Epidemiology** Endemic, epidemic and pandemic. Historical aspects of epidemiology. Worst epidemic and pandemic conditions in the past. Epidemiological modelling and public health assessment. Tools and study design in epidemiology. Epidemiological traits. Prevention and control of diseases during epidemic conditions, uses, approaches, fields in epidemiology. Epidemiological methods in health management- national and international.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
	Suggested Readings 1. Atlas, R. M. (1997). Principles of microbiology (2nd ed), Tata McGraw Hill (international ed), 1098. 2. Goldsby, R.A., Kindt, T.J. & Kuby, J. (2006) Immunology (6th edition). W.H. Freeman & Co Ltd. 3. Jawetz, M. & Adelberg (2015) Medical Microbiology (27th edition). Mc Graw Hill. 4. Jeffrey C. Pommerville,(2006). Alcamo's fundamental of microbiology, Jones and Barlett, Boston. 5. Leon, G. (2013). Epidemiology (5th ed). Elsevier Saunders. 6. Pelzar, M. J., Chan, E. C. S., & King, N. R. (2002). Microbiology-concepts and applications, McGraw Hill, Jnc, 1. New York. 7. Porta, M. (2014). A dictionary of epidemiology. Oxford University Press. 8. Prescott, Harley & Klein's, (2008). Microbiology, 7th edition, Tata McGraw Hill international edition, Page 1-1086. 9. Rao, C. V (2005). Immunology, 2nd edition, Narosa Publishing House, New Delhi.			

	10. Roitt, I. (1997). Essential Immunology, Blackwell Scientific Publications. Boston. 11. Roitt, I., Brostoff, J. and Male, D. (2012) Immunology (8th edition). Wiley. 12. Ryan & Ray Sherris (2004). Medical Microbiology, 4th Ed. (Eds.), McGraw-Hill, ISBN: 0-8385-8529-9. 13. Schneider, D., & Lilienfeld, D. E. (2015). Lilienfeld's foundations of epidemiology, (4th Edition). Oxford University Press.
	Web Resources 1. https://onlinelearning.hms.harvard.edu/immunology 2. https://uscmed.sc.libguides.com 3. https://libraryguides.mcgill.ca 4. https://microbiology.columbia.edu 5. https://libguides.library.usyd.edu.au 6. https://www.ncbi.nlm.nih.gov 7. https://libguides.tulane.edu 8. https://www.journals.elsevier.com
Prepared by : Dr. V. Pushpa Rani	

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the pathology of diseases caused by various microorganisms such as bacteria, virus, parasites and fungus.	**K1, K2**
CO2	To explain the concepts of vaccination, autoimmunity, immunodeficiency, hypersensitivity and related techniques.	**K3**
CO3	To analyse the immune response in disease control, vaccination, and process of immune interactions.	**K4**
CO4	To recognize the patters of disease in human population and to list out the control measures.	**K5**
CO5	To design simple and cheap epidemiological methods in health management.	**K6**

Course Code	PZO3MC03
Course Title	Toxicology, Pharmacology and Bioethics
Credits	04
Hours/Week	03
Category	Major Core (MC) - Theory
Semester	III
Regulation	2022

Course Overview

1. The course briefs the outline of the history, scope, classification of various toxic agents, routes of administration of drugs and their therapeutic effects on various models.
2. This course will challenge students to analyze, assess and apply analytical skills, critical thinking skills in handling various toxic substances.
3. This course gives a broad overview drug designing, mechanisms of toxicity, and environmental pollutants toxicants on organ system and drug disposition.
4. To know the parasympathetic, sympathetic and neuromuscular transmissions and drug that modify their functions.
5. Course module is designed to critical study of the code of pharmaceutical Ethics drafted by pharmacy council of India.

Course Objectives

1. To provide the scientific basis and principles for a variety of special applications, such as the study of drug actions in the health sciences, the use of drugs as therapeutic agents in medicine or as tools in scientific research, and the development and regulation of pharmaceuticals.
2. To highlight the skills of toxicologists who works with materials and chemicals to determine the toxic effects they may have on the environment and/or living organisms.
3. To evaluate the principles, processes involved in the mechanism of action, disposition, side effects, drug-drug interactions, and contraindication of the drugs.
4. To know effect of agonist and antagonist at receptor sites, determine the relationship between effective dose and lethal dose of drugs.
5. To implement good scientific practices for safe handling, measurement and experimentation of biological material, reagents, instruments and devices used in pharmacology and toxicology.

Prerequisites	Basic knowledge on Physiology, Cell Biology and Environmental Biology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**History and branches of toxicology.** Introduction to toxicology, branches of toxicology, dosage and time response relationships. Biotic and abiotic aspects effecting toxicity. Classification of toxic agents- natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins. Bio-distribution, biomagnification, biotransformation of xenobiotics- brief introduction to Phase-I and Phase-II reactions.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Drug Designing and Mechanisms of Toxicity** Drug Designing, Dose-effect and dose-response relationship- acute toxicity, chronic toxicity reversible and irreversible effects. Mechanism of Neurotoxicity - selective vulnerability, sites of neurotoxic action, Axonopathy, Myelopathy, Immunotoxicity, Genotoxicity. Mechanism of drug-resistance.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Toxic risk assessment and chemotherapy** Means of exposures. Impact of toxicants on organism (Direct/ indirect, long term etc.) Toxic risk assessment. Techniques - bacterial reverse mutation assay, *in vitro* toxicology testing, *in vivo* toxicology testing, comet assay. LD50, LC50, LC90 determination. Chemotherapy – application, side effects and management.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**General Pharmacology** Introduction to pharmacology. Nature and sources of drugs, routes of drug administration. General anesthetics, drugs acting on CNS, respiratory system, and blood. Efficacy and toxicity evaluation using different experimental models, dose-response analysis, margin of safety in pre-clinical development.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

V	**Bioethics** Drug dependence and abuses, Common laboratory animals and their physiological parameters, factors affecting the nature and degree of pharmacological responses; Handling and care of different animals; Bleeding, different routes of administration of drugs and anaesthetics used in animal research and chemical euthanasia. Humanized mouse model and ethical issues.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Arunabha Ray & Kavita Gulati, (2007) Current trends in Pharmacology I.K.International Publishing House Pvt.Ltd.
2. Brenner, & Stevens. (2017). Pharmacology (5th ed). Elsevier.
3. Budhiraja, R. D. (2011). Elementary pharmacology and toxicology (4th ed). Popular Press Prakashan Pvt, Ltd.
4. Casarett and Doulls's 1980. Toxicology: The Basic Science of Poisons.. II (Eds.) Macmillan publishing co., Inc. NY.
5. David E. Golan, Armen H. Tashjian & Ehrin J. Armstrong · 2011 Principles of Pharmacology pathophysiologic Basis of Drug Therapy 3rd Edition Wolters Kluwer/Lippincot Williams & Wilkins.
6. Duffs, J., & Worth, H. (2006). Fundamental toxicology, RSC publishing.
7. Goel, & Parashar. (2013). IPR, biosafety and bioethics (1st ed). Pearson Education.
8. Gupta, P. K. (1985). Modern toxicology, II. Metropolitan Book, Co.. (P) Ltd. New Delhi.
9. Haley, T. J., & Berndt, W. O. (1987). Handbook of toxicology. Hemisphere Publishing Corporation.
10. John A. Timbrell (2009). Principles of Biochemical Toxicology. 4th Edition. CRC Press.
11. Klaassen, C. (2007). Casarett and Doull's Toxicology The basic science of poisons. McGraw-Hill.
12. Matsumura, F. (1980). Toxicology of insecticides. Plenum Press.
13. Raj, G. M., & Raveendran, R. (2019). Introduction to basics of pharmacology and toxicology, 1. General and Molecular Pharmacology: Principles of Drug Action. Springer Publication.
14. Rang, & Dale. (2018). Pharmacology (9th ed). Elsevier.
15. Salil Bhattacharya., Parantapa Sen & Arunabha Ray (2003). Pharmacology, Reed Elsevier Pvt, New Delhi.
16. Singer, P. A., & Viens, A. M. (2008). The Cambridge textbook of bioethics. Cambridge University Press.
17. Timbrell, John (2002). Introduction to Toxicology, UK: Taylor and Francis.

18. Williams, P. L., James, R. C., & Roberts, S. M. (2003). Principles of toxicology: Environmental and industrial applications. John Wiley & Sons, Inc.

Web Resources

1. https://pharmtox.utoronto.ca
2. https://www.toxicology.org
3. https://www.asmalldoseoftoxicology.org
4. https://www.tandfonline.com
5. https://www.niehs.nih.gov
6. https://www.med.unc.edu
7. https://onlinelearning.hms.harvard.edu/pharmacology
8. https://www.asmalldoseoftoxicology.org

Prepared By : Dr. M. Balachandar

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the basic principles of toxicology with emphasis on toxic chemicals, pollutants, and basic drug over dosage scenarios.	**K1, K2**
CO2	To correlate types of toxins and their physiological and genetic effects.	**K3**
CO3	To analyze the mechanisms by which drugs alter biological systems in an attempt to improve health and alleviate disease.	**K4**
CO4	To evaluate the potential of chemotherapy and toxic risk assessment for a healthier society.	**K5**
CO5	To design experiments using animal models to provide valid solutions for the betterment of society.	**K6**

Course Code	PZO3MC04
Course Title	Computational Biology
Credits	03
Hours/Week	03
Category	MC
Semester	III
Regulation	2022

Course Overview

1. Computational Biology is an interdisciplinary subject integrating the fields of computer science, molecular cell biology, biochemistry and statistics.
2. The aim of the course is to give basic knowledge about how to store, analyze and interpret biological data.
3. The different units of the course will examine different areas of computational biology including how to use private and public data bases in phylogenetic studies, retrieve sequences from data, compare sequences etc.
4. In this course, we will discuss about the tools and techniques used in genomics and proteomics and learn the methods of docking which help in drug designing.

Course Objectives

1. To understand the applications of biological data bases.
2. To know how to use different computational tools to store, retrieve and analyze data.
3. To apply the knowledge of computational biology for analyzing the structure of biomolecules.
4. To use different computational programs for phylogenetic analysis and docking methods for drug designing.

Prerequisites	Basic knowledge of computer science and Biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Basic biological computing tools** Significance of computational biology in research and education; Basic components - Hardware (CPU, input, output, storage devices) and Software (operating systems); Introduction to MS Excel - in-built statistical functions, graphical tools in MS Excel for presentation of data; Literature retrieval – PubMed, PubMed Central,	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Scopus, Web of Science, Shodhganga; Reference management software like Mendeley, Endnote, Zotero, Google Scholar.			
II	**Biological databases** Types of biological databases – primary, secondary and composite databases; Nucleic acid sequence and structural databases – NCBI, DDBJ, EMBL, ExPASy, CSD, Nucleic acid database (NDB); Protein sequence and structural databases – UniProt, PDB, MMDB; Chemical and drug databases – PubChem, ChEMBL, DrugBank; Specialized databases – FlyBase, ACeDB, dbSNP, TIGR, OMIM, OBIS-SEAMAP, Earthworm Database of India; Zoological Information Management System (ZIMS); Barcode of Life Data Systems (BOLD); Kyoto Encyclopedia of Genes and Genomes (KEGG).	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Tools for sequence analysis** Tools for gene and genome annotation; Gene prediction – steps in gene prediction, methods of gene prediction, gene prediction tools; Sequence alignment – Types of sequence alignment; Pairwise sequence alignment tools; BLAST – Sequence formats accepted by BLAST, Alignment method, types of BLAST; Multiple sequence alignment (MSA) – Steps in multiple sequence alignment, Heirachical MSA in Clustal Omega; MSA visualization in JalView; Significance of multiple sequence in phylogenetic tree construction; Phylogenetic tree construction – Types of trees, interpretation of trees, methods of tree construction – distance based and character based methods; PHYLIP; Tree of Life web project.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Tools for structural analysis and drug design** Protein structure visualization tools – RasMol, PyMol, Cn3D, MMDB, PDB visualization tools - Mol* 3D viewer, protein feature view, genome view; Relevance of pharmacogenetics and pharmacogenomics in drug design; Computer-aided drug design (CADD) – Drug discovery pipeline and steps in CADD: virtual high-	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	throughput screening, structure-based and ligand-based drug design, tools for molecular modelling, target prediction, docking and toxicity studies.			
V	**Novel computational approaches in biology** Computational ecology - ecological modelling, predictions and biodiversity studies; Computational medicine - disease diagnosis, therapy and patient care. Use of artificial intelligence in medicine, climate change and conservation biology. Role of bioinformatics in global collaborative genome sequencing and environmental projects.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Barnes, M. R., & Gray, I. C. (2003). Bioinformatics for geneticists, Wiley.
2. Cynthia, G., & Jambeck, P. (2001). Developing bioinformatics computer skills, Shroff, Mumbai.
3. David, M. (2001). Bioinformatics: Sequence and Genome Analysis Cold Spring Harbor Laboratory Press.
4. Gibas, C., & Jambeck, P. (2000). Developing bioinformatics skills, O'Reilly and associates, California.
5. Harshawardhan, P. B. (2007). Bioinformatics – Principles and applications. Tata McGraw Hill.
6. Mount, D. W. (2001). Bioinformatics – Sequence and genome analysis. Cold Spring Harbor, NY.
7. Rashidi, H., & Buehler, L. K. (1999). Bioinformatics basics applications in biological science and medicine. CRC Press.
8. Stephen, A. K., & Womble, D. D. (2003). Introduction to bioinformatics: A theoretical and practical approach. Humana Press.
9. Tisdall, J. D. JD. (2001). Beginning PERL for bioinformatics, Shroff, Mumbai.
10. Vincent, D. J., & Witten, M. (Eds.). (1996). *Computational Medicine, Public Health and Biotechnology: Building A Man In The Machine-Proceedings of The First World Congress (In 3 Parts)* (Vol. 5). World Scientific.
11. Zhang, W. (2010). *Computational ecology: artificial neural networks and their applications*. World Scientific.
12. Zhumur, G., & Bibekanand, M. (2008). Bioinformatics (principles and applications). Oxford University Press.

Web Resources

1. https://bit.ly/3JsEpdJ
2. https://bit.ly/3GMabR3
3. http://www.freebookcentre.net/Biology/BioInformatics-Books.html
4. https://www.youtube.com/watch?v=sX4cMu9Azgs
5. https://eol.org/
6. http://seamap.env.duke.edu
7. http://tolweb.org/tree/phylogeny.html

Prepared by : Dr. Renilda Sophy A. J

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the tools and techniques used in biological data analysis.	**K1, K2**
CO2	To explore information stored in major database and compare with the different biological data.	**K3**
CO3	To analyze database and predict protein and gene sequences	**K4**
CO4	To correlate between information in database and predict the evolutionary significance.	**K5**
CO5	To design new proteins and nucleotide sequences which have applications in different fields.	**K6**

Course Code	PZO3MC05
Course Title	Animal Physiology, Microbiology and Immunology Lab Course
Credits	03
Hours/Week	06
Category	Major Core (MC) – Lab
Semester	III
Regulation	2022

Course Overview

1. The course paves way for a practical exploration of the various physiological parameters through laboratory experiments.
2. The techniques to study and measure physiological, microbiological and immunological characteristics are elaborated.
3. This course will equip learners to pursue research in animal physiology, microbiology and immunology.
4. Skills in organizing, analyzing and recording experimental data will be emphasized to a great extent.

Course Objectives

1. To understand the effects of physiological changes in animals and the characteristics of microbes through experimentation.
2. To understand the use of specific techniques and experimental set-ups to study physiological, microbiological and immunological parameters.
3. To handle and analyze environmental samples of physiological and microbiological interest.
4. To record experimental data and report and discuss the experimental results accurately.

Prerequisites	Basic knowledge in Biology or Zoology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Effect of environment on physiology** Effect of temperature on the respiratory rate of fish. Effect of decreasing oxygen availability on the muscle lactic acid content of fish. Effect of posture and exercise on blood pressure and heart rate in humans.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Effect of adrenalin, acetylcholine and aspirin on the heart beat of *Daphnia* sp.			
II	**Markers of physiological changes on toxin exposure** Assay of brain acetylcholinesterase on exposure of fish to pesticides or any other pollutants. Influence of sub lethal (50-60 ppm) ammonia (as liquor ammonia/ ammonium hydroxide/ ammonium chloride) on a suitable fish exposed to ammonia stress for 7 days with reference to the following parameters: ● Level of excretory ammonia ● Level of amino acid content of muscle, gill, brain and liver.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Homeostasis, physiological and histological parameters** Estimation of salt loss and salt gain in fish exposed to fresh water and sea water. Comparative study of digestive enzymes in carnivorous (shark) and omnivorous (nile tilapia) fishes. Assay of enzyme markers of liver function (alanine aminotransferase, aspartate aminotransferase, acid phosphatase and alkaline phosphatase) in chicken liver sample. Study and identification of normal and abnormal electroencephalography (EEG) and echocardiography (ECG) waveforms using photographs. Histological observations using permanent slides of testis, ovary, spleen, liver, thyroid gland, pancreas, muscles, cartilage, bone, stomach, oesophagus, duodenum, kidney, spinal cord, pituitary, parathyroid, adrenal gland.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Basic microbiological techniques** Preparation of nutrient agar slant, stab streak, pour and spread plate cultures. Serial dilution of environmental bacterial samples and plating to establish viable bacterial cell count. Establishment of pure bacterial cultures from environmental samples. Selective growth of amylase-producing bacteria on starch agar plate.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

V	**Bacterial characterization and immunotechniques** Simple staining, negative staining and Gram staining of bacterial smears. IMViC test for identification of the bacteria. Double immunodiffusion and Radial immunodiffusion Rocket immunoelectrophoresis Competitive ELISA	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Chess, B. (2019). Laboratory applications in microbiology: A case study approach. McGraw-Hill Education.
2. Erkmen, O. (2021). Laboratory practices in microbiology. Elsevier Science.
3. Hay, F. C., & Westwood, O. M. (2008). Practical immunology. John Wiley & Sons.
4. Maheshwari, D. K. (2002). Practical microbiology, S. Chand Pvt. Ltd.
5. Mali, R. P., & Afsar, S. K. (2015). A practical manual on innovative animal physiology. Oxford Book Company.
6. Mondschein, W., Pollack, R. A., Findlay, L., & Modesto, R. R. (2018). Laboratory exercises in microbiology. Wiley.
7. Parvathi, K., Karthegaa, J., & Sivakumar, P. (2021). A manual of practical zoology. Darshan Publishers.
8. Pawar, K. R., & Desai, A. E. (2019). Practical course in zoology. Nirali Prakhashan.
9. Pommerville, J. C. (2017). Laboratory fundamentals of microbiology. Jones and Bartlett Publishers Learning, LLC.
10. Roy, A. K., & Prasad, M. M. (2009). Laboratory manual of microbiology. New India Publishing Agency.
11. Saxena, J., Baunthiyal, M., & Ravi, I. (2015). Laboratory manual of microbiology, biochemistry and molecular biology. Scientific Publishing.
12. Verma, P. S., & Srivastava, P. C. (2002). Advanced practical zoology. S. Chand Pvt. Ltd.
13. Wallis, C. J. (2015). Practical zoology: For advanced level and intermediate students. Elsevier Science.
14. Zane, H. D. (2001). Immunology: theoretical & practical concepts in laboratory medicine. Saunders.

Web Resources

1. https://practicalbiology.org/control-and-communication/control-of-heart-rate/investigating-factors-affecting-the-heart-rate-of-daphnia
2. https://www.ronaldschulte.nl/files/Laboratory_manual_in_general_microbiology.pdff
3. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
4. https://www.youtube.com/watch?v=aDU4GpKLF8Q

5. https://www.youtube.com/watch?v=HhOUwlOdxkA
Prepared By : Dr. M. D. Anitha Sebastian

CO – Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To describe and to examine physiological and immunological changes in animals and the characteristics of microbes.	**K1, K2**
CO 2	To employ the use of specific techniques and experimental set-ups to study physiological, immunological and microbiological parameters and to associate the observations with the theoretical background.	**K3**
CO 3	To experiment with environmental samples of physiological, immunological and microbiological interest and to analyze them appropriately.	**K4**
CO 4	To assess the changes in physiological and environmental parameters that affect animals and microbes and to predict and justify the consequences of those changes.	**K5**
CO 5	To compile experimental data and to report and validate the experimental results accurately.	**K6**

Course Code	PZO4MC01
Course Title	Methods in Biology
Credits	05
Hours/Week	05
Category	Major Core (MC) – Theory
Semester	IV
Regulation	2022

Course Overview

1. The course highlights on a variety of current experimental techniques used in modern biology and also exploring advanced topics in molecular biotechnology.
2. This course will challenge students to equip, analyze and apply critical thinking skills to their readings, class activities and field biology exercises.
3. This course gives a broad overview of the foundations and applications of different molecular techniques widely used in Genetics, Biochemistry and Molecular Biology.
4. Course module is designed to learn various techniques like estimation methods, Immunological assays, microbial and molecular techniques.

Course Objectives

1. To understand the principles and use of modern biological techniques, research methods. Utilize skills relating to the process of conducting life sciences methods.
2. To acquire the skills of using biomolecules for the experimental assessment of biological problems in the areas of molecular diagnosis.
3. To implement good scientific practices for safe handling, measurement and experimentation of biological material, reagents, instruments and devices used in modern biology.
4. To interpret and evaluate the principles, processes involved in Molecular Biology and Recombinant DNA methods.
5. To use research-based knowledge including design of experiments, analysis and interpretation of data to provide valid solutions to society.

Prerequisites	Basic knowledge on Molecular Biology, Cell Biology and Biotechnology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Microscopic techniques** Good laboratory practices. Preparation of common laboratory reagents and buffers. Microscopes – Confocal microscopy, Atomic Force microscope, Scanning tunneling microscope, Scanning and transmission microscopes, different fixation and staining techniques for EM. Image processing methods in microscopy.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Analytical techniques** Detection of molecules using ELISA, RIA, western blot, immune precipitation, flow-cytometry, immunofluorescence, *in situ* localization by techniques such as FISH and GISH. Protein sequencing methods, detection of post translation modification of proteins. Types of PCR. DNA sequencing methods – Sanger and next generation sequencing, RFLP, RAPD and AFLP techniques.	20	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Isolation and purification methods** Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis. Isolation, separation and analysis of carbohydrate and lipid molecules. Isolation and purification of antibodies.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Radiolabelling Methods** Basics of Radioactivity, Commonly used radioisotopes in Biology, Incorporation of Radioisotopes in Biological Systems, Molecular Imaging and measurement of Radioactivity. Nuclear medicine-Internally administered radioisotopes. Radio iodine in thyroid function analysis. Renal, liver and lung function analysis. Safety guidelines.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Field biology methods** Introduction to field Biology, Methods of estimating population density of animals and plants, ranging patterns	13	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

	through direct, indirect and remote observations. Sampling methods. Identification of species using barcoding.		CO4 CO5	

Suggested Readings

1. Andreas H & Samuel C. (2018).Wilson and Walker's principles and techniques of biochemistry and molecular biology (8th ed). Cambridge University Press.
2. Bajpai, P. K. (2010). Biological instrumentation and methodology. Publisher – S Chand and company.
3. Ignacimuthu, S. (2002). Methods in biotechnology. Phoenix. New Delhi.
4. Jain, H. C (1994). Radiation and Man. National Book trust, India.
5. Kiefer, J. (2004). Life sciences and radiation. Springer.
6. Plummer, D. (2017). An introduction to practical biochemistry (3rd ed). McGraw-Hill.
7. Primrose, S. B., & Twyman, R. M. (2006). Principles of gene manipulation and genomics (7th ed). Blackwell Publishing, West.
8. Saha, G. B. (2006). Physics and radiobiology of nuclear medicine, (3rd ed), Springer.
9. Schmauder, H. P., & Scjweozer, M. (2002). Methods in biotechnology. Taylor & Francis.
10. Steve Forshier. (2008). Essentials of radiation biology and protection. (2nd ed). Cengage Learning.
11. Upadhyay (2016). Biophysical chemistry: Principles and techniques. Himalaya Publishing House.
12. Williams, B. L., & Keith Wilson, A. (1981). Biologist guide to principles and techniques of practical biochemistry, (2nd ed). Hodder.
13. Wilson, K., & Walker, J. (2010). Experimental biochemistry. Cambridge University Press.
14. Wilson, K., & Walker, J. (2018). Principles and techniques of biochemistry and molecular biology (8th ed). Cambridge University Press.

Web Resources

1. https://ucsd.libguides.com
2. https://libguides.humboldt.edu
3. https://www.ableweb.org
4. https://subjectguides.lib.neu.edu
5. https://www.khanacademy.org
6. https://www.omicsonline.org
7. https://www.cellbio.com
8. https://libguides.princeton.edu

Prepared By : Dr. M. Balachandar

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the principle and procedure of modern techniques in biology.	**K1, K2**
CO2	To perform and interpret the results of widely used molecular biology techniques.	**K3**
CO3	To analyze and apply the outcomes of molecular techniques in exploring the functioning of cells.	**K4**
CO4	To explore modern molecular techniques and compile their applications in different fields of industry, agriculture and medicine.	**K5**
CO5	To formulate and compile new methods for isolation, purification and analysis of biomolecules.	**K6**

Course Code	PZO4MC02
Course Title	Genetic Engineering
Credits	04
Hours/Week	04
Category	MC
Semester	IV
Regulation	2022

Course Overview

1. This course gives insight into the functioning of Recombinant DNA molecules, their constructions, analysis and fine tuning.
2. This course also gives various ideas and approaches for development of drugs and other medicinal needs.

Course Objectives

1. To understand how recombinant molecules are created analysed with respect to DNA, RNA, and Protein.
2. To monitor both in-vitro and in-vivo activity especially functioning of Recombinant DNA molecules, their constructions, analysis and fine tuning.
3. To suggest more rational approach to solve problem of a living system at a molecular level.
4. To analyze and compare the various instruments have been used in genetic engineering.
5. To develop and formulate the Insulin and Blood clotting factor VIII for medicine.

Prerequisites	Knowledge of Biochemistry, Microbiology, Molecular Biology, Genetics.

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Introduction** Introduction to nucleic acids. Prokaryotic and eukaryotic gene organization. Central Dogma. Overview of recombinant DNA technology – tools and techniques.	10	CO1 CO2 CO3 CO4 CO5	K1, K2,K3, K4, K5, K6
II	**Enzymes and markers for Recombinant Technology** Restriction Endonucleases (Classification, blunt end, sticky end, mode of action). DNA polymerases, Reverse transcriptase, Polynucleotide kinase, Terminal transferase, Alkaline phosphatase, S1-Nuclease, Bal-31,	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	DNA ligase. Reporter genes, selectable and scorable markers, prokaryotic and eukaryotic markers (lacZ, CAT, Gus, GFP,cre-loxP system, sac B system, npt II gene, luciferase gene, dhfr gene, herbicide resistance gene).			
III	**Vectors** Cloning and expression vectors. Plasmids- Basic features classification, size and copy number, conjugation & compatibility. Plasmids, Bacteriophages (Lambda and M13 type), Cosmids and Phagemids, plant and animal cell vectors. Library construction (Genomic and cDNA type) and Screening of clones. Foreign gene expression in E. coli, Fusion proteins. Purification of recombinant proteins.	12	CO1 CO2 CO3 CO4 CO5	K1, K2,K3, K4, K5, K6
IV	**DNA transfer and gene manipulation** Gene transfer techniques – physical, chemical and biological – Transformation, Transfection, Membrane Fusion, Electroporation, Gene-Gun and Micro-injection. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Gene editing. Cloning by somatic cell nuclear transfer.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Applications of rDNA** Antisense and RNA interference technology and their applications. rDNA in medicine, agriculture, food industry and environmental sciences. Gene therapy. Transgenic plants and animals. Ethical issues and regulations related to rDNA technology.	12	CO1 CO2 CO3 CO4 CO5	K1, K2,K3, K4, K5, K6

Suggested Readings

1. Alberts, B (2004). Molecular Biology of the Cell. Garland Publications, USA.
2. Benjamin Lewin,. (2008) Genes IX. John Wiley and Sons, New York, 2008.
3. Brown, T. A. (2001) Gene Cloning & DNA analysis: An Introduction. Blackwell Publishing.
4. Carroll S.B., Doebley J., Griffiths, A.J.F. & Wessler, S.R. (2018) An Introduction to Genetic Analysis. W. H. Freeman and Co. Ltd.
5. Gardner, E.J., Simmons, M.J & Snustad, D.P. (2008). Principles of Genetics. (8^{th} Edition) Wiley India.
6. Nicholl, D.S.T. (2008). An introduction to Genetic Engineering (3rd edition) Cambridge University Press.

7. Peter J. Russell (2009) iGenetics, A molecular approach. (3rd Edition). Benjamin Cummings.
8. Primrose, S.B. & Twyman, R. (2006) Principles of Gene manipulation and Genomics (7th edition) Blackwell Publishing.
9. Primrose, S.B., Twyman, R. & R.W. Old (2004). Principles of Gene Manipulations (Sixth edition) Blackwell Science.
10. Watson, J.D. (2006) Recombinant DNA (3rd edition) Cold Spring Harbor Laboratory Press.
11. William S Klug & Michael R Cummings. (2016). Concepts of Genetics. (10th Edition). Pearson Education India.

Web Resources

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2. https://www.teachengineering.org
3. https://le.ac.uk
4. https://library.ship.edu
5. https://www.edx.org
6. https://www.udemy.com
7. https://www.classcentral.com
8. https://www.genome.gov
9. https://onlinelearning.hms.harvard.edu

Prepared By : Dr. K. Thresia Mathews

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand how recombinant molecules are created analysed with respect to DNA, RNA, and Protein.	**K1, K2**
CO2	To compare the various instruments and molecular methods used in genetic engineering.	**K3**
CO3	To monitor the construction of recombinant DNA molecules and fine tuning of genetic material and to analyze their function.	**K4**
CO4	To compile the applications of rDNA technology in various fields.	**K5**
CO5	To develop and formulate new biomolecules having application in industry, agriculture and health sectors.	**K6**

Course Code	PZO4MC03
Course Title	Methods in Molecular Biology Lab Course
Credits	06
Hours/Week	06
Category	Major Core (MC) - Lab Course
Semester	IV
Regulation	2022

Course Overview

1. This course will challenge students to apply critical thinking skills to their readings, class activities, laboratory exercises and to gain an in-depth knowledge on applied molecular techniques.
2. This course gives a broad overview of the foundations and applications of different techniques widely used in Genetics, Biochemistry and Molecular Biology.
3. Course emphasis on a variety of current experimental techniques used in modern biology and also exploring advanced topics in molecular biotechnology.
4. Course module is designed to learn various laboratory techniques like estimation methods, microbial techniques, chromatography techniques, nucleic acid isolation and analysis, protein purification methods, primer design and Immunological assays.

Course Objectives

1. To identify the fundamental aspects of molecular biology techniques.
2. To acquire the skills of using biomolecules for the experimental assessment of biological problems.
3. To implement good scientific practices for Safe handling, measurement and experimentation of biological material, reagents, instruments and devices used in Biology.
4. To understand the essential facts, concepts, physical and chemical principles of molecular techniques and their applications in the areas of molecular diagnosis.
5. To Interpret and evaluate the process and standard laboratory experimental protocols involved in analytical tasks.

Prerequisites	Basic knowledge in Molecular Biology, Cell Biology and Biotechnology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Isolation And Purification Techniques** • Protein purification by gel filtration/ion exchange chromatography. • Isolation and partial purification of amylase from sweet potato by ammonium sulphate fractionation and dialysis. • Synthesis of nanoparticles and size analysis.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Molecular Analysis** • Isolation of RNA and DNA and quantification. • Agarose gel electrophoresis of isolated DNA of quantitative and qualitative estimation. • Perform Southern blotting for DNA analysis • Isolation of protein from the given sample. • Separation of protein by SDS-PAGE. • To perform western blotting for qualitative estimation of protein.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Genetic Engineering** • Isolation of bacterial/ plasmid DNA • Determining the purity of isolated genomic/plasmid DNA using UV-Vis spectrophotometer. • PCR and analysis of PCR amplified DNA. • Gel elution of expected size PCR amplicons. • Cloning of gel eluted amplicons in suitable vector. • Analysis of cloned product by Restriction analysis.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Animal cell culture** • Sterilization of equipment used in animal tissue culture laboratory and laboratory practices. • Primary culture chick cardiac myocytes or skin fibroblasts. .	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	• Cell viability testing using trypan blue dye/ MTT assay • Cell cloning by dilution method. • Sub culturing/splitting of monolayer culture. • Cell migration assay			
V	**Institutional and Industrial visit** • Electron microscopes. • Atomic Force microscope. • DNA sequencer. • XRD. • Laser scanning confocal microscope. • Flow cytometry. • HPLC. • Mass spectrophotometry.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Bajpai P.K. (2010). Biological Instrumentation & Methodology. S Chand & Company.
2. Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings. Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical & applied, Volume I-III, Churchill-Livingstones
3. Green, M. R & Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.
4. Hartl DL, Ruvolo M. (2011) Genetics – Analysis of Genes & Genomes. 8th Student Ed. *Jones & Bartlett*.
5. John R.W. Masters (2000). Animal Cell Culture: A Practical Approach. Oxford University Press, UK.
6. Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
7. Primrose, S. B. & Twyman, R. M., (2006), Principles of Gene Manipulation & Genomics, 7th Ed, Blackwell Publishing, West Sussex, UK
8. Robert Braun. Introduction to Instrumental Analysis. McGraw Hill International Editions
9. Wilson, K. & Walker, J. (2018) Principles & Techniques Of Biochemistry & Molecular Biology (8th Edition),Cambridge University Press.
10. Wilson, K.& Goulding K.H.., A Biologist Guide to Principles & Techniques of Practical Biochemistry., ELBS Edn.

Web Resources

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3. https://www.ableweb.org
4. https://subjectguides.lib.neu.edu
5. https://www.khanacademy.org
6. https://www.omicsonline.org
7. https://www.cellbio.com
8. https://libguides.princeton.edu
9. https://www.asbmb.org

Prepared by : Dr. D. Robert Selvam

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To record and recall the basic principles of analytical methods, compare and contrast the working mechanism of modern laboratory instruments.	**K1, K2**
CO2	To classify and explain the structure and general characteristics of biological samples, formulate the equipment available and identify the appropriate experiments for research.	**K3**
CO3	To analyze molecular techniques, develop suitable analytical methods for the Isolation, Identification and Quantification of Biomolecules.	**K4**
CO4	To rank and rate the required laboratory skills to perform, interpret and analyze widely used molecular biology techniques.	**K5**
CO5	To compile and construct different laboratory techniques to investigate immunological and histological examination.	**K6**

Course Code	PZO2SE01
Course Title	Remote Sensing and Bioresource Management
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	II
Regulation	2022

Course Overview

1. This course will enable students to learn and obtain field data suitable for the various needs of their project
2. This course discusses encompass project planning sampling plans suitable for selecting spectral training sites or accuracy assessment sites.
3. This course emphasizes on finding locations in the field using a global positioning system obtaining basic measurements for studies of vegetation soil and water
4. It focuses on forest, agriculture, soil, land use and human resources, etc. which are considered more essential for environmental planning and development

Course Objectives

1. To identify Geo-identity of regions.
2. To acquire the skills of using methodology: empirical or Observational Technique.
3. To assess problems and formulate objectives in Remote Sensing Field work
4. To Interpret and evaluate the importance of bio resources

Prerequisites	Basic knowledge on Remote sensing and bio resource management

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Remote sensing** Introduction, Aim and Objectives. Geo-identity of regions; Location and Extent, The Region and The Problem. Methodology: Empirical or Observational Technique, Statistical Technique, Remote Sensing Technique. Preparation of Base Map Analysis and Synthesis of Data.The Geographic Information System (GIS) and Global Positioning System (GPS)—its applications	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	**Physical Background** Physical Background: Geology, Relief, Drainage, Climate, Soil and Forests. Landforms, water resources, soil resources and mineral resources. Biotic Resource system. Agriculture Development	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Field Method in Remote Sensing** Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods. Problems and Objectives in Remote Sensing Field work sampling methods in the study of behavior, habitat characterization: ground and remote sensing method. Field Spectroscopy. Collecting Thematic Date in the Field. Applying Concepts of Field Work to Urban Projects	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Bioresources Utilization** Bioresource and uses of biodiversity. Bioremediation and phytoremediation Biosensors. Utilization of Natural Resources (Water, Soil and Climate). Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Utilization , Household Industry and other Services of Food and other Crops. Utilization of Human Resources (Agriculture)	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Bio Resources Conservation and Management** Management of Water, Energy and Bioresources in the Era of Climate Change: Emerging Issues and Challenges Conservation of BioResources: Forest, Soil and Water	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Adams, J. B., & Gillespie, A. R. (2006). Remote sensing of landscapes with spectral images: A physical modeling approach. Cambridge University Press.
2. Campbell, J. B. (2002): Introduction to Remote Sensing. (5th edition). Taylor and Francis, London

3. Cracknell, A. & Hayes, L. (1990): Remote Sensing Year Book, Taylor and Francis, London
4. Curran, P.J. (1985): Principles of Remote Sensing, Longman, London.
5. Deekshatulu, B.L. & Rajan, Y.S. (ed.) (1984) Remote Sensing. Indian Academy of Science, Bangalore.
6. Ghosh, S.K. & Singh, R. (2003). Social forestry and Forest Management. Global Vision Pub.
7. Guham, P. K. (2003): Remote Sensing for Beginners. Affiliated East-West Press Private Ltd., New Delhi.
8. Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). Remote sensing and image interpretation. John Wiley & Sons.
9. McCoy, R. M. (2005). Field methods in remote sensing. Guilford Press.
10. Miller, G.T. (2002). Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc.
11. Moser, G., & Zerubia, J. (2018). Mathematical models for remote sensing image processing, Springer, Berlin.
12. Porwal, M. C. (1997). Remote Sensing analysis of Environmental Resources for Planning and development. APH Publishing.
13. Raju, N. J., Gossel, W., Ramanathan, A. L., & Sudhakar, M. (Eds.). (2014). Management of water, energy and bio-resources in the era of climate change: emerging issues and challenges. Springer.
14. Teluguntla, P., & Thenkabail, P. S. (2015). Remote Sensing Handbook (Volume II): Land Resources Monitoring, Modeling, and Mapping with Remote Sensing, Chapter: 6, Pub.
15. Thenkabail, P. S., (2016). Remote Sensing Handbook; Volume 1: Remotely Sensed Data Characterization, Classification, and Accuracies. Taylor & Francis.
16. Thenkabail, P. S., (2016). Remote Sensing Handbook; Volume 3: Remote Sensing of Water Resources, Disasters, and Urban Studies. Taylor & Francis.
17. Thenkabail, P., Lyon, J. G., Turral, H., & Biradar, C. (2009). Remote sensing of global croplands for food security. CRC Press.

Web Resources

1. https://ncert.nic.in/textbook/pdf/kegy307.pdf
2. https://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/
3. https://www.guilford.com/excerpts/mccoy.pdf?t
4. https://www.aidash.com/resource/remote-sensing-art-behind-geospatial-data-collection
5. https://www.fao.org/3/T0446E/T0446E04.htm

Prepared by : Dr. S. Maria Packiam

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To record and recall the basic principles of analytical methods, compare and contrast the mechanism of modern laboratory instruments.	**K1, K2**
CO2	To classify and explain the structure and general characteristics of biological samples, identify the appropriate experiments for research.	**K3**
CO3	To analyze molecular techniques, Develop suitable analytical methods for the Isolation and Quantification of Biomolecules.	**K4**
CO4	To rank and rate the required laboratory skills to perform, interpret and analyze widely used molecular biology techniques.	**K5**
CO5	To compile and construct different laboratory techniques to investigate immunological and histological examination.	**K6**

Course Code	PZO2SE02
Course Title	Endocrinology and Neuroscience
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	II
Regulation	2022

Course Overview

1. The course highlights on the hormones, their biochemical origin, functions and the contribution of comparative studies to the field of neuroendocrinology.
2. To understand the neuroendocrine influences on health across the lifespan from development, puberty, adulthood and aging.
3. To understand the physiological/endocrinological mechanisms to underpin the evolutionary correlations and constraints commonly observed at higher levels of biological organization.
4. To impart knowledge on the major contributions that comparative endocrinologists have made to the science of endocrinology, and we highlight the emerging areas of research and how endocrinologists can contribute to the study of organismal biology in the 21st century.
5. The course module is designed to learn the most comprehensive up-to-date source covering basic principles, neural regulation, hormone function and behavior, and neuroendocrine pathology.

Course Objectives

1. To provide a basic understanding of central nervous system function and how body systems are controlled through neuronal and hormonal mechanisms.
2. To help in advancing their knowledge on endocrine pathology employing molecular tools and techniques.
3. To focus on animal studies unravelling the endocrine disorders, improving their diagnosis and enhancing their management in all animal species.
4. To provide molecular level insight on endocrinological events in the animal body to focus on various approaches to understand hormone action and its related applications in the field of life science.
5. To know the general organization of brain, physiological, cognitive processes and the effects of drugs cellular function in the nervous system.

Prerequisites	Basic knowledge on Molecular Biology, and Animal Physiology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Introduction to Endocrinology** Introduction to the endocrine system, Discovery of hormones, Classification of hormone, –basic concepts and methods, Modes of hormone secretion, Endocrine glands and hormones, structural features of endocrine glands, Hormonal effects and regulation Hormones as messengers, Hormones and eukaryotic metabolic regulation.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Hormone Mechanism** Biochemical Aspects of Metabolism, Mechanism of action of Peptide hormones, Thyroid hormones, Steroid hormones. Biosynthesis of steroid hormones de novo, Biosynthesis and secretion of pancreas, adrenal, ovary, testis and thyroid hormones, Factors influencing secretion, Cascade of reaction linked to signal transduction, Hormones and behavior Hormonal control of growth and reproduction in vertebrates Neuro-endocrine integration in vertebrate, Endocrine disorders-brief description, endocrine disease and hormone-replacement therapies, Hormones and human health.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Endocrinology of invertebrates** Concepts of neurosecretions - endocrine systems in crustaceans - endocrine control of moulting and metamorphosis - neuroendocrine system in insects - endocrine control of moulting - metamorphosis and reproduction. In Annelids: Neurohemal organ and its function, In Mollusks: Neurohemal organ and its function, Endocrine physiology of Arthropods. In Insects: Types of hormones and their release sites, Prothoracicotropic hormone, Ecdysteroids, Juvenile hormone, Neuropeptides, Vertebrate-type hormones In Crustaceans: X-organ, Y-organ and associated neurohemal organs. Endocrine physiology of Echinodermata: Neuropeptides and reproduction.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

IV	**Fundamentals of Neuroscience** Functional neuro anatomy, Evolution of the nervous system, organization of vertebrate brain, Basic plan and evolution of the vertebrate nervous system, Structure and function of neurons; types of neurons; Synapses; Glial cells; myelination; Basic of development-formation of neural tube, vesicles and derivatives of each vesicle, Blood Brain barrier; Neuronal differentiation; Characterization of neuronal cells; Meninges and Cerebrospinal fluid; Spinal Cord.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Neurophysiology and **Artificial Intelligence** Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons, Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function, Animal models for neurobiological research, AI in Neuroscience, Swarm robots, the artificial neural networks, AI in Neurological Healthcare, Challenges and prospective of AI in modern biology.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Baer, M.F. & Connors B.W. (2015) Neuroscience: Exploring the brain. Lippincott Williams and Wilkins.
2. Barington. (1979). Hormones and evolution, I & II. Academic Press.
3. Barrington, E. J. W. (1985). An introduction to general and comparative endocrinology. Claredon Press Oxford.
4. Bentley, P. J. (1985). Comparative vertebrate endocrinology (2nd ed). Cambridge University Press.
5. Byrne, J.H., Heidelberg, R. & Waxham, M.N. (2014) From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience. Academic Press.
6. David, V., Dai, B., Martin, A., Huang, J., Han, X., & Quarles, L. D. (2013). Calcium regulates FGF-23 expression in bone. Endocrinology, 154(12), 4469–4482. https://doi.org/10.1210/en.2013-1627

7. Gordon M. Shepherd G.M, & Shepherd, (1994) Neurobiology. (3rd ed). Oxford University Press.
8. Hadley, M. E., & Levine, J. E. (2007). Endocrinology (6th ed). Prentice Hall. NJ.
9. John, F. Laycock & Peter H. Wise. (1996). Essential endocrinology. (3rd edition). Oxford University Press;
10. Kandel, E.R., Schwartz, J.H. & Jessell, T.M. (2000) Principles of Neural Science (4th edition) McGraw Hill Companies
11. Mathews, G. G. (2000). Neurobiology (2nd ed). Blackwell Publishing Science.
12. Nobil. E.K &. Neil. JU. D (1988). The physiology of reproduction, I and II. Raven Press.
13. Nussey, S.S. & Whitehead, S.A. (2001) Endocrinology: An Integrated Approach, Oxford: BIOS Scientific Publishers.
14. Simmons, J. & Young, D. (2003) Nerve Cells and Animal Behaviour (2nd edition) Peter. CUP. 75, Cambridge University Press.
15. Stahl, S.M. (2000) Essential Psychopharamacology- Neuroscientific Basis and Practical Applications (2nd edition), Cambridge University Press.
16. Turner, C. D., & Bangara, J. T. (1986). General endocrinology. Saunders International Student edition. Toppan Company Limited.
17. Vilayanur, S.R. & Blakeslee S. (1998) Phantoms in the Brain. Probing the Mysteries of the Human Mind. William Morrow & Conmpany. New York.
18. Wigglesworth, B. (1972). The principles of insect physiology by, V. ELBS and Chapman & Hall.
19. Wiliaimas, R. H. (1974). Textbook of endocrinology V. Ed. Saunders Press, London.

Web Resources

1. https://www.intechopen.com/books
2. https://academic.oup.com/icb/article/49/4/339/644276
3. https://onlinelibrary.wiley.com/journal/13652826
4. https://joe.bioscientifica.com/
5. https://pll.harvard.edu/subject/neuroscience

Prepared By : Dr. M. Balachandar

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand how body systems are controlled through neuronal and hormonal mechanisms.	**K1, K2**
CO2	To correlate the effects of hormones in the neuronal functions and behaviour of animals.	**K3**
CO3	To compare the endocrine system of vertebrates and invertebrates.	**K4**
CO4	To explain the functioning of endocrine organs and the physiological and cognitive processes of nervous system.	**K5**
CO5	To design research plans using animal models for advanced research in neurobiology.	**K6**

Course Code	PZO2SE03
Course Title	Breeding in Plants and Animals
Credits	02
Hours/Week	04
Category	Subject Elective (SE) - Theory
Semester	II
Regulation	2022

Course Overview

1. The course emphasizes the importance of breeding programs in the national and international contexts.
2. Traditional and novel breeding methodologies have been elaborated to encourage the learners to practically apply the concepts in the field.
3. The course introduces the desirable economic traits in plants and animals and the importance of identifying genetic variations.
4. The course involves stimulating evidence-based thinking skills to conceive innovative solutions to the present challenges in this field of study.

Course Objectives

1. To understand the basic principles in plant and animal breeding and its beneficial applications.
2. To introduce innovative techniques to the learners that would serve to boost farm entrepreneurship.
3. To identify economic traits of organisms and to plan breeding programs suited for the global and national scenarios.
4. To assess the quality of breeding techniques and to select the most suitable breeding method for a particular breed or species.
5. To collaborate with local farmers and design economical breeding solutions.

Prerequisites	Basic knowledge on Biology or Zoology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Importance of breeding programs** Objectives and scope of plant and animal breeding programs. Economic traits in plants and animals. Government schemes and missions to promote animal rearing in India. National and state livestock policies for breeding.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Selection methods in plant and animal breeding** Criteria for selection of plant and animal breeding stocks. Natural and Artificial selection. Selection methods for plant breeding – pure line and mass selection methods. Selection methods for animal breeding – individual selection, pedigree selection, family and progeny selection, unified score card system and body condition score system. Molecular tools for selection in plant and animal breeding - marker-assisted selection and genome-wide association studies.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Plant breeding techniques** Significance of apomixis in plant breeding. Emasculation and crossing techniques. Hybridization and back crossing methods. Self-incompatibility and male sterility and their utilization in crop improvement. Heterosis, inbreeding depression, synthetic and composite varieties, pure line hybrids and inbred hybrids. Mutation breeding and genome editing technique. Plant tissue culture – micropropagation and transgenesis.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Animal breeding techniques** Inbreeding - voluntary and constrained inbreeding, monitoring the rate of inbreeding, risks of inbreeding, prevention of inbreeding. Crossbreeding – heterosis, two-way cross, three-way cross, four-way cross, two-way rotation, three-way rotation, introgression, grading-up, random breeding, monogamous and polygamous mating	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	(harems), trios mating, creation of synthetic breeds. Hybridization – interspecies and intraspecies hybrids.			
V	**Reproductive techniques in the breeding of farm animals** Artificial insemination, embryo transfer technologies, multiple ovulation and embryo transfer (MOET), embryo splitting, embryo and semen sexing, *in vitro* fertilization. Use of gene editing technology in breeding. Techniques for mating laboratory animals such as fish, mice and guinea pigs.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Acquaah, G. (2020). Principles of plant genetics and breeding. Wiley.
2. Fisker, C. (2017). Animal breeding and genetics. Scitus Academics LLC.
3. Hartung, F., & Schiemann, J. (2014). Precise plant breeding using new genome editing techniques: Opportunities, safety and regulation in the EU. Plant Journal: For Cell and Molecular Biology, 78(5), 742–752. https://doi.org/10.1111/tpj.12413
4. Jadon, N. S. (2020). Animal genetics and breeding, animal nutrition, livestock production and management. New India Publishing Agency.
5. Johnson, D. V., Al-Khayri, J. M., & Jain, S. M. (2019). Advances in plant breeding strategies: Industrial and food crops, Springer International Publishing.
6. Kuckuck, H., Kobabe, G., & Wenzel, G. (2020). Fundamentals of plant breeding. Walter de Gruyter GmbH & Co. KG.
7. Pal, A., & Chakravarty, A. K. (2019). Genetics and breeding for disease resistance of livestock. Elsevier Science.
8. Prasad, A. K. (2015). Animal breeding: A recent graduate's concept. Lap Lambert Academic Publishing GmbH KG.
9. Ram, M. (2014). Plant breeding methods. Public Health Institute Learning.
10. Sanders, S. (2022). Understanding animal breeding and genetics. Murphy and Moore Publishing.
11. Schön, C. C., & Simianer, H. (2015). Resemblance between two relatives—Animal and plant breeding. Journal of Animal Breeding and Genetics, 132(1), 1–2. https://doi.org/10.1111/jbg.12137
12. Shaw, T. (2019). Animal breeding. HardPress.
13. Singh, B. D., & Shekhawat, N. S. (2019). Plant Breeding in 21st Century. Scientific Publishing.

Web Resources

1. https://www.sciencedaily.com/releases/2021/12/211203081525.htm
2. https://www.youtube.com/watch?v=44Wp8zI5NWI
3. https://www.youtube.com/watch?v=8ATRfaiaOLg
4. https://www.youtube.com/watch?v=3agp4U61TaQ

Prepared By : Dr. M. D. Anitha Sebastian

CO – Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To identify the key principles and criteria in plant and animal breeding and to translate the theoretical knowledge gained into beneficial applications.	**K1, K2**
CO2	To solve current problems in breeding programs and employ innovative techniques that would serve to boost farm entrepreneurship.	**K3**
CO3	To categorize the organisms based on their economic traits and to plan breeding programs suited for the global and national scenarios.	**K4**
CO4	To assess the quality of breeding techniques and to select the most suitable breeding method for a particular breed or species.	**K5**
CO5	To collaborate with local farmers and design economical breeding solutions.	**K6**

Course Code	PZO2SE04
Course Title	Nanotechnology and Synthetic Biology
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	II
Regulation	2022

Course Overview

1. Nanotechnology is an interdisciplinary subject integrating the fields of physics, chemistry, biology, material science etc.
2. The aim of the course is to give knowledge about properties and applications of nanoparticles in the modern era.
3. In this course, we will discuss about the social issues related to nanotechnology and also the impact of this new technology in environmental pollution.
4. It also includes the concepts and application of synthetic biology in field of medicine, agriculture and industry.

Course Objectives

1. To understand the properties and characteristics of nanoparticles.
2. To know how to use different tools to synthesize, quantify and characterize nanoparticles.
3. To apply the knowledge of nanotechnology in different fields like biotechnology, medical sciences, food technology and environmental science.
4. To know the ethical issues related to the use and disposal of nanomaterials into the environment.
5. To understand the concept of synthetic biology and its scope in future.

Prerequisites	Basic knowledge of physics and Biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Introduction to nanotechnology** History, properties and morphology of nanoparticles, classification and characterization. Synthesis of nanoparticles using biological, chemical and physical methods. Mechanism of self-assembly and examples of self- assembly. Imaging techniques in nanotechnology.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	**Application of nanotechnology in health care and biotechnology** Drug delivery systems – nanocarriers, antibody and antibody conjugates, targeted delivery – chitosan and alginate. Bacterial dependent delivery of vaccines. Nanoscale biosensors. Nanotechnology in gene therapy. Stem Cell technology. Blotting techniques-Nanoprobes.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Applications of nanomaterials in agriculture and food industry** Nanofertilizers, Nanoherbicide, nanopesticide and nanofungicide. Preparation and applications of Nano cochleates, Nanolaminates and Nanoemulsions in food industry. Nanoencapsulation technology. Nanocomposites. Nanopackaging for enhanced shelf life; Nanotechnology in intelligent packaging.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Nanotechnology and environment** Role of nanoparticles in environmental pollution, effect on human health, Green nanotechnology, Testing of environmental toxic effect of nanoparticles using microorganisms. Nanotechnology and bioethics	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Synthetic Biology** Introduction to synthetic biology, recent developments and applications in medicine, industry, agriculture. Concept of artificial life and achievement. Biosafety and biosecurity.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Brown. P. J & Stevens. K. (2007). Nanofibers and Nanotechnology in Textiles. Woodhead Publishing Limited, Cambridge.
2. David S Goodsell (2004). Biotechnology. John Wiley & Sons.
3. Harry F. Tibbals (2010). Medical Nanotechnology and Nanomedicine. CRC Press.
4. Jennifer Kuzma & Peter VerHage (2006). Nanotechnology in agriculture and food production. Woodrow Wilson International.
5. Lee, S.Y., Neilsen, J., Stephanopoulos, G (2018). Synthetic Biology. Volume 8, Wiley Blackwell publications.
6. Lynn. J, Frewer, WillehmNorde. R. H, Fischer & Kampers. W. H. (2011). Nanotechnology in the Agrifood sector, Wiley-VCH Verlag.

7. Manuel Porcar & Juli Pereto (2014). Synthetic Biology: From iGEM to the artificial cell., Springer publication.
8. Phoenix, D.A. & Ahmad, W (2014) Nanobiotechnology. One Central Press Ltd
9. Pradeep, T. (2017) The Essentials: Understanding Nanoscience and Nanotechnology: McGraw-Hill Education.
10. Qingrong Huang, (2012) Nanotechnology in the Food, Beverage and Nutraceutical Industries, Elsevier.
11. Sulabha k. Kulkarni (2014). Nanotechnology – Principles and practices, Third edition, Capital Publishing company, New Delhi.
12. Thomas Varghese & K.M. Balakrishna (2021) Nanotechnology, Atlantic.

Web Resources

1. https://bit.ly/3gOgDg3
2. https://bit.ly/3sHX6Dz
3. https://bit.ly/3oVYRMm

Prepared by : Dr. Renilda Sophy A. J

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the concept of nanotechnology and synthetic biology.	**K1, K2**
CO2	To correlate the properties and functions of biomolecules in different biological systems	**K3**
CO3	To analyze the tools and techniques used in nanotechnology and synthetic biology.	**K4**
CO4	To explain the applications of nanoparticles and artificial cells	**K5**
CO5	To design nanoparticles and redesign biological systems to improve human welfare.	**K6**

Course Code	PZO2SE05
Course Title	Wildlife Conservation and Management
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	II
Regulation	2022

Course Overview

1. Wildlife conservation and management course provide deep knowledge in the study of essential concepts, principles, national and international policies, and importance of wildlife along with threats and management.
2. This course includes the broad aspect of the wild animals with reference to their distribution, natural history, niche concept food and feeding habits of wildlife species, population, territorial defence, home range of the individual species populations.
3. A detailed study on policy and regulation, case studies, IUCN revised red list categories, National and international conventions, role of NGO in conservation are included for establishing the priorities and implementing conservation and management actions.
4. This course enlightens the modern aspects of conservation on wildlife ecology by monitoring and survey techniques, GIS and habitat management practices.
5. This course also focusses on the impacts of illegal wildlife trafficking, critical analysis by wild life forensics, and foundation of wild life research institutes and organization for wildlife conservation and endangered species for implementing action plans and solutions.

Course Objectives

1. To understand the modern concepts in wildlife management.
2. To understand the conservation policies in national and global level.
3. To understand landscape approach to conservation and acquire skills for planning scientific wildlife management.
4. To understand the human wildlife conflict.

Prerequisites	Basic knowledge in Environmental science

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Introduction to Wildlife** Habitat diversity of Indian wildlife and faunal zonation; major biomes of the world, biogeographic zones of India; Zoogeographic regions of the world Endemic species, Important Indian fauna and their distribution; Wildlife habitat and characteristics, Fauna and adaptation with special reference to Tropical forest. Wildlife depletion & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, RAMSAR reserves; cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5. K6
II	**Wildlife Conservation** Conservation and management: In-situ conservation and Ex-situ conservation; Regional, National and global Conservation efforts and legal aspects: IUCN revised red list categories, Red Data Book and red listing. Wildlife census, radio telemetry in wildlife studies; National and international conventions: MAB, CITES, TRAFFIC; Indian case studies on conservation / management strategy; Special projects for wildlife conservation; Rio Protocol, Rio 20+ , Project Tiger, Project Elephant, Gir Lion Project, Crocodile Breeding Projects, Project Hangul(1972). Sampling forest ecosystems and analyzing the data collected. Scat analysis; Captive breeding and reintroduction of threatened species. Role of NGO in conservation.	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Conservation Breeding and Wildlife Utilisation** Captive breeding and Propagation; Conservation breeding Management Plans. Role of scientific institution in Conservation Breeding Programme. Principles of biological requirements of species; Case studies on Conservation Breeding Programme of endangered wild	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	animals. Wildlife Utilisation: Non-consumptive and consumptive utilization, their economic benefit. Game ranching and controlled off-take from the wild population, rationale, management design, harvesting by management or hunting licences, marketing procedures. Use of wildlife; Wildlife Tourism.			
IV	**Wildlife Management** Principles and practices of wildlife management. cause of extinction, Management of special habitats; riparian zones. Grasslands etc. Analysis and need for wildlife management, problems in plantations and exploited forests; Role of Biology in management. Mammalogy, Ornithology, Herpetology and Ichthyology, Joint forest management. Forest spatial structure, Fire ecology; effects on forest dynamics, Field Ethics; Migration Corridors-Man Animal Conflict; Animal Conflict Environment Impact Assessment (EIA).Human Dimensions in Wildlife Management Wildlife Health Management.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6
V	**Landscape approach in Management and Use of Modern Technology** Wild Life Management and Restoration; Management plan for Protected Areas;Field techniques in Wildlife studies, communications, staff and visitor amenities, monitoring. GIS/GPS/Imagery, camera trapping/Drones etc.Principles of planning, objectives, resource surveys, analysis of surrounding region, management zones, theme plans, Financing protected areas; Wild Life Forensics; Wild life research institutes and conservation organization.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Agrawal, K.C., (2000). Wildlife of India: Conservation and Management. Nidhi Publishers, India.
2. Bailey, J.A. (1984). Principles of Wild Life Management. John Wiley & Sons, New York.
3. Bookhout, T.A. (1996) Research and Management Techniques for Wildlife and Habitats (5th edition) The Wildlife Society, Allen Press.
4. Caughley.G & Sinclair, A.R.E (1994) Wildlife ecology and management. Blackwell Science Ltd, UK.

5. Deshmann, R. F. (1992). Wildlife biology. Wiley Eastern Publisher, New Delhi.
6. Ellerman, J.R. (1961). The fauna of India. Manager of Publications, New Delhi.
7. Eugene P. Odum, (1972). Fundamentals of Ecology, W.B. Saunders Company, London.
8. Gee, E.P., (1964). The wild life of India. Collins, London.
9. Giles R.H., (1980). Wild life management techniques. Wildlife Society, Washington.
10. Hunter M.L., Gibbs, J.B. & Sterling, E.J. (2008) Problem solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.
11. Krishnan M, (1978). India's Wildlife, Bombay Natural History Society, India.
12. Majid Husain, (2015). Environment and Ecology, Access Publishing
13. Nair SM,(1992). Endangered animals of India, National Book Trust, India.
14. Noen AN, (1984). Wildlife Ecology: An Analytical Approach, WM Freeman and Co, New York.
15. Owen, D.S. (1985). Natural Resources Conservation – An ecological approach. McMillan Publications & Co., New York.
16. Sanderson, Ivan T. (1955). Living mammals of the world. Hamilton, London.
17. Shah JH, (1975). Introduction to Wildlife Management, McGraw Hill, New York.
18. Sharma. B.D. (2002). Indian Wildlife-Threats and Preservations. Anmol Publications Pvt. Ltd. India.
19. Sinha, P.C., (1998). Wildlife and forest conservation. Anmol Publication Pvt. Ltd, New Delhi.
20. Smith, M.A. (1941). The fauna of British India, Ceylon and Burma including the whole of the Indo-Chinese sub-Chinese subregion. Taylor and Francis, London.
21. Stanley, A.H., (2002). Managing our wildlife resources. Prentice-Hall, USA.
22. Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy. Blackwell Sciences 95
23. Teague R.D., (1967). A manual of wildlife conservation. Natraj Publishers, Dehradun
24. Usher MB, (1986). Wildlife Conservation and Evaluation Chapman and Hall, London.
25. Woodroffe, R., Thirgood, S. & Rabinowitz, A. (2005) People and Wildlife, Conflict or Co-existence? Cambridge University.

Web Resources:

1. https://www.mgkvp.ac.in/Uploads/Lectures/49/859.pdf
2. https://courses.lumenlearning.com/wm-biology1/
3. https://www.nature.com
4. https://www.arlis.org/docs/vol1/69415913/hundal_edited_final_march_10.pdf
5. https://libguides.princeton.edu
6. https://www.youtube.com/watch?v=hhgQRkm7odc

7. https://www.greenpeace.org/india/en/
8. https://www.petaindia.com/
9. https://sstcn.org/
10. https://www.worldwildlife.org/

Prepared By : Dr. S. Maria Pakiam

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the modern concepts in wildlife conservation and management.	**K1, K2**
CO2	To explain and Correlate human encroachments and wildlife depletion.	**K3**
CO3	To analyse the national and global policies and management strategies to improve wildlife conservation.	**K4**
CO4	To assess the diversity in wildlife habitats and landscape approaches to conserve it.	**K5**
CO5	To collate and discuss for the innovation of new methods in conservation breeding and implement of new approaches in management programs.	**K6**

Course Code	PZO3SE01
Course Title	Bioremediation, Phytoremediation and Biosensors
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	III
Regulation	2022

Course Overview

1. Bioremediation, Phytoremediation, and Biosensors is a structured course for the development of biotech solutions in real-life problems.
2. This course covers the basic concepts and principles of Biomolecules and its applications in the environment.
3. It provides a broad perspective knowledge on the versatility applications of microbial systems to treat environmental pollutants, to familiarize students with the application of bio remedial technologies in natural environments.
4. The various aspects of phytoremediation on the environment for the removal and treatment of contaminants, metal from soil and water to render for eco-restoration.
5. Special emphasis is given to the development of biosensors and bioindicators to monitor pollution, and to eliminate pollutants from the environment, restore contaminated sites and avoid future pollution.

Course Objectives

1. To understand the nature and importance of bioremediation, phytoremediation, and biosensors.
2. To understand when each strategy would be most applicable.
3. To understand the influence of contaminant characteristics on remediation (e.g. chemical structure, toxicity, and solubility).
4. To understand the development and importance of biosensors and their applications in various filed.

Prerequisites	Basic knowledge in Environmental biology and Microbiology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Biomolecules in Environmental Applications** Biomolecules in remediation, Cell wall substances; Cell membrane Exudates; Root exudates; Proteins; Enzymes.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Bioremediation Strategies** Principles of Bioremediation; constraints and priorities of Bioremediation; Evaluating Bioremediation; Use of indigenous micro-organisms, Bio stimulation of Naturally occurring microbial activities; Bioaugmentation; Genetically manipulated organisms.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Bioremediation Techniques** In situ, ex situ, engineered bioremediation techniques; Bioremediation of heavy metals; Bioremediation of coal; Gaseous Bioremediation; Bioremediation of xenobiotics in environment; molecular techniques in bioremediation.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Phytoremediation** Concepts of phytoremediation; Strategies of phytoremediation; Rhizoremediation; Ideal plants for phytoremediation, Applications of genetic engineering to phytoremediation.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6
V	**Biosensors** Principles and characteristics of Biosensors; General construction of biosensor devices; Types of biosensors; Applications in environmental pollution detection and monitoring; living biosensors for the management and manipulation of microbes; Biosensors in clinical diagnosis, chiral technology, monoclonal antibodies for immunotherapy and nanotechnology.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Ahmed, N.F.M. Qureshi & Khan, Q.Y. (2001). Industrial Environmental Biotechnology. Horizon Press, Chennai, India, 207pp.
2. Allan Scragg, (2010). Environmental Biotechnology. Oxford University Press. New York. 447pp.

3. Baker, K.H. & Herson, D.S. (1994). Bioremediation. Mc. Graw Hill Inc, New York.375pp.
4. Bhatia, S.C. (2011). Hand Book of Environmental Biotechnology. Atlantic Publishers Ltd. New Delhi.
5. Evans, G.M. & Furlong, J.C. (2012). Environmental Biotechnology: Theory and Application. John Wiley and Sons, USA. 292pp.
6. Jeong-Yeol Yoon, (2016). Introduction to Biosensors (12th ed.). Springer-Verlag, New York.
7. Mishra, C.S.K. & Asha A Juwarkar, (2007). Environmental Biotechnology. APH Publishing corporation, New Delhi. 466pp.
8. Metcalf & Eddy Inc. (1978). Waste engineering - treatment, disposal and reuse (2nd ed.). Tata McGraw Hill, New Delhi.
9. Mohammed Zourob, (2010). Recognition Receptors in Biosensors (1sted.). Springer-Verlag New York. 863pp.
10. Pepper, I., Gerba, C., Gentry, T., & Maier, R. (2008). Environmental Microbiology. Academic Press, USA. 624pp.
11. Rochelle, P.A., (2001). Environmental Molecular Biology: Protocols and applications. Horizon Press, India. 263pp.
12. Singh, A., Kuhad, R.C., & Ward O.P. (2009). Advances in Applied Bioremediation. Springer-Verlag Berlin Heidelberg, Germany.
13. Vineet kumar, Gaurav Saxena & Maulin P. Shah, (2020). Bioremediation for Environmental Sustainability: Approaches to Tackle Pollution for Cleaner and Greener Society (1sted.). Elsevier, 538pp.
14. Zvi Liron, (2012). Novel Approaches in Biosensors and Rapid Diagnostic Assays (1sted.). Springer US. 323pp.

Web Resources:

1. https://bit.ly/3rSsLCV
2. https://clu-in.org/bioremediation/
3. http://ei.cornell.edu/biodeg/bioremed/
4. https://bit.ly/3rUiBll
5. https://bit.ly/356Fj0r

Prepared by : Dr. V. Jelin

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the basic principles and strategies of bioremediation, phytoremediation and biosensors.	**K1, K2**
CO2	To explain the techniques and interpret the applications to many aspects of environment	**K3**
CO3	To analyse the different forms of persistent pollutants to formulate biological methods of treating pollution.	**K4**
CO4	To assess the importance of biomolecules, genetically modified organisms and biosensors that are capable of degrading and monitoring pollutants.	**K5**
CO5	To collate and prepare a flow chart to design a suitable technique to improve the quality of our environment	**K6**

Course Code	PZO3SE02
Course Title	Fishery Science
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	III
Regulation	2022

Course Overview

1. Fishery science is a multidisciplinary science that includes the study on biology, evolution, culture, capture, economics, and management of fishes.
2. It covers the basic concepts such as Systematics and taxonomy of fishes, basic morphology of major groups of fishes, fresh water and brackish water fishery resources, recent trends and techniques in fisheries.
3. This course offers to build advanced knowledge of culturing techniques in riverine, brackish and seawater fisheries and conservation.
4. This course focusses on the economic importance of fishing, fish processing stock management for a better quality of marketing.
5. This course also gives a basic idea of artificial intelligence in fisheries.

Course Objectives

1. To understand the prehistoric and current diversity of fishes
2. To understand fishery resources, biological functions and the ecological roles that fishes play in freshwater, brackish water and marine ecosystems.
3. To understand the methodology in fishing, fish processing and stock management.
4. To understand the biomonitoring systems in fisheries.

Prerequisites	Basic knowledge in Zoology and aquaculture

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Introduction to Fishes** Systematics and taxonomy of fishes; Mechanism of evolution; speciation genetics; Ecological classification of fishes; Major groups of fishes in the world. Biology of commercially important fishes of India; Survey of world fisheries.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Fishery Resources and Management** Riverine fisheries, Cold water fisheries, Estuarine fisheries, Marine fisheries, Coastal resource management. Anthropogenic activities and their impact on coastal fisheries. Management of marine fisheries in Indian context.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Culture Fisheries** Fresh water fish culture; Brackish water fish culture; Mariculture; Nutrition, and disease management; Genetic improvement and hybridization.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Capture, Economics and Fish Processing** Marine fish catch in India and fisheries of commercial importance; classical and modern tools in fishing; Methods of fish stock identification; Recent advances in fish stock assessment, Marking and tagging and its significance. Economics and Fish processing; Fish marketing methods in India; Harvesting; handling, packaging and transport of fish and shell fishes; Methods of preservation and processing of fish. Fishery biproducts marketing.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Recent Techniques in Fisheries** Application of statistical methods in fisheries; Data processing techniques in fisheries; Application of remote sensing in conservation of management of fish and faunal diversity; sonar, radar; Fishways and screens. Fishery monitoring centre and monitoring tools; Fish conservation and Fishing laws. Fisheries research institute in India,	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Bardach, J.E., Ryther, J.H. & Miller, M.D. 2013. Aquaculture: The Farming Husbandry of Freshwater and Marine organisms, B. John Wiley & amp; Sons, New York, 844pp.
2. Bond E. Carl, (2006). Biology of Fishes (3rd ed.). Academic Press Inc., New York, 820pp.
3. Day. F. (1958). Fishes of India (Vol. I and Vol. II). William Sawsan and Sons Ltd., London.
4. Govindan, T.K. (1985). Fish processing, technology. Oxford University, Delhi.
5. Gupta, S.K. and Gupta, P.C. (2006). General & Applied Ichthyology: Fish and Fisheries.
6. S. Chand & company, Mumbai. 1156 pp.
7. Helfman, G.S., Collette, B.B., Facey, D.E., & Bowen, B.W. (2009). The Diversity of Fishes (2nd ed). Wiley-Blackwell Inc., 720 pp.
8. Hoar, W.S. & Randall, D.J. (1984). Fish Physiology (Vol. I-IX). Academic Press, New York, 416pp.
9. Jhingran, V. G. (1997). Fish and fisheries of India. Hindustan publications, India.751pp.
10. Khanna, S.S., & Singh H.R. (2014). A text book of fish biology & fisheries. Narendra publishing house. Jammu. India. 610pp.
11. Kells, V., & Carpenter, K. (2011). A Field Guide to Coastal Fishes: From Marine to Texas. Johns Hopkins University Press, 448pp
12. Lagler, K.F., Bardach, J.E., Miller, R.R., & Passino D.R.M. (2012). Ichthyology (2nd ed). John Wiley & Sons, New York.
13. Megrey, B. A. & Moksness, E., (2009). Computers in Fisheries Research. Springer, USA.
14. Mogalekar, H.S., & Johnson Canciyal., (2015). Remote sensing and GIS for fisheries management, LAP Lambert Academic Publishing, Germany, 132pp.
15. Potts, G.W., & Wootten, R.J., (1984). Fish Reproduction: Strategies and Tactics. Academic Press. 424pp.
16. Parihar, R.P. (1996). A text book of fish biology and Indian fisheries. central publishing house, Allahabad, India.

Web Resources:

1. https://www.fisheries.tn.gov.in
2. https://www.fao.org
3. https://www.oecd.org
4. https://basu.org.in
5. https://bit.ly/3Jtql4a
6. https://fisheries.org/books-journals/online-resources/

Prepared by : Dr. V. Jelin

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the phylogeny, taxonomic classification, basic organisation of fishes, and major fisheries in India and world.	**K1, K2**
CO2	To explain the biology, culturing, fishing, processing and marketing of various fishes	**K3**
CO3	To analyse and compare the anatomy, reproductive potentiality and ecological adaptations in order to improve the aquaculture practices.	**K4**
CO4	To summerise the biology, ecology, pathology, evolution and reproduction to evaluate sustainable fishery.	**K5**
CO5	To collate and discuss to develop advanced techniques and to enhance research in the field of fishery.	**K6**

Course Code	PZO3SE03
Course Title	Environmental Impact Analysis
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	III
Regulation	2022

Course Overview

This course examines principles, procedures, methods, and applications of environmental impact assessment. The goal of the course is to promote an understanding of how environmental impact assessment is conducted and used as a valuable tool in the minimization of development's negative effects.

Course Objectives

1. Appreciate the purpose and role of EIA in the decision-making process;
2. Understand strengths & limitations of environmental management;
3. To critically examine assumptions inherent in impact assessment.
4. To develop skills in identifying and solving problems.
5. To examine a range of environmental impact assessments.
6. To identify and explore impact assessment fields and approaches.
7. To enable students to develop skills in critical thinking and professional procedures through various forms of oral and written presentation and individual and group work.
8. To encourage students to develop their own perspectives on impact assessment and to be able to relate this to other subject areas and to their wider understanding.

Prerequisites	Basics of Environmental biology and Toxicology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Science and Sustainability** Earth's Physical Systems: Matter, Energy, Geology. Environmental Systems and Ecosystem Ecology; Ethics, Economics, and Sustainable Development. Environmental Policy: Making Decisions and Solving Problems. Biodiversity, and Conservation Biology; Forest Management, and Protected Area. The Urban Environment: Creating Sustainable Cities;	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Environmental Health and Toxicology. Marine and Coastal Systems Resources; Atmospheric Science, Air Quality, and Pollution Control. Global Climate Change. Fossil Fuels, Their Impacts and Energy Conservation. Conventional Energy Alternatives; New Renewable Energy Alternatives.			
II	**Classification of Pollution and Pollutants** **Air Pollution**: Primary and Secondary Pollutants, air pollutants-sulfur dioxide- nitrogen dioxide, carbon monoxide, Impact of air pollutants on human, vegetation and environment, , Ambient Air Quality Standards **Water Pollution**: Point and Non-point Source of Pollution, Major Pollutants of Water, Physical, chemical and biological characteristics of water , Water borne diseases, Water Quality standards **Solid Waste**: Classification and sources of Solid Waste, Characteristics of Solid Waste, e waste, Radioactive wastes **Land/Soil Pollution**: Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, pesticide pollution, Effect on Environment **Noise Pollution**: Sources of Noise, Effects of Noise, measurement of noise, Equivalent sound pressure level, Control measures. Radioactive Pollution, Heat/ Thermal Pollution, Light Pollution. **Classification of Pollution:** Classification of pollutants based on the number and spatial distribution and type of emission.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**EIA Origin, Development and Process** Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in planning a Project and its implementation. Assessment process of Environmental Impact: Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation,	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	Appendices and Forms of Application, Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, EIA Document.			
IV	**Main participants in EIA Process** Roles of Project proponents and environmental consultants, Roles of the State Pollution Control Boards (PCBs) /Pollution Control Committee (PCCs), Impact Assessment Act (IAA). Public participation.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Environmental appraisal and procedures in India and EIA** Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation. Impact on Environmental component: air, noise, water, land, biological, social and environmental factors.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Anjaneyulu Y & Manickam Valli, (2011). "Environmental Impact Assessment Methodologies", CRC Press
2. Bryan, F.J. Manly. (2009). Statistics for Environmental Science and Management. CRC Press.
3. Canter, W. L. (1995) Environmental Impact Assessment, McGraw-Hill Science/ Engineering/ Math, New York;
4. Glasson, J., Riki, T., & Andrew, C. (2012). *Introduction to environmental impact assessment* (4th ed). Oxford Brookes University.
5. Kulkarni, V., & Ramachandra, T. V. (2006). *Environmental management, capital pub*. Co. New Delhi.
6. Marriott, B. (1997). *Environmental Impact assessment: A practical guide*. McGraw-Hill Publication.
7. Morris, P. & Therivel, R. (1995) Methods of Environmental Impact Assessment, UCL Press, London;
8. Morris, P., & Therivel, R. (1995). Petts, J. (1999) (ed) Handbook of Environmental Impact Assessment, volume 1 and 2 p. 7. Methods of Environmental Impact Assessment, University College London Press. Blackwell Publishing Science.
9. Naik, S.C. and Tiwari, T.N. (2006). Society and Environment. Oxford & IBH Publishers.
10. Santra, S.C. (2011). Environmental Science. New Central Book Agency

11. Petts, J. (1999) (ed) Handbook of Environmental Impact Assessment, volume 1 and 2, Blackwell Science, Oxford;
12. Rump, H. H. (2000). Laboratory Manual for the Examination of Water, Waste water and soil. Wiley-VCH.
13. Sapru, R. K. (1987). Environmental Management in India (Vol. I & II). Ashish Publishing House.
14. Sawyer, C. N.; McCarty, P. L. & Parkin, G. F. (2002). Chemistry for Environmental Engineering and Science. John Henry Press.
15. Shrivastava, A. K., Nicola, B., & Grimm, J. (2003). *Environmental impact assessment*. APH Publishers.
16. Therivel, R. & Partidario, M.R. (1996) (eds) The Practice of Strategic Environmental Assessment, Earthscan, London; 8. Vanclay, F. and Bronstein, D.A. (1995) (eds) Environmental and Social Impact Assessment, Wiley & Sons, Chichester.
17. Wathern, P. (1990). *Environmental impact assessment: Theory and practice*. Routledge Publishers.

Web Resources

1. https://moef.gov.in/en//
2. https://cpcb.nic.in/
3. http://www.tnpcb.gov.inn/
4. https://www.neeri.res.inn/
5. https://www.secon.inn/
6. https://www.unep.org/
7. https://onlinecourses.nptel.ac.in/

Prepared by : Dr. M. C. John Milton

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To define, describe and recognize the relevance of science and sustainability and enumerate details on pollution and environmental impact assessment.	**K1, K2**
CO2	To illustrate, apply and interpret the origin, magnitude and environmental consequence of pollution and solve issues through Environmental Impact Assessment.	**K3**
CO3	To classify, compare and analyse the types of pollution and its impact on environmental sustainability.	**K4**
CO4	To evaluate and appraise the process involved in Environmental Impact Assessment.	**K5**
CO5	To hypothesize remedial measures for better environmental standards and formulate sustainable methods to implement Environmental Impact Assessment protocols.	**K6**

Course Code	PZO3SE04
Course Title	Intellectual Property Rights
Credits	02
Hours/Week	04
Category	Subject Elective (SE)
Semester	III
Regulation	2022

Course Overview

1. The study lesson provides an in-depth understanding to the students about the various forms of the intellectual property, its relevance and industrial impact in the changing global business environment.
2. Course module is designed to develop greater awareness among students about the patent law in India; importance of patent information in business development; patent search and its importance, and the various database available for conducting patent search.
3. The students must know the importance of Intellectual Property Rights, how the disclosure of invention is to be made in the patent application and to understand the legal aspects governing the various types of infringement.
4. This course will challenge the legal position relating to trade marks, copy rights and geographical indications of goods in India; who are entitled for registration; and when is a registered geographical indication said to be infringed.

Course Objectives

1. To define and discuss the historical perspectives of different types of intellectual property rights.
2. To explain the concept and significance of intellectual property and property rights.
3. To explain the nature and important elements of the intellectual property rights registration and its enforcement.
4. To establish a mutually supportive relationship between the world trade organization and world intellectual property organization.
5. To describe the issues and agenda of the intellectual property rights; legal position relating to IPR and Patent infringement.

Prerequisites	Basic knowledge on IPRs

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**History of IPR** Introduction to IPRs, Basic concepts and need for Intellectual Property - Types and Important Elements of IPR, India's journey to intellectual property right– Genesis and Development, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations.	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Agreements and Legislations** Major International Instruments concerning Intellectual Property Rights: International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, IPR Acts of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Patent** Concept of Patent, Salient Features of Patents, Elements of Patentability- Product/Process of Patents application, duration of Patents - Types of Patent Applications, Filing of a Patent Application, Processing of Application, Patentable Inventions in Biotechnology and patent infringement.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Trade Marks & Copyright** Historical Perspective, Definitions, Object of Trade Marks and copyright. Registration Procedure, Filing and Prosecuting Trade Mark and copyright applications, International Registration Distinction between "Trade Mark" and "Certification Mark" Duration and Renewal procedure.	13	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Industrial Designs** Concept of Design, Procedure for Registration of Designs, Classification of Designs. **Geographical Indications** - Salient Features- Geographical Indication, **Plant variety protection:** meaning and benefit sharing and farmers' rights, other issues related to IPR - Plagiarism.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Damodar Reddy, S. V. (2019). *Intellectual Property Rights—Law and Practice, Asia law house publisher*.
2. Kitchin, D. QC, Llewelyn, D., Mellor, J., Meade, R., Moody-Stuart, T., Keeling, D., & Jacob, R. (2005). *Kerly's law of trademarks and trade names* (14th ed). Sweet and Maxweel.
3. Bouchoux, D. E. (2015). Intellectual property: The law of trademarks. *s Patents and Trade Secrets* (4th ed). Cengage India.
4. Gopalakrishnan, N. S., & Agitha, T. G. (2009). *Principles of Intellectual Property right*. Eastern Book Company.
5. Bansal, K., & Bansal, P. (2013). *Fundamentals of intellectual property for engineers*. BS Publications/British Society of Periodontology Books.
6. Pandey, M., & Dr Pandey, P. (2020). *Intellectual property rights*. Technical Publications.
7. Narayanan, P. (2010). *Law of Copyright and Industrial Designs; Eastern law House, Delhi*.
8. Parulekar, A., & D'Souza, S. (2006). Indian Patents Law. Legal and business implications. Macmillan India Ltd.
9. Ganguli, P. (2011). *Intellectual property rights: Unleashing the knowledge economy, published by TATA*. McGraw-Hill Publishing Company.
10. Satakar, S. V. (2002). *Intellectual property rights and copy rights*. EssEss Publications.
11. ScopleVinod, V. (2012). Managing Intellectual Property, Prentice Hall of India Pvt Ltd.
12. Wadehra, B. L. (2000). *Law relating to patents, trademarks*, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd.

Web Resources

1. https://guides.lib.uchicago.edu
2. http://www.tanscst.nic.in/
3. https://iprindia.org/
4. https://www.wipo.int/
5. https://ipindia.gov.in/

Prepared by : Dr. D. Robert Selvam

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To identify and asses current and emerging issues relating to the intellectual property rights and its protection.	**K1, K2**
CO2	To prepare and practice various forms of IPRs, employ procedures to protect different forms of IPRs.	**K3**
CO3	To assess rights and responsibilities of the holder of patent, copy right, trademark, industrial design and plan variety protection. (CO4- add "to").	**K4**
CO4	To summarize the procedure for registration, effect of registration, statutory provision and terms of protection.	**K5**
CO5	To design and develop legal steps needed to ensure that intellectual property rights remain valid and enforceable. (CO3 – add "to")	**K6**

Course Code	PZO3SE05
Course Title	Histochemistry and Clinical Lab Technology Lab Course
Credits	02
Hours/Week	04
Category	Subject Elective Lab
Semester	III
Regulation	2022

Course Overview

1. Understand the basic concepts of tissue fixation, dehydration, embedding, sectioning, staining and mounting of slides for histological examination
2. This course presents the morphological characteristics of microorganisms, their cultivation methods, and identification. Life cycle, economic importance and microbial diseases
3. This course enables students to stain and identify different macromolecules and nucleic acids
4. This course will help in understanding of basic concepts of practical bacteriology, mycology and procedures involved in tissue culture.
5. This course will help students understand biochemical aspects in clinical lab technology

Course Objectives

1. To understand fixation and staining procedures employed in histochemistry
2. To understand staining and identification of macromolecules and differentiation of nucleic acid
3. To understand the basic concepts of microbiology and bacteriological techniques
4. To understand the mycological and tissue culture procedures in clinical lab technology

Prerequisites	Basic knowledge in Histochemistry and Clinical lab technology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**Tissue Collection, Fixation and Processing** Sources and types histological specimens, Collection methods, Receiving, Recording and labeling. Fixation, Basic principle, properties and classification of fixing fluids. Processing of histological tissues, Tissue Processor - dehydration, cleaning and wax embedding. Technique of bone for histological studies. Decalcification of calcified tissue.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5. K6
II	**Section Cutting and Staining** Equipment for sectioning: Microtome, knife, honing and stropping. Types, care and use of microtome. Techniques and principles of sections cutting – Frozen Section Techniques: Carbon Dioxide Freezing, Cryostat and freezing microtome. Preparation of slide, deparaffinization and Staining. Basic principle and mechanism of Hematoxillin and Eosin staining.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Clinical Laboratory and Molecular Haematology** Code of safe lab practice, safe lab premise, personal safety measures, decontamination of infectious material and disposal of lab waste. Molecular Haematology-Clinical applications of molecular technology in haematology, PCR for Alpha and Beta Thalassemia, and Osmotic Fragility Test (OFT).	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Examination of body fluids** Clinical importance of body fluids, blood, Cerebrospinal fluids, amniotic and Synovial fluid - Formation and function, Chemical composition, Collection, Testing - Gross examination, Chemical analysis, Microbiological examination, Immunological tests, Cytological examination and clinical correlation.	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6
V	**Clinical Chemistry** Glucose determination – Oxidase method, Glucose tolerance test, HbA1C and G-6PD (glucose 6 –	12	CO1 CO2 CO3	K1, K2, K3, K4, K5, K6

	phosphate dehydrogenase). Identify, measure and monitor a wide array of drugs and metabolites in the blood for clinical purposes, The Special Testing Unit performs high-performance liquid chromatography (HPLC) for major biochemical diagnosis.		CO4 CO5	

Suggested Readings

1. Dubey, R. C., & Maheswari, D. K. (2005). A textbook of Microbiology, S. Chand, New Delhi.
2. Fischbach, F. T., & Dunning, M. B. (2009). A Manual of laboratory and Diagnostic Tests. Lippincott Williams & Wilkins.
3. Guyton, A. C., & Hall, J. E. (2010). Textbook of medical physiology. Elsevier.
4. Godkar, P. B., & Godkar, D. B. (2006). Medical laboratory technology, Bhalani, New Delhi.
5. Hall, J. E., & Guyton, A. C. (1996). A textbook of Medical physiology. Saunders.
6. Mukerjee, K. L., & Ghosh, S. (2010). Medical laboratory technology, II. McGraw-Hill
7. Ochei, J., & Kolhatkar, A. (2000). Medical laboratory science: Theory and practice. McGraw-Hill.
8. Pellicciari, C., Biggiogera, M., & Pellicciari. (2017). *Histochemistry of single molecules*. Springer.
9. Rose, S. (1984). Clinical Laboratory safety. Lippincott.
10. Shyamasundari, K., & Rao, K. H. (2007). Histochemistry in focus: A sourcebook of techniques and research needs. Mjp Publishers.
11. Stoward, P. J. (Ed.). (1973). Fixation in histochemistry. Springer.
12. Sood, R. (2006). Text book of Medical Laboratory Technology, Jaypee, New Delhi.
13. Topley, W. W. C., Wilson, S. G. S., & Miles, S. A. (1936). The principles of bacteriology and immunity, Edward Arnold.

Web Resources:

1. https://nios.ac.in
2. https://health.info.com/web/health
3. https://histologyguide.com/
4. https://digitalhistology.org/
5. https://www.rcpath.org/

Prepared By : Dr. S. Maria Packiam

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and recall the basic concepts, main developmental stages, expression of genes, environmental influence in development and causes of infertility.	**K1, K2**
CO2	To determine the mechanism of genetic, cellular, anatomical and environmental interaction on development, and apply experimental procedures and techniques to examine the normal and abnormal embryonic development.	**K3**
CO3	To differentiate and compare the developmental stages of animals and analyse the process of development with appropriate biomolecular techniques.	**K4**
CO4	To assess the regulation and coordination of biomolecules for normal developmental process.	**K5**
CO5	To collate and discuss the interaction of biomolecules and environment in development to Select a broad perspective study on suitable techniques to erase infertility and other developmental genetic disorders.	**K6**

Course Code	PZO3ID01
Course Title	System Physiology – Plant
Credits	03
Hours/Week	06
Category	Inter-Disciplinary (ID)
Semester	III
Regulation	2022

Course Overview

1. Plant physiology is the study of the functional aspects of plants.
2. The aim of the course is to give basic knowledge about how fundamental processes like respiration, photosynthesis, defense, communication and growth takes place in plants.
3. In this course, we will discuss about how biomolecules behave inside cells.
4. It also includes stress physiology in plants, hormone functions and environmental physiology.

Course Objectives

1. To understand the role of different biomolecules in the functioning of plants.
2. To know the process of photosynthesis, respiration, metabolic pathways, translocation etc.
3. To explain the role of different enzymes, secondary metabolites and hormones in stress physiology, growth and reproduction.
4. To know the concept of biological clock and how plants react to environmental changes.

Prerequisites	Basic knowledge in Biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	Absorption and transportation of water, Transpiration, Phtosynthesis, light harvesting complexes, mechanism of electron transport, photoprotective mechanism, Carbon dioxide fixation – C3, C4 and CAM pathways light reactions, carbon reactions, translocation in phloem.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	Respiration, citric acid cycle, ATP synthesis, alternate oxidase, photorespiratory pathway, assimilation of mineral nutrients, nitrogen metabolism – nitrate and ammonium assimilation, amino acid biosynthesis.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	Gametogenesis, embryo sac development and double fertilization, embryogenesis, establishment of symmetry, seed formation and germination.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	Cell aggregation and differentiation in *Dictyostelium*. Shoot and root development, leaf development and phyllotaxy.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	Plant growth regulations, phytochrome and cryptochrome, plant movement, photoperiodism and biological clock. Plant hormones. Fruiting and flowering- *Arabidopsis* and *Antirrhium*. Stress physiology Plant defenses, secondary metabolites.	18	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Bewley, J. D., & Black, M. (1985). Seed physiology of development and germination. Plenum Press.
2. Copeland, L. O., & McDonald, M. B. (2001) Principles of seed sciences and technology. Burgers Publ.Co.
3. Dwivedi, & Dwivedi. (2005). Physiology of abotic stress in plants. Agro bios. India.
4. Hopkins, W. G., & Huner, N. P. A. (2004). Introduction to plant physiology. John Wiley & Sons.
5. Levitt, J. (1981). Plant responses to environmental stresses, I & II. Academic Press.
6. Mukherji, S., & Ghosh, A. K. (2005). Plant physiology. New Central Book Agency.
7. Noggle, G. R., & Fritz, G. (1976). Introductory plant physiology, prentice—Hall, India.
8. Panda, S. K. (2002). Advances in stress physiology of plants. Scientific Publishing.
9. Paul, J. Kramer. (1983). Water Relations of Plants. Academic Press.
10. Salisbury F. B. and Ross. C. 1992. Plant physiology. Wadsworth Publishing Company, Belmont, Califonia.
11. Srivastav, L. M. (1985). Plant growth and development: Hormones and environment. Academic Press.

Web Resources:

1. https://bit.ly/3qmwc3w
2. https://bit.ly/3NhNjO7
3. https://bit.ly/3IuG1Tk
4. https://bit.ly/3rdqcKT
5. https://bit.ly/3JjK7hv
6. https://bit.ly/375wuFF

Prepared By : Dr. Renilda Sophy A. J

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand the functions of organelles in different biological processes in plants.	**K1, K2**
CO2	To correlate the role of hormones/enzymes in different physiological functions of the plants.	**K3**
CO3	To analyze the metabolic pathways of respiration and photosynthesis and mechanism of defense.	**K4**
CO4	To explain the process of regulation in different biological processes in plants.	**K5**
CO5	To compile the various steps involved in gametogenesis, embryogenesis, growth and defense in plants.	**K6**

Course Code	PZO2CD01
Course Title	Biogeography and Conservation Biology
Credits	01
Hours/Week	03
Category	Cross Disciplinary (CD)
Semester	II
Regulation	2022

Course Overview

Biogeography is a dynamic field that seeks to understand the role of historical factors in shaping biodiversity and to develop predictive capacities for gauging how biodiversity will respond to our rapidly changing world. Historically largely descriptive, it has become a rigorous science. The field synthesizes information from a broad range of fields, and the conceptual diversity of the field of biogeography is enormous, including basic sciences and also social sciences.

Course Objectives

1. To understand the historical background and ecological foundations of this area of specialization.
2. To understand the distribution and abundance of species and their changes over time.
3. To familiarize the technologies (including genomic tools and environmental models) to examine the relevance of the field to global change biology, conservation, and invasion biology, as well as sustainable food systems and ecosystem services.

Prerequisites	Knowledge in basic biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**World Climatic Zones and Biomes** History of Biogeography - development of concepts (Linnaeus, Humboldt, Darwin, Wallace, Wegener, Hennig, Brundin, Croizat). Natural Vegetation and Ecosystem, Tundra Biomes, Classifying the Bio climatic Zones, Biogeography Processes, Geographical Distribution of Fungi, Global Distribution of Plants, Global Distribution of animals, Types and Distribution of Forest, Types and Distribution of Fisheries, Phytogeography, Phylogeography	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5. K6

II	**Island Biogeography, Marine Biogeography and Paleobiogeography** Island biogeography: Islands, including sky islands, lakes, mountaintops; progression, Equilibrium theory. Evolution on islands, Endemism, island phenomena; island rule, taxon cycles gigantism, Adaptive radiation; convergence, Marine biogeography, Open ocean, Marine lakes and shallow waters. Island biogeography of marine organisms. Paleobiogeography & fossils, paleobiogeography & fossils (including the potential & limitations of fossils in biogeographic inference).	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Human Biogeography** Biogeography of people and languages. Human Impacts, Domestication, agricultural origins, Invasion biology, Anthropocene and modified dynamics; extinction debts, Modelling the future, Human Races in India, Ecosystem Budget, Human Induced Community Change, Major Gene Centre, Geography of Community, Lifestyle of Humankind, Population and Settlement, Man-Environment Relationship, Domestication of life.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Levels of threats to Biodiversity** Biodiversity at global, regional and local levels. Monitoring & measurement of Biodiversity; useful indices. Threats like overexploitation, fragmentation, habitat loss, poaching of wildlife, man-wildlife conflicts, natural calamities, effect of degeneration of biodiversity on future of evolution. Hotspots and Megadiversity Countries, India as a mega-diversity nation; flora & fauna of other Mega diversity countries; Endangered and Endemic species of India:	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6
V	***In-Situ* and *Ex-Situ* Conservation** Concept and practice; manipulation of wild populations; control of predators, herbivores and competitors; management of problem species; captive breeding; plant propagation; reestablishment and relocation, advance technology in service of endangered species, zoos and botanical gardens, conservation of plant diversity in seed	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	banks, gene banks or germplasm reserves, conservation beyond park, sanctuaries & reserves: habitat conservation. Marine Protected areas.			

Suggested Readings

1. Ackerly, D. D., Loarie, S. R., Cornwell, W. K., Weiss, S. B., Hamilton, H., Branciforte, R., & Kraft, N. J. B. (2010). The geography of climate change: Implications for conservation biogeography. *Diversity and Distributions*, *16*(3), 476–487. https://doi.org/10.1111/j.1472-4642.2010.00654.x
2. Angert, A. L., Crozier, L. G., Rissler, L. J., Gilman, S. E., Tewksbury, J. J., & Chunco, A. J. (2011). Do species' traits predict recent shifts at expanding range edges? *Ecology Letters*, *14*(7), 677–689. https://doi.org/10.1111/j.1461-0248.2011.01620.x
3. Chapman, J.L. & Reiss, M.J. (1999). Ecology: Principles and applications (2nd edition) Cambridge University Press.
4. Daily, G. C., Ceballos, G., Pacheco, J., Suzán, G., & Sánchez-Azofeifa, A. (2003). Countryside biogeography of Neotropical mammals: Conservation opportunities in agricultural landscapes of Costa Rica. *Conservation Biology*, *17*(6), 1814–1826. https://doi.org/10.1111/j.1523-1739.2003.00298.x
5. Dawson, M. N., & Santos, A. (2016). Island and islandlike marine environments. *Global Ecology and Biogeography*, *25*(7), 831–846. https://doi.org/10.1111/geb.12314
6. De Meester, L., Vanoverbeke, J., Kilsdonk, L. J., & Urban, M. C. (2016). Evolving perspectives on monopolization and priority effects. *Trends in Ecology and Evolution*, *31*(2), 136–146. https://doi.org/10.1016/j.tree.2015.12.009
7. Emerson, B. C., & Gillespie, R. G. (2008). Phylogenetic analysis of community assembly and structure over space and time. *Trends in Ecology and Evolution*, *23*(11), 619–630. https://doi.org/10.1016/j.tree.2008.07.005
8. Gavin, M. C., & Sibanda, N. (2012). The island biogeography of languages. *Global Ecology and Biogeography*, *21*(10), 958–967. https://doi.org/10.1111/j.1466-8238.2011.00744.x
9. Ghosh, S.K. & Singh, R. (2003). Social forestry and Forest Management. Global Vision Pub.
10. Green, J. L., Harte, J., & Ostling, A. (2003). Species richness, endemism, and abundance patterns: Tests of two fractal models in a serpentine grassland. *Ecology Letters*, *6*(10), 919–928. https://doi.org/10.1046/j.1461-0248.2003.00519.x
11. Haggett, R. J. (2004). *Fundamentals of biogeography*. Routledge-Taylor and Francis Group.
12. Joseph, B. (2008) Environmental studies, Tata McGraw Hill.

13. Miller, G.T. (2002). Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc.
14. Mittermeier, R. A., Turner, W. R., Larsen, F. W., Brooks, T. M., & Gascon, C. (2011). Global biodiversity conservation: The critical role of hotspots. In *Biodiversity hotspots* (pp. 3–22). Springer.
15. Richardson, D. M., & Whittaker, R. J. (2010). Conservation biogeography–foundations, concepts and challenges. *Diversity and Distributions*, *16*(3), 313–320. https://doi.org/10.1111/j.1472-4642.2010.00660.x
16. Sax, D. F., Stachowicz, J. J., Brown, J. H., Bruno, J. F., Dawson, M. N., Gaines, S. D., Grosberg, R. K., Hastings, A., Holt, R. D., Mayfield, M. M., O'Connor, M. I., & Rice, W. R. (2007). Ecological and evolutionary insights from species invasions. *Trends in Ecology and Evolution*, *22*(9), 465–471. https://doi.org/10.1016/j.tree.2007.06.009
17. Singh, R. B. (2009). *Biogeography and biodiversity*. Rawat Publication.

Web Resources:

1. https://conbio.onlinelibrary.wiley.comm/
2. https://www.gsi.gov.in/
3. https://ansi.gov.inn/
4. https://www.worldwildlife.orgg/
5. https://cites.org/engg/
6. https://www.undp.org/
7. https://www.unep.org/
8. https://www.biogeography.org/

Prepared by : Dr. M. C. John Milton

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand, describe and explain the dimensions of biogeography and its relevance to conservation of natural resources.	**K1, K2**
CO2	To apply, demonstrate and interpret the forms and expressions of biogeographic principles in constructing models and proposing experimental designs to aid conservation policies and initiatives.	**K3**
CO3	To distinguish, categorise and compare the information pertaining to kinds of biogeography to analyze and appraise conservation of natural resources.	**K4**
CO4	To summarise, evaluate and criticise the pros and cons of *in situ* and *ex situ* conservation in the light of economy, demography and value of biodiversity.	**K5**
CO5	To compile, organise and formulate methods and protocols to address issues pertaining to the understanding of biogeography and conservation programmes	**K6**

Course Code	PZO2CD02
Course Title	Forensic Biology
Credits	01
Hours/Week	03
Category	Cross Disciplinary (CD)
Semester	II
Regulation	2022

Course Overview

1. The fundamental principles and functions of forensic science.
2. The significance of forensic science to human society.
3. The working of the forensic establishments in India and abroad.
4. Beginning to apply knowledge from all scientific disciplines to the study of crime.
5. Apply forensic science research to the development of highly discriminating, accurate, reliable, cost-effective, rapid methods for the identification, analysis and interpretation of physical evidence.
6. Produce professional graduates with critical thinking, analysis abilities, laboratory skills and problem-solving skills.

Course Objectives

1. To define forensic science and describe various areas related them to modern day practice.
2. To emphasize the importance of scientific methods in crime detection.
3. To get the information on careers in forensic science.
4. To recognise, identify, examine and testify any and every kind of physical evidence mostly found in crime scenes.
5. Produce graduates who demonstrate ethical backgrounds, articulate the ethical and professional standards of the discipline.
6. To provide a platform for students and forensic scientists to exchange views, collaborative programs and work in a holistic manner for the advancement of forensic science.
7. To write report on different type of crime cases.

Prerequisites	Knowledge in Biology

SYLLABUS				
Unit	**Content**	**Hrs**	**COs**	**Cognitive Level**
I	**History & Development of Forensic Science** Definition, History & Development, Scope, Ethics in Forensic Science Nature, Types, Search methods, Collection, Preservation, Packing & Forwarding of Physical & Trace evidence for forensic analyses, Custody. Crime Scene: Unnatural deaths, Criminal assaults, Sexual offences, Poisoning, Vehicular accidents Courts: Types, powers and jurisdiction, Admissibility of evidence. Organization of Forensic Science Laboratories of Centre and State, NCRB and NICFS Fundamental Rights: Right of Equality (Articles 14 to 18) and Right of Freedom (Articles 19 to 22) as per Constitution of India. Criminal Profiling: Profile of victim and culprit, its role in crime investigation, Lie detection (Polygraphy), Brain mapping,	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Tools and Techniques in Forensic Science** Microscopy, Stereoscopic, Fluorescent and Electron Microscopes. Spectrophotometry: UV, Visible, IR, Atomic absorption, X – rays, XRD, ,Mass Spectroscopy. Chromatographic Techniques: TLC, GLC, HPLC, HPTLC, GC-MS, LC-MS, IR-MS and ICP-MS. Electrophoresis:Immunoassays: Principle, Types, Techniques and applications.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Sample Analysis in Forensic Science** Detection and Identification of Blood stains. Blood Group Systems. Detection of Seminal and other body fluids and their Blood. Disputed Paternity & Maternity. DNA: Structure, DNA as genetic marker, DNA Extraction and Profiling Techniques and RNA Profiling & their applications. Analysis of Ethyl alcohol in beverages, liquors, biological fluids, liquors. Analysis of Chemicals in Trap Cases. Insecticides & Pesticides, & Sedatives, Narcotics, Drugs of abuse and their Toxicity Plant poisons	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

IV	**Forensic Investigation** Fire and Arson: Analyses of Petroleum Products and other incendiary materials. Explosives: Definition, Types and Analyses. Bombs: Country made bombs, Improvised Explosive Devices (IEDs)and their examination. Investigation in Explosion and Arson related cases. Photography: Types, application in criminal investigation & Forensic evidence examination. Hair & Fibers: Nature, Types, Structure and Examination. Pollens and Diatoms: Their application in Forensic investigation. Dust & Soil: Nature, Types, Forensic Examination. Paint, Lacquer & Varnishes: Nature, composition and forensic examination. Glass: Composition, Types, Fractures, Examination. Cement, Mortar and Concrete: General Composition, Forensic Analysis. Computer Forensics: Introduction, Types of Computer crimes, Digital evidence- Seizure, Acquisition and Forensic examination. Mobile Phone Forensics.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Examination, Documentation and Report writing Forensic Science** **Biology:** Comparison of the suspect's and victim's body fluids and hair; most often DNA analysis. **Chemistry:** Identifying non-biological substances found at a crime scene, such as paint, glass, liquids, fuels, and explosive substances. **Toxicology:** The examination of body fluids to determine the level of alcohol present in the body, and providing expert opinions in relation to the extent of intoxication. **Documents Examination:** The analysis of documents to determine authenticity for fraud allegations. Can also provide handwriting comparison. **Firearms Ballistics:** Matching shells, casing, and fired bullets to a weapon and making a determination of bullet trajectory. **Tool mark examination**: Matching tool impressions to an originating suspect tool.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Dahiya, M. S. (2015). Priciples and practices in contemporary forensic sciences, shanti Prakashan.
2. James, S. H., & Nordby, J. J. (2005). Forensic science: An introduction to scientific and investigative techniques (2nd ed). CRC Press Press.
3. Krishnamachari, V. (2017). Law of evidence (7th ed), S. Gogia, & Company.
4. Maloney, M. S. (2014). Crime Scene Investigation: Procedural Guide, CRC Press.
5. Robert, C. (2011). Shaler, crime scene forensics: A scientific method approach. CRC Press.
6. Tilstone, W. J., Hastrup, M. L., & Hald, C. (2013). Fisher's techniques of crime scene investigation. CRC Press Press.
7. Vij, K. (2014). Textbook of forensic medicine and toxicology: Principles and practice—E-book. Elsevier India. ISBN: 8131237850, 9788131237854.

Web Resources:

1. https://bit.ly/3G3jQ6a
2. https://bit.ly/3KHqRg3
3. https://bit.ly/3GRJBqB
4. https://bit.ly/3IqswV2
5. https://bit.ly/3qUM0eO
6. https://bit.ly/3Ky81Yz

Prepared by : Dr. V. Pushpa Rani

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand and Gain knowledge about crime and its elements.	**K1, K2**
CO2	To demonstrate skill in handling clinical equipment	**K3**
CO3	To explain the characteristics of clinical samples analysis.	**K4**
CO4	To evaluate role of the Forensic scientist and physical evidence within the criminal justice system.	**K5**
CO5	To identify and Inspect crime detection and prevention	**K6**

Course Code	PZO3VA01
Course Title	Apiculture, Sericulture and Lac Culture
Credits	01
Hours/Week	02
Category	Value Added (VA)
Semester	III
Regulation	2022

Course Overview

1. The course would provide knowledge on bee keeping, sericulture and lac culture and throw light on the importance of pursuing them as a leisure activity and entrepreneurial venture.
2. Knowledge gained and skills acquired would enhance expertise in this area of specialization and would promote self-employment.

Course Objectives

1. To gain knowledge on apiculture, sericulture and Lac culture and take up entrepreneurship.
2. To improve the technical knowledge on bee keeping, silk and lac production.
3. To develop and promote technical expertise in economic zoology for entrepreneurship.

Prerequisites	Knowledge in basic biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Hive Bees and Bee Keeping** History of beekeeping, beekeeping in India. Species of true honey bees (belonging to genus *Apis*) in the world: Rock bee, *Apis dorsata*, Little bee, *A. florea*, Asian bee, *A. cerana* and European bee, *A. mellifera*. General morphology and anatomy of honey bee. Colony organization, division of labour and life cycle. Social behavior honey bees.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5. K6

II	**Equipment and Tools of Bee Keeping** Bee hive construction, types and installation. Handling of honey bee colony and maintenance of apiary record. Collection and preservation of bee pasture. Seasonal management of honey bee colonies (Spring, Summer, Monsoon, Autumn and Winter Management). Migratory bee keeping. Dividing, uniting, queen management, supplementary feeding, shifting bee colonies, robbing, absconding. Manipulations for Honey Production. Economics of bee keeping. Queen rearing. Familiarization with Enemies of Honey Bees and their Control. Familiarization with diseases of honey bees and their control.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Silkworm Biology** Life cycle of *Bombyx mori*; morphology of egg, larva, pupa and adult. Morphology and anatomy of digestive, circulatory, excretory, respiratory, nervous system of silkworm larva. Morphology and anatomy of reproductive systems of silk moth. Morphology and anatomical structure of Silk gland. Life cycle of *Bombyx mori*- Morphology of egg, larva, pupa and adult of *Bombyx mori*. Sex separation in larva, pupa and adult of the silkworm *Bombyx mori*.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Mulberry Cultivation and Silkworm Rearing** Mulberry cultivation: Propagation of mulberry-seedling, sapling , grafting and layering. Raising of commercial nursery. Establishment of mulberry garden under rain-fed and irrigated conditions. Manures and fertilizers. Intercultivation practices. Irrigation, Leaf harvesting Importance of leaf quality. Silkworm rearing: Rearing house, Rearing appliances, Disinfection, Selection of silkworm races/breeds for rearing, Incubation, Chawki rearing, Late age silkworm rearing, Identification of spinning larva, Harvesting.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6

V	**Lac Culture** Lac insect taxonomy, distribution, life cycle, host plants, strains of lac insect, lac cultivation, local practice, improved practice. Propagation of lac insect, inoculation period, harvesting of lac, composition of lac, lac processing, stick lac, seed lac, shellac, handmade process, heat process, solvent processes. Lac products and their use, lac dye, lac wax, shellac, bleached shellac, dewaxed bleached shellac, aleuritic acid (shellac aleuritic powder).	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Charsley, S.R. (1982). Culture and Sericulture. Academic Press Inc., New York, U.S.A
2. Ganga, G., & J. Sulochana Chetty. (1991) An Introduction to Sericulture. Oxford & IBH Publishing Company.
3. Gatoria, G.S., Gupta, J. K., Thakur, R.K. and Singh, J. (2011). Mass queen bee rearing and multiplication of honey bee colonies. All India Co-ordinated project on honey bees and pollinators, ICAR, HAU, Hisar, p70.
4. Ghorai, N. (1995). Lac-culture in India. India: International Books & Periodicals Supply Service.
5. Glover, P. M. (1937). Lac Cultivation in India: A Practical Manual of Lac Cultivation. (n.p.): Indian Lac Research Institute.
6. Graham, J M (1992) The hive and the honey bee. Dadant and Sons, Hamilton, IIIinois.
7. Gupta, J K. (2010). Spring Management of honey bee colonies. In "OAPI-012 Management of honey bee colonies; Seasonal and specific management (Block 2), Indira Gandhi National open university, school of Agriculture, New Delhi, UNIT-I, pp 5-14, p 105.
8. Gupta, J K. (2010).Management in autumn season. In "OAPI-012 Management of honey bee colonies; Seasonal and specific management (Block 2), Indira Gandhi National open university, school of Agriculture, New Delhi, UNIT-IV, pp 34-40, p 105.
9. Gupta, J K. (2010).Management in monsoon season. In "OAPI-012 Management of honey bee colonies; Seasonal and specific management (Block 2), Indira Gandhi National open university, school of Agriculture, New Delhi, UNIT-III, pp 26-33, p 105.
10. Gupta, J K. (2010). Management in summer. In "OAPI-012 Management of honey bee colonies; Seasonal and specific management (Block 2), Indira Gandhi National open university, school of Agriculture, New Delhi, UNIT-II, pp 15-25, p 105.

11. Gupta, J K. (2010).Management in winter. In "OAPI-012 Management of honey bee colonies; Seasonal and specific management (Block 2), Indira Gandhi National open university, school of Agriculture, New Delhi, UNIT-V, pp 41-50, p 105.
12. Gupta, J.K., Sharma, H K & Thakur, R K. 2009. Practical Manual on Beekeeping. Department of Entomology and Apiculture, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, p 83.
13. Hasao Aruga (1994). Principles of Sericulture (Translated From Japanese) Oxford & Ibh Publishing Co., Pvt. Ltd. New Delhi.
14. Jabde, P. V. (2005). Text Book Of Applied Zoology. India: Discovery Publishing House Pvt. Limited.
15. Kichisaburo M. (1997) Moriculture – Science of Mulberry Cultivation. Oxford & IBH
16. Krishnaswami, S.; Narasimhanna, M.N.; Suryanarayan, S.K And Kumararaj, S. (1973) Sericulture Manual-2 - Silkworm Rearing. Agriculture Service Bulletin, FAO, Rome.
17. Mishra R.C. (1995) Honey bees and their management in India. ICAR Publication, New Delhi.
18. Rajanna, L., Das, P.K., Ravindran, S., Bhogesha, K., Mishra, R.K., Singhvi, N.R., Katiyar, R.S. & Jayaram, H. (2005) Mulberry Cultivation and Physiology. Central Silk Board, Bangalore.
19. Rangaswami, G.; Narasimhanna, M.N.; Kasiviswanathan, K., Sastry, C.R. & Jolly, M.S. (1976) Sericulture Manual-1- Mulberry Cultivation. Agriculture Services Bulletin, FAO, Rome.
20. Sharma, K. K., Ramani, R.& Jaiswal, A. K. (2011). LAC Culture Operations When, why &How?. India: Indian Institute of Natural Resins and Gums.
21. Singh, J. P & Jaiswal, A. K. (2010). How to Culture Lac Insect on *Schleichera oleosa* (Kusum) Tree?. India: ICAR, Indian Institute of Natural Resins and Gums.

Web Resources:

1. https://icar.org.in/
2. http://www.csrtimys.res.in//
3. http://www.csrtiber.res.in//
4. https://csb.gov.in//
5. https://cmerti.res.in//
6. https://iinrg.icar.gov.in//
7. https://www.kvic.gov.in//
8. https://www.iihr.res.in//
9. https://nbb.gov.in/

Prepared by : Dr. M. C. John Milton

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand, identify and recognise areas and specialization in the field of zoology for the promotion of entrepreneurial ventures.	**K1, K2**
CO2	To explore, apply and demonstrate the possibilities of animal rearing methods and illustrate and promote self-employment.	**K3**
CO3	To compare, categorise and explain the efficiency of cultivable species of insects and propose appropriate species types and methods to promote entrepreneurship.	**K4**
CO4	To summarize and appraise the different methods of culturing beneficial insects and recommend and promote insect culturing as a recreational activity and business venture.	**K5**
CO5	To design, formulate and construct insect culture models for small, medium and large scale industries.	**K6**

Course Code	PZO3VA02
Course Title	Freshwater and Brackish water Aquaculture
Credits	01
Hours/Week	02
Category	Value Added (VA)
Semester	III
Regulation	2022

Course Overview

1. This course offers an insight on the scientific practices involved in the culture, rearing and marketing of fishery resources from fresh and brackish water habitats.
2. The knowledge gained would promote entrepreneurship.

Course Objectives

1. To know the present status of freshwater and brackish water aquaculture and their role in world economy and food production.
2. To gain knowledge on carp, prawn, shrimp and crab culture and composite fish culture systems.
3. To improve the technical knowledge on fish and shrimp hatchery technology and culture practices. To improve the knowledge and technical skills for the identification of cultivable finfish and shellfish.

Prerequisites	Knowledge in Basic biology

SYLLABUS

Unit	Content	Hrs	COs	Cognitive Level
I	**Cultivable species and Culture systems** Status, scope and prospects of aquaculture. Freshwater and brackish water ecosystems in India. Cultivable species of fishes and their biology. Culture of air breathing fishes- *Channa, Heteropneustes, Clarius, Anabas*. Monoculture and polyculture of – *Chanos chanos, Mugil cephalus, Lates calcarifer*. Breeding and Culture of milk fish, *Chanos chanos*; Asian sea bass, *Lates calcarifer*; grey mullet, *Mugil cephalus* ; *Osteobrama belangeri*. Culture systems - Water-based systems (cages and pens, inshore/offshore). Land-based	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5. K6

	systems (rain fed ponds, irrigated or flow-through systems, tanks and raceways). Recycling systems (high control enclosed systems, more open pond based recirculation).			
II	**Reservoir fisheries & Integrated Farming** Inland water bodies suitable for culture in India. Major reservoirs in India, measures for increasing production from reservoirs in India. Recent development in integrated farming – Rice cum fish culture, Duck cum fish culture, Poultry cum fish culture and Pig cum fish culture. Organic aqua farming. Aquaculture for stable environment: Sewage fed fish culture, sewage treatment, Sewage cum fish culture in India. Fish in relation to public health – Larvivores fishes and mosquito eradication using fishes.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Culture of crustaceans and molluscs** Cultivable species of freshwater and brackish water prawns and their biology. Culture of *Penaeus monodon, Penaeus indicus, Litopenaeus vannamei.* Essentials of prawn Hatchery; Culture management techniques of Nursery and Grow-out ponds. Freshwater pearl culture – Present status of freshwater pearl culture and production in India. Culture of pearl oysters. Fish and shellfish culture in cages and pens. Crab culture (*Scylla serrata, Scylla occeanica and Charybdis sp*.): Pond design, management of crab farm, fattening process of crab. Culture of sea weeds: Commercial importance of seaweed species. Extensive, semi-intensive and intensive shrimp farming practices.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Ornamental Fish culture and Aquarium plants** Breeding of ornamental fish with reference to live bearer species. Breeding of Guppies, Mollies, Sward tail fish and Platy fish. Breeding of ornamental fish with reference to selected egg layer species. Breeding of Angel fish, Zebra fish and Neon tetra. Hatchery and nursery management system for live bearers and egg layers. Ornamental Fish-diseases and their	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5,K6

	management. Live Food culture for tropical ornamental fish. Aquarium plants and its propagation techniques. Management of ornamental aquatic plants and its trading.			
V	**Hatchery technology in aquaculture** Hatchery management-seed production of carps. Hypophysation of Indian major carps and exotic carps, history of hypophysation. Pituitary gland. Collection and preservation of gland. Other ovulating agents. Brood stock management, sexing, dosage for injection, mechanism of ovulation. Carp Production System and Seed production of other Fishes. Transport of fish seed and brood fishes. Causes of mortality during transport, techniques of transport, open and closed systems, methods of transportation, use of anaesthetics. Carp seed resources in major rivers India. Bundh breeding, types of bundh breeding techniques. Problems of bundh breeding. Seed Production of Crustaceans and Molluscs. Seed production and nursery rearing of *Penaeus indicus, Penaeus monodon and Macrobrachium rosenbergii*. Hatchery operations of pearl oysters, crabs, lobster. Hatchery Management and Design of shrimp hatcheries. Site selection. Operation and management of maturation section. Operation and management of larval section. Operation and management of post larval section. Live feed culture system, Mechanical and biological filters.	6	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. Blackwell Rath, R. K. (2000). *Freshwater aquaculture*. Scientific Publishing.
2. Boyd, C. E. (1982). *Water quality management for pond Fish culture. Elsevier Sci. Publ*. CO.
3. Chakraborty, C., & Sadhu, A. K. (2000). *Biology hatchery and culture technology of tiger prawn and giant freshwater prawn. Daya Publ. House*.
4. CIFE. (1993). *Training manual on culture of live food organisms for aqua hatcheries*. CIFE.
5. De Silva, S. S., & Anderson, T. A. (1995). *Fish nutrition in aquaculture. Chapman and hall aquaculture series*.

6. Food and Agriculture Organization. (2007). Manual on freshwater prawn farming.
7. Huet, J. (1986). *A textbook of Fish Culture*. Fishing News Books Ltd.
8. Indian Council of Agricultural Research. (2006). *Hand book of fisheries and aquaculture*. Indian Council of Agricultural Research.
9. Jhingran, V. G. (1998). *Fish and fisheries of India*. Hindustan Publishing Corporation.
10. Bardach, J. E., Ryther, J. H., & McLarney, Wm. O. (1972). *Aquaculture: The farming and husbandry of freshwater and marine organisms*. John Wiley & Sons.
11. Landau, M. (1992). *Introduction to aquaculture*. John Wiley & Sons.
12. Mcvey, J. P. (1983). *Handbook of mariculture*. CRC Press.
13. New, M. B. (2000). *Freshwater prawn farming*. CRC Press Publishing.
14. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture- principles and practices* (2nd ed). Blackwell Publishing.
15. Rath, R. K. (2000). *Freshwater aquaculture*. Scientific Publishing.
16. Stickney, R. R. (1979). *Principles of warmwater Fish culture*. John Wiley & Sons.

Web Resources:

1. https://www.fao.org/aquaculture/en/
2. https://www.cmfri.org.in//
3. https://fsi.gov.in//
4. http://www.ciba.res.in//
5. https://cifnet.gov.in//
6. https://www.agrifarming.in//
7. www.mpeda.com
8. www.cifa.in/
9. www.ofish.org
10. www.nabard.org/english/fish_ornamental_fish.aspx

Prepared by : Dr. M. C. John Milton

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To understand, identify, recognise and popularise the potential of aquaculture and promote self-employment.	**K1, K2**
CO2	To explore, apply and demonstrate cost effective aquaculture practices for entrepreneurial ventures	**K3**
CO3	To compare, categorise and explain the efficiency of cultivable species of fishes and propose appropriate species types and methods to impart employable skills and promote entrepreneurship.	**K4**
CO4	To summarize and appraise the different methods of culturing fishes and recommend and promote aquaculture as a recreational activity and business venture.	**K5**
CO5	To design, formulate and construct business models for small, medium and large scale industries.	**K6**

LOCF BASED DIRECT ASSESSMENTS

COGNITIVE LEVEL (CL) AND COURSE OUTCOME (CO) BASED CIA QUESTION PAPER FORMAT (PG)

SECTION		Q. NO	COGNITIVE LEVEL (CL)					
			K1	K2	K3	K4	K5	K6
A	(5 x 1 = 5) Answer ALL	1(a)	+					
		(b)	+					
		(c)	+					
		(d)	+					
		(e)	+					
	(5 x 1 = 5) Answer ALL	2(a)		+				
		(b)		+				
		(c)		+				
		(d)		+				
		(e)		+				
B	(1 x 8 = 8) Answer 1 out of 2	3			+			
		4			+			
C	(1 x 8 = 8) Answer 1 out of 2	5				+		
		6				+		
D	(1 x 12 = 12) Answer 1 out of 2	7					+	
		8					+	
E	(1 x 12 = 12) Answer 1 out of 2	9						+
		10						+
No. of CL based Questions with Max. marks			5 (5)	5 (5)	1 (8)	1 (8)	1 (12)	1 (12)
No. of CO based Questions with Max. marks			CO1		CO2	CO3	CO4	CO5
			10 (10)		1 (8)	1 (8)	1 (12)	1 (12)

Forms of questions of **Section A** shall be MCQ, Fill in the blanks, True or False, Match the following, Definition, Missing letters. Questions of **Sections B, C, D and E** could be Open Choice/ built in choice/with sub sections. Component III shall be exclusively for cognitive levels K5 and K5 with 20 marks each. CIA shall be conducted for 50 marks with 90 min duration.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 60034

Department of Advanced Zoology and Biotechnology

FIRST CONTINUOUS ASSESSMENT TEST, JULY, 2022

PZO2MC04 Cellular Organization and Molecular Processes (MC)

I MSc Zoology 15.07.2022

Time : 10.00am to 11.30 am Max. Marks : 50

	SECTION A		
Answer ALL the Questions			
1.	**Define the following**	**(5 x 1 = 5)**	
a)	PPLO.	K1	CO1
b)	Resolving power of a microscope.	K1	CO1
c)	Suicide bags.	K1	CO1
d)	Transcription.	K1	CO1
e)	Genetic code.	K1	CO1
2.	**Fill in the blanks**	**(5 x 1 = 5)**	
a)	Uncontrolled proliferation of cells is known as _____.	K2	CO1
b)	_____ is a vital stain.	K2	CO1
c)	Proliferative cell division is known as _____.	K2	CO1
d)	_____ is an example for a fixative.	K2	CO1
e)	_____ is an example for an oncogene.	K2	CO1
	SECTION B		
Answer any ONE of the following in 250 words		**(1 x 8 = 8)**	
3.	Classify 'Endoplasmic reticulum' giving reasons	K3	CO2
4.	Illustrate the animal cell and enumerate points on cell organelles	K3	CO2
	SECTION C		
Answer any ONE of the following in 250 words		**(1 x 8 = 8)**	
5.	Analyse the role of ribosomal subunits in protein synthesis	K4	CO3
6.	Distinguish the roles of Euchromatin and Heterochromatin.	K4	CO3
	SECTION D		
Answer any ONE of the following in 500 words		**(1 x 12 = 12)**	
7.	Compare the intrinsic and extrinsic properties of DNA.	K5	CO4
8.	Evaluate the ultrastructure, composition and functions of cytoplasm.	K5	CO4
	SECTION E		
Answer any ONE of the following in 500 words		**(1 x 12 = 12)**	
9.	Summarize the structure, composition and functions of cytoplasm.	K6	CO5
10.	Double helical structure provides stability to DNA – Substantiate.	K6	CO5

COGNITIVE LEVEL (CL) AND COURSE OUTCOME (CO) BASED END SEMESTER EXAMINATION QUESTION PAPER FORMAT (PG)

SECTION		Q. NO	COGNITIVE LEVEL (CL)					
			K1	K2	K3	K4	K5	K6
A	(5 x 1 = 5) Answer ALL	1(a)	+					
		(b)	+					
		(c)	+					
		(d)	+					
		(e)	+					
	(5 x 1 = 5) Answer ALL	2(a)		+				
		(b)		+				
		(c)		+				
		(d)		+				
		(e)		+				
B	(3 x 10 = 30) Answer 3 out of 5	3			+			
		4			+			
		5			+			
		6			+			
		7			+			
C	(2 x 12.5 = 25) Answer 2 out of 4	8				+		
		9				+		
		10				+		
		11				+		
D	(1 x 15 = 15) Answer 1 out of 2	12					+	
		13					+	
E	(1 x 20 = 20) Answer 1 out of 2	14						+
		15						+
No. of CL based Questions with Max. marks			5 (5)	5 (5)	3 (30)	2 (25)	1 (15)	1 (20)
No. of CO based Questions with Max. marks			CO1		CO2	CO3	CO4	CO5
			10 (10)		3 (30)	2 (25)	1 (15)	1 (20)

IMPORTANT

- Forms of questions of **Section A** shall be MCQ, Fill in the blanks, True or False, Match the following, Definition, Missing letters.
- Questions of **Sections B, C, D and E** could be Open Choice/ built in choice/questions with sub divisions.
- Maximum sub divisions in questions of Sections B, C shall be 2 and 4 in Sections D, E).

UNIT WISE DISTRIBUTION OF CL AND CO BASED QUESTIONS AND MARKS FOR END OF SEMESTER QUESTION PAPER SETTING (PG)

	SECTION A		SECTION B	SECTION C	SECTION D	SECTION E
	K1	K2	K3	K4	K5	K6
UNIT I	1 (1)	1 (1)	1 (12.5)			
UNIT II	1 (1)	1 (1)	1 (12.5)	1 (12.5)	1 (20)	
UNIT III	1 (1)	1 (1)	1 (12.5)	1 (12.5)	1 (20)	
UNIT IV	1 (1)	1 (1)	1 (12.5)	1 (12.5)		1 (20)
UNIT V	1 (1)	1 (1)	1 (12.5)	1 (12.5)		1 (20)
No. of CL based Questions with Max. Marks	5 (5)	5 (5)	3 (30)	2 (25)	1 (15)	1 (20)
No. of CO based Questions with Max. Marks	CO1		CO2	CO3	CO4	CO5
	10 (10)		3 (30)	2 (25)	1 (15)	1 (20)

TOTAL MARKS DISTRIBUTION OF DIRECT ASSESSMENTS BASED ON CL AND CO (PG)

Course Outcome	CO1		CO2	CO3	CO4	CO5	TOTAL
Cognitive Levels	K1	K2	K3	K4	K5	K6	
CIA 1	5	5	8	8	12	12	50
CIA 2	5	5	8	8	12	12	50
Comp III	-	-	-	-	20	20	40
Semester	5	5	30	25	15	20	100
Total Marks (CL)	15 (6%)	15 (6%)	46 (19%)	41 (17%)	59 (25%)	64 (27%)	240
Total Marks (CO)	30 (12%)		46 (19%)	41 (17%)	59 (25%)	64 (27%)	240

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 60034

Department of Advanced Zoology and Biotechnology

END SEMESTER EXAMINATION, OCTOBER, 2022

PZO2MC04 Cellular Organization and Molecular Processes (MC)

I MSc Zoology 15.11.2022

Duration : 3 hrs Max. Marks : 100

	SECTION A			
Answer ALL the Questions				
1.	**Match the following**			**(5 x 1 = 5)**
a)	BRCA1	DNA	K1	CO1
b)	G1 Phase	Codon	K1	CO1
c)	Centriole	Chromosome	K1	CO1
d)	Replication	Cancer marker	K1	CO1
e)	UGG	mRNA	K1	CO1
2.	**TRUE or FALSE**			**(5 x 1 = 5)**
a)	All cells have a cell wall.		K2	CO1
b)	Chromosomes are found in the cytoplasm.		K2	CO1
c)	There is a cell membrane around all cells.		K2	CO1
d)	All cells have a central cell vacuole filled with fluid.		K2	CO1
e)	A nucleus is smaller than a molecule.		K2	CO1
	SECTION B			
Answer any THREE of the following in 500 words				**(3 x 10 = 30)**
3.	Explain Signal peptide hypothesis.		K3	CO2
4.	Illustrate and explain the structure and principle behind SEM.		K3	CO2
5.	Prepare and present the protocol of tissue sectioning by microtome.		K3	CO2
6.	Write down the details on Fluid Mosaic model of plasma membrane.		K3	CO2
7.	Analyse the role of ribosomal subunits in protein synthesis.		K3	CO2
	SECTION C			
Answer any TWO of the following in 500 words				**(2 x 12.5 = 25)**
8.	Analyse the role of macrophage in defence mechanism.		K4	CO3
9.	Classify cell organelles giving reasons.		K4	CO3
10.	Compare the structural properties of plant and animal cell.		K4	CO3
11.	Correlate the details on ribosomal subunits with protein synthesis.		K4	CO3

SECTION D			
Answer any ONE of the following in 1000 words			**(1 x 15 = 15)**
12.	Evaluate details on the following a) Types of cancer b) Causes of cancer c) Prognosis of cancer d) Diagnosis of cancer.	K5	CO4
13.	Summarise the details on the following with illustrations. a) Mitosis b) Meiosis	K5	CO4
SECTION E			
Answer any ONE of the following in 1000 words			**(1 x 20 = 20)**
14.	Double helical structure gives stability to DNA molecule – Organise your defence on the following lines. a) Bonding and base pair b) Base pairing mechanism	K6	CO5
15.	Summarise the road map for cell cycle and gene manipulation (or) Formulate the methodology involved in the synthesis of recombinant DNA technology and vaccine production.	K6	CO5