G.T.N. ARTS COLLEGE (Autonomous)

Dindigul

(Affiliated to Madurai Kamaraj University)

(Accredited by NAAC with 'B' Grade)

DEPARTMENT OF ZOOLOGY

SYLLABUS

Under Outcome Based Eduation (OBE)

(With effect from the academic year 2020 – 2021)

DEPARTMENT OF ZOOLOGY

About the Department

The Department of Zoology was established in the academic year 1964 as an ancillary department and was upgraded to offer under graduate programme in the year 1986 during the tenure of Mr. R. Rajaraman, the Head of the Department. The special interest of the department is to impart education to rural students and to inculcate value based professionals in Life Science. The department has a well maintained library and museum with diverse collection of specimens and well equipped laboratory. The department has well qualified and experienced faculty members who constantly motivate, inspire and guide the students for their personal growth and to become technically competent. The Department frequently organizes guest lectures, workshops and National level seminars to promote scientific attitude among the students and young teachers which will motivate them to take up research. Students are encouraged to take up individual projects to meet their academic requirements. Moreover, our staff members present research papers and participate in many national and international conferences, seminars and workshops.

The Department offers all major courses related to Zoology, Ancillary Courses, Skill Enhancement Certificate Courses to develop job and entreprenuer skills in the field of biology and agriculture to promote self employment opportunities. The Department offers two Non Major Elective Courses (NME) for interested students from all the disciplines to promote employment skills among the student. Special emphasis is given for field trips and study tours to nearby Poultry farms, Vermicompost units, to gain practical skills. Students also undergo Hands on Training in Clinical Laboratories, Mushroom technology, Poultry farming etc.

PRINCIPAL

Dr. P. Balagurusamy,M.A., M.Phil., M.Ed., P.G.D.C.A., Ph.D.,

STAFF MEMBERS

1.Dr.K. Krishnaveni, M.Sc., M.Phil. Ph. D.	**Assistant Professor and DeanMentor-Mentee**
2. Dr. N. Renuga Devi, M.Sc., M.Phil., Ph. D.	**Assistant Professor and Head**
3. Dr. A. Jeevalatha, M.Sc., M.Phil., SET, Ph. D.	**Assistant Professor**
4. Dr. S. Dharaneedharan, M.Sc., Ph.D.	**Assistant Professor**
5. Mrs. B. Subasri, M.Sc., B.Ed., M.Phil., SET	**Assistant Professor**

Under Choice Based Credit System (CBCS)

Course Pattern for B.Sc., Zoology

The Undergraduate degree course consists of five vital components. They are as follows:

Part I Language (Tamil / French)
Part II English
Part III Core Course (Theory, Practical, Electives, Allied, Project and Internship).
Part IV Skill Based, Non Major Electives, Environmental Studies, Value Education and Self Study
Part V Physical Education (Non Semester) and Extension Activities.

Objectives

The Syllabus for **B.Sc., Zoology** Programme under semester system has been designed on the basis of Choice Based Credit System (CBCS), which would focus on job oriented programmes and value added education. It will come into effect from June 2020 onwards.

Eligibility

Candidates should have passed the Higher Secondary Examination, Government of Tamil Nadu or any other examination accepted by the syndicate of Madurai Kamaraj University as equivalent there to.

Duration of the Course

The students who join the **B.Sc., Zoology** Programme shall undergo a study period of three academic years – Six semesters.

Summary of Hours and Credits

Part	Semester	Specification	No. of Course	Hrs	Credit	Total Credits Credits
I	I - IV	**Languages** (Tamil / French)	4	24	12	12
II	I - IV	**English**	4	24	12	12
III	I - VI	**Core Courses**				102
		Theory	12	42	44	
		Practicals	5	20	10	
	V	Project / Internship	1	-	02	
	V & VI	**Core Electives Courses**	2	6	06	
	I - VI	**Allied Courses**				
		Theory	8	32	32	
		Practicals	4	16	08	
IV	I – IV	**Skill Based Courses**	4	8	8	20
	III & IV	**Self Study Courses** 1. Soft Skill I 2. Soft Skill II	2	-	4	
	I & II	**Non Major Electives**	2	4	4	
	I	**Value Education**	1	2	2	
	II	**Environment & Gender Studies**	1	2	2	
V		**Physical Education (Practical)**	1	-	2	4
		Extension Activities	1	-	2	
		TOTAL	**52**	**180**	**150**	**150**

Programme Outcomes (POs)

On successful completion of the B.Sc. programme, the graduates will be able to,

1. Apply the knowledge acquired in the respective disciplines and also have a multidisciplinary perspective towards the study of sciences.
2. Attain skills like analytical reasoning, critical thinking and problem solving to evince interest in higher education and research for offering solutions to societal and environmental problems.
3. Communicate articulately and effectively and interpret the results obtained from scientific studies and put forth innovative ideas to carve a niche in their domain.
4. Instill the principles and ethics learnt from the field of study and exhibit the qualities like leadership, entrepreneurship and teamwork for discharging their duties as responsible citizens.
5. Utilize the growing advancements in Information and Communication Technology and embrace digital learning to become life-long learners.

Program Specific Outcomes

After the completion of three years under graduation programme of Zoology, the students will be able to :

PSO1	Demonstrate basic vital concepts and comprehensive knowledge of various disciplines of Life Sciences and to appreciate the complexity and rich diversity of living organisms, their bio chemical, physiological, ecological and evolutionary interrelationships between them and their environment.
PSO2	Classify the Animal Kingdom into different phyla, describe their salient features, identification, morphology, anatomy, physiology and parasitology of living organisms.
PSO3	Recognize and analyze the relationships between structure and functions at different levels of biological organizations (eg. biomolecules, metabolic pathway, genes, genome, cells, tissues, organs, organ systems, development of an organisms, populations and species) for the major group of animals.
PSO4	Construct basic skills in the physical, chemical, biological and statistical techniques, observation and study of nature, experimental skills and scientific investigation, modern scientific and IT tools and to attain the excellence in critical thinking and problem solving and apply that skills for the upliftment of one-self and the society.
PSO5	Develop scientific temper among the students for higher studies and keen interest in research and to have concern for the conservation of flora, fauna and live with scientific values.
PSO6	Develop and update domain knowledge in arts, science subjects relevant to the chosen career and clear the various levels of competitive exams.
PSO7	Be a part of nation building initiatives as a biologist to cultivate the character and courage to shoulder responsibilities to solve the environmental and epidemiological issues in the community.
PSO8	Infer personal and multidimensional skills and aware of applications of Life Sciences and to highlight the potential of various branches to become an entrepreneur.
PSO9	Demonstrate proficiency in communicating competently in groups and organizations, competence in interpersonal communication and to possess skills to deliver formal and informal presentations effectively.
PSO10	Illustrate and appreciate environmental conservation process and its importance, pollution control and biodiversity and protection of endangered species and to develop empathy and love towards animals.
PSO11	Improve a conviction to believe in self, impart professional and ethical attitude, nurture to be an effective team member, infuse leadership qualities, build proficiency in Biological skills and the abilities to relate with the social issues.
PSO12	Develop a passion to be an independent lifelong learner by imbibing real time changes in the socio - technological context, promoting continuous development and improvement of the knowledge and skills needed for employment and personal fulfillment.

Course Pattern – from 2020-2021 Onwards

Sem	Part	Study Component	Course Code	Course Title	Hrs	Credit
I	I	Tamil	20UTAL11	jw;fhyf; ftpijAk; rpWfijAk	6	3
	II	English	20UENL11	Language through Literature - I	6	3
	III	Core Course I	20UZOC11	Animal Diversity I – Non Chordates	3	3
		Core Course II	20UZOC12	Cell Structure and Dynamics	3	3
		Core Practical - I	20UZOC2P	Core Practical - I	2	-
		Allied – Chemistry	20UCHA11	Inorganic and Organic Chemistry	4	4
		Allied – Chemistry Practical - I	20UCHA2P	Volumetric Analysis	2	-
	IV	Non Major Elective Course – I	20UZON11	Pisciculture and Management	2	2
		Value Education	20UVEV11	Value Education	2	2
				Total	**30**	**20**
II	I	Tamil	20UTAL21	gf;jp ,yf;fpaKk; GjpdKk;	6	3
	II	English	20UENL21	Language through Literature - II	6	3
	III	Core Course III	20UZOC21	Animal Diversity II - Chordates	3	3
		Core Course IV	20UZOC22	Embryology and Human Reproductive Technology	3	3
		Core Practical - I	20UZOC2P	Core Practical - I	2	2
		Allied Chemistry - II	20UCHA21	Inorganic and Physical Chemistry	4	4
		Allied – Chemistry Practical - I	20UCHA2P	Volumetric Analysis	2	2
	IV	Non Major Elective Course - II	20UZON21	Insect and Pest Management	2	2
		Environment & Gender Studies	20UEGS21	Environment & Gender Studies	2	2
	V	Physical Education (Non-Semester Course)	20UPEV2P	Physical Education - Practical	-	2
				Total	**30**	**26**
III	I	Tamil	20UTAL31	Fhg;gpa ,yf;fpaKk; ciueilAk;	6	3
	II	English	20UENL31	Language through Literature - III	6	3
	III	Core Course V	20UZOC31	Principles of Genetics and Evolutionary Biology	4	4

		Core Practical - II	20UZOC4P	Core Practical - II	2	-
		Allied Chemistry - III	20UCHA31	Organic and Physical Chemistry	4	4
		Allied Chemistry Practical - II	20UCHA4P	Organic Analysis	2	-
		Allied Botany - I	20UBOA11	Thallophytes & Archegoniatae	4	4
		Allied Botany Practical - I	20UBOA2P	Thallophytes,Archegoniatae, Biodiversity and Plant Biotechnology Practicals	2	-
	IV	Self Study Course I	20USSS31	Soft Skills I	-	2
				Total	**30**	**20**
IV	I	Tamil	20UTAL41	gz;ila ,yf;fpaKk; ehlfKk;	6	3
	II	English	20UENL41	Language through Literature - IV	6	3
	III	Core Course VI	20UZOC41	Molecular Biology	4	4
		Core Practical - II	20UZOC4P	Core Practical - II	2	2
		Allied Chemistry - IV	20UCHA41	Organic, Inorganic & Physical Chemistry	4	4
		Allied – Chemistry Practical - II	20UCHA4P	Organic Analysis	2	2
		Allied Botany - II	20UBOA21	Biodiversity,and Plant Biotechnology	4	4
		Allied Botany Practical - I	20UBOA2P	Thallophytes,Archegoniatae, Biodiversity and Plant Biotechnology Practicals	2	2
	IV	Self Study Course II	Soft Skills	Soft Skill II	-	2
	V	Extension Activity - All Clubs, NCC, NSS, etc..	20UEX4EC	Eco Club	-	2
				Total	**30**	**28**
V	III	Core Course VII	20UZOC51	Biostatistics and Research Methodology	4	4
		Core Course VIII	20UZOC52	Human Anatomy and Physiology	4	4
		Core Course IX	20UZOC53	Biotechnology and rDNA Technology	3	4
		Core Practical - III	20UZOC6P	Core Practical - III	2	-
		Core Practical - IV	20UZOC6Q	Core Practical - IV	2	-
		Core Practical - V	20UZOC6R	Core Practical - V	2	-
		Core Elective - I	20UZOE51	Endocrinology	3	3
			20UZOE52	Nanobiology		
			20UZOE53	Biodiversity & Conservation Biology		

		Allied Botany – III	20UBOA31	Angiosperm Taxonomy, Plant Embryology and Ethnobotany	4	4
		Allied Botany Practical - II	20UBOA4P	Angiosperm Taxonomy, Plant Embryology and Ethnobotany	2	-
		Project			-	2
	IV	Skill Based Course - I	20UZOS51	Aquaculture	2	2
		Skilled Based Course - II	20UZOS52	Bio-fertilizer and Organic Farming	2	2
				Total	**30**	**25**
VI	III	Core Course X	20UZOC61	Biochemistry	4	4
		Core Course XI	20UZOC62	Applied Microbiology	4	4
		Core Course XII	20UZOC63	Immunology and Immuno technology	3	4
		Core Practical – III	20UZOC6P	Core Practical - III	2	2
		Core Practical - IV	20UZOC6Q	Core Practical - IV	2	2
		Core Practical - V	20UZOC6R	Core Practical - V	2	2
		Core Elective Course II	20UZOE61	Clinical Pathology & Laboratory Techniques	3	3
			20UZOE62	Food Nutrition & Public Health		
			20UZOE63	Insect Diversity		
		Allied Botany – IV	20UBOA41	Plant Physiology and Horticulture	4	4
		Allied Botany Practical - II	20UBOA4P	Angiosperm Taxonomy, Plant Embryology and Ethnobotany, Plant Physiology and Horticulture	2	2
		Internship			-	-
		Skilled Based Course - III	20UZOS61	Intellectual Property Rights	2	2
	IV	Skilled Based Course - IV	20UZOS62	Basic Bioinformatics	2	2
				Total	**30**	**31**
	Overall Total for all VI Semesters				**180**	**150**

*** Practical Examination will be held at the end of the Academic year.**

Programme	**B.Sc. Zoology**	**Programme Code**	**UZO**
Course Code	**20UZOC11**	**No. of Hrs per Cycle:**	**3**
Semester	**I**	**Max: Marks:**	**60**
Part	**III**	**Credit**	**3**
Core Course I			
Course Title	**ANIMAL DIVERSITY I - NON CHORDATES**		
Cognitive Level – Up to K3 Level			

Preamble

Enhance the knowledge about the taxonomy of animals and their general characteristic features, significance of coral reefs, life cycle and adaptation of endo-parasites.

Unit I: Classification of Kingdom Animalia **9 Hours**

Three branches - Mesozoa, Parazoa and Eumetazoa - classification upto classes with their salient features.

Branch 1- Mesozoa: Phylum Orthonectida eg. Rhopalura

Branch 2 - Parazoa: Phylum Placozoa eg. *Trycoplax adherens*

Phylum Porifera - Classification upto classes and their salient features

Class 1 Calcarea eg. Leucillia
Class 2 Hexactinellida eg. Pheronemia
Class 3 Demospongia eg. Chalina

General topic - Skeleton and Reproduction in Sponges

Branch 3 - **Eumetazoa –** Unique characters

Unit II: Radiata **9 Hours**

Phylum Coelenterata classification upto classes with their salient features

Class 1 Hydrrozoa eg. Pennaria
Class 2 Scyphozoa eg. Rhizostoma
Class 3 Anthozoa eg. Aurelia

General topic - Polymorphism in Coelenterates

Coral and coral reefs with special features to conversion of reef fauna

Structure and functions of nematocyst

Phylum Ctenophora - Classification upto classes and their salient features. eg. Pleurobrachia **General topic** - Affinities of Ctenophora

Unit III: Acoelomata and Pseudocoelomata **9 Hours**

Phylum Platyhelminthes - classification upto classes with their salient features.

Class 1 Turbellaria eg. Gunda
Class 2 Trematoda eg. Polystomum
Class 3 Cestoda eg. Echinococcus (granulosa)

General topic - Life history of *Fasciola hepatica*

Platyhelminth parasites of man –eg. *Hymen lepis nana, Diphyllobothrium latum* and dog – eg. *Echinococcus*

Phylum Ascheleminthes - classification upto classes with their salient features.

Class 1 Rotifera eg. Brachionus
Class 2 Gastrotricha eg. Chaetonotus
Class 3 Kinorhyncha eg. Echinoderes
Class 4 Nematomorpha eg. Nectonema
Class 5 Nematoda eg. *Ancyclostoma duodenale*.

General topic - Parasitic adaptations of Nematodes

Unit IV: Eucoelomata-1 - Annelida, Onychophora, Arthropoda **9 Hours**

Phylum Annelida - classification upto classes with their salient features

Class 1 Polychaeta eg. Nereies

Class 2 Oligochaeta eg. Tubifex
Class 3 Hirudinea eg. Branchellion
Class 4 Archiannelida eg. Polygordius
Class 5 Echiuroidea eg. Echiurus
Class 6 Sipunculoidea eg. Sipunculus
Class 7 Priapulida eg. Priapulus
Class 8 Myzostomaria eg. Myzostoma

General topic - Metamerism in Annelida

Phylum Onychophorae - eg. Perpatus - mention its affinities

Phylum Arthopoda - classification upto classes with their salient features

Sub Phylum Trilobitomorpha - classification upto class with their salient features

Class 1 Trilobita eg. Triarthrus

Sub Phylum Chilicerata - classification upto classes with their salient features

Class 1 Merostomata eg. Limulus (horse shoe crab)
Class 2 Arachinida eg. Palamnaeus
Class 3 Pycnogonida eg. Pycnoneum

Sub Phylum- Mandibulata - classification upto classes with their salient features

Class 1 Crustacea eg. *Penaeus*
Class 2 Chilopoda eg. Scolopendra
Class 3 Symphyla eg. Scolopendrella
Class 4 Pauropoda eg. Pauropus
Class 5 Diplopoda eg. Julus
Class 6 Hexapoda eg. Dragonfly, *Bombyx mori*

General topic – Neuro-secretion in Insects.

Unit V: Eucoelomata II – Mollusca and Echinodermata **9 Hours**

Phylum Mollusca - classification upto classes with their salient features

Class 1 Apalcophora eg. Neomenia
Class 2 Monoplacophora eg. Neopilinia
Class 3 Polyplacophorea eg. Chiton
Class 4 Gastropora eg. Doris
Class 5 Scaphoda eg. Dentalium
Class 6 Pelecypoda eg. Mytillus
Class 7 Cephalopoda eg. Sepia

General topic – Torsion in Mollusca

Phylum Echinodermata - classification upto classes with their salient features

Class 1 Asteriodea eg. *Asterias ruben*
Class 2 Ophiuroidea eg. Ophiothrix
Class 3 Echinoidea eg. Echinocardium
Class 4 Holothuroidea eg. Cucumaria
Class 5 Crinoidea eg. Antedon

General Topic - Water vascular system in Starfish
Pedicellaria – types and its functions

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion,Insect Collection and Field Study

Text Books

1. Arumugam, N. (2017) Text book of Invertebrata, Saras Publiation, Kottar, Nagercoil.
2. Jordan, E.L., and Verma, P.S., (2009). Invertebrate Zoology, (Multicolor revised ed), New Delhi: S. Chand and Co.Print.

Reference Books

1. EkambarathaAyyer, M and Ananthakrishna, T.M.(2003) Manual of Zoology, Viswanathan publishers-Chennai.
2. Kotpal, R.L (2003) Echinodermata (5^{th} Ed.,) Meerut, India: Rastogi Publications.
3. Jan A. Pechenik, (2014) Biology of the Invertebrates. McGraw-Hill McGraw-Hill Companies, 7th Revised Edition.

E-Resources

- Invertebrate Zoology Online – Lander Universityhttp://webs.lander.edu/rsfox/invertebrates/
- www.enchantedlearning.com/subjects/invertebrates/index.shtml
- www.ucmp.berkeley.edu/echinodermata/echinodermata.html
- Invertebrate Zoology – Bishop Museum www.bishopmuseum.org/research/natsci/invert/
- Invertebrates – Animal Kingdomhttp://animalkingdom.net/category/invertebrates/

Course Outcomes

At the end of the course, students would be able to:

CO1	Classify non-chordates along with their salient features and special adaptations.
CO2	Describe the classification, salient features, affinities and special adaptations of Coelenterata and Ctenophora.
CO3	Explain the classification, salient features, life cycle and parasitic adaptations of Acoelomata and Pseudocoelomata.
CO4	Illustrate the classification, general characters, affinities and special adaptations of Annelida, Onychophora and Arthropoda.
CO5	Relate the classification, general features and unique adaptations of Mollusca and Echinodermata

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	2	2	3	3	2	0	1	3	2	3
CO2	3	3	2	2	3	3	2	0	1	3	2	3
CO3	3	2	2	2	3	3	2	0	1	3	2	3
CO4	3	3	2	2	3	3	2	0	1	3	2	3
CO5	3	3	2	2	3	3	2	0	1	3	2	3

1 – Low **2 – Moderate** **3- High**

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	(K1&K1)	K1&K1	1(K2)
2	CO2	Up to K2	2	(K1&K1)	K2&K2	1(K2)
3	CO3	Up to K2	2	(K1&K1)	K2&K2	1(K2)
4	CO4	Up to K3	2	(K1&K1)	K2&K2	1(K3)
5	CO5	Up to K3	2	(K1&K1)	K2&K2	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice
K1	10	8	-	18	18%
K2	-	32	30	62	62%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	

LECTURE PLAN

ANIMAL DIVERSITY I - NON CHORDATES 20UZOC11				
Unit	**S.No.**	**Topics**	**Hours**	**Teaching mode**
I	i	Outline classification of Kingdom Animalia upto branches	2	Class room lecture, Power Point Presentation, Chalk and Talk, Videos, Specimens, Field Visit
	ii	Porifera - Classification upto classes and their salient features	2	
	iii	Skeleton in Sponges	2	
	iv	Reproduction in Sponges	3	
		Total Hours	**9**	
II	i	Classification of Coelenterata upto classes with their salient features	1	Class room lecture, Power Point Presentation, Chalk and Talk, Spotters, Field Visit
	ii	Structure and functions of nematocyst	2	
	iii	Polymorphism in Coelenterates	2	
	iv	Coral and coral reefs with special features to conversion of reef fauna	2	
	v	Classification upto classes and their salient features, Affinities of Ctenophora	2	
		Total Hours	**9**	
III	i	**Platyhelminthes** - classification upto classes with their salient features.	2	Class room lecture, Power Point Presentation, Chalk and Talk, Spotters, Field Visit
	ii	Life history of *Fasciola hepatica*	2	
	iii	Parasitic adaptations of Nematodes	2	
	iv	Platyhelminth parasites of man and dog	1	
	v	Classification of Aschelminthes upto class level	2	
		Total Hours	**9**	
.IV	i	**Annelida** - classification upto classes with their salient features.	2	Class room lecture, Power Point Presentation, Chalk and Talk, Videos, Spotters, Field Visit
	ii	Metamerism in Annelida	2	
	iii	**Onychophorae** – general characters, Perpatus - its affinities.	1	
	iv	**Arthopoda** - classification upto classes with their salient features.	3	
	v	Neurosecretion in Insects.	1	
		Total Hours	**9**	
V	i	**Phylum Mollusca** - classification of mollusca upto classes with their salient features.	2	Class room lecture, Power Point Presentation, Chalk and Talk, Charts, Spotters, Field Visit
	ii	Torsion in Mollusca	2	
	iii	**Echinodermata** - classification upto classes with their salient features.	2	
	iv	Water vascular system in Starfish	2	
	v	Pedicellaria – types and its functions	1	
		Total Hours	**9**	

Course designed by: Prof. K. Krishnaveni, Prof. A. Jeevalatha, Dr. S. Dharaneedharan

Programme	I B.Sc. Zoology	Programme Code	UZO
Course Code	20UZOC12	No. of Hrs per Cycle:	3
Semester	I	Max: Marks:	60
Part	III	Credit	3
Core Course II			
Course Title	CELL STRUCTURE AND DYNAMICS		
Cognitive Level Upto K3			

Preamble

This course imparts the fundamental knowledge on cell architecture, cytological techniques and functions. It provides deep insights into cell division, cell communications, cell regulation, cancer biology and stem cells.

Unit - I: Tools and Techniques in Cell Biology **9 Hours**

Working mechanism and Applications of Microscopy- Compound Microscope, Phase Contrast, Electron Microscopy - (Transmission and Scanning) and Fluorescence Microscope, Sub-Cellular Fractionation – Microtome: Fixation, Sectioning, Embedding and Staining - Heatoxylin and Eosin, Gimsa staining.

Unit - II: Cell Membrane and Cellular Communication **9 Hours**

Cell Membrane – Structure and Function, Evolution and Experimental Evidence in Fluid Mosaic Model, Extra Cellular Matrix (ECM), Cell Adhesion, Cell Migration, Cell Junctions, Cell - Cell Communication (Cell Signalling): Types, Mechanism of Cellular Signalling –G- Protein Linked Surface Receptors, Steroid Hormone Receptors, Cell Signalling Through Second Messengers.

Unit - III: Cell Organelles **9 Hours**

Structure and Functions of - Mitochondria, Ribosomes, Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Cytoskeleton Structure.

Unit - IV: Nucleus and Cell division **9 Hours**

Structure and functions of Nucleus and Chromosome, Cell cycle - G1phase and regulation of cell proliferation, S phase and DNA replication, G2 phase, Cell division: Phases and functions - Mitosis and Meiosis.

Unit - V: Cancer Biology and Stem cell Therapy **9 Hours**

Cancer- Properties, Types, Diagnosis and Treatment, Oncogenes, Tumour Supressor Genes, Metastatis, interaction of cancer cell with normal cells, Apoptosis, Stem cell - Types and Applications , Molecular basis of Aging and Genes responsible for Aging.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Activity based teaching and Lab Visit.

Text Books

1. Arumugam, N. (2017) Cell Biology and Molecular Biology, Saras Publiation, Kottar, Nagesrcoil.
2. Verma, P.S. and Agarwal, V.K. (2012). Cytology, Revised edition S. Chand & Company Ltd., New Delhi.

Reference Books

1. De Robertis EDP and De Robertis EMF (2017) Cell and Molecular Biology, Eighth edn, BI Waverly Pvt. Ltd, New Delhi.
2. Powar, C.B. (2009). Cell Biology, Himalayas Publishing House, Bombay.
3. Karp, Gerald (2012). Cell and molecular Biology, John Wiley and sons, New York.

E-Resources

- https://www.hccfl.edu/media/572066/microscopy.pdf
- http://www.science-info.net/docs/AO-Spenser/GreysHandbook.pdf
- http://www.microbiologynotes.com/differences-between-prokaryotic-and-eukaryotic-cells/
- https://www.kenhub.com/en/library/anatomy/cellular-organelles
- http://www.iupui.edu/~anatd502/lecture.f04/cell.f04/Nucleus.pdf

Course Outcomes

At the end of the course, students would be able to:

CO1	Apply the tools and cytological techniques in cell biology.
CO2	Explain the cell membrane and cellular communications.
CO3	Interpret the morphology and different functions of cell organelles.
CO4	Explain the structure and function of nucleus, stages of cell cycle and cell division.
CO5	Illustrate the importance of cancer biology and stem cells therapy.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO 10	PSO 11	PSO 12
CO 1	3	2	3	3	3	2	1	0	1	0	2	3
CO 2	3	2	3	2	3	2	1	0	1	0	2	3
CO 3	3	2	3	2	3	2	1	0	1	0	2	3
CO 4	3	2	3	3	3	2	2	0	1	0	2	3
CO 5	3	2	3	3	3	2	2	0	2	0	2	3

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
2	CO2	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
3	CO3	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
4	CO4	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
5	CO5	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice
K1	10	-	-	10	10%
K2	-	40	30	70	70%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

LESSON PLAN

Cell Structure and Dynamics – 20UZOC12				
UNIT	**S.No**	**Topics**	**Hours**	**Teaching Mode**
I		**Tools and techniques in Cell Biology**		Class room lecture Live and video demonstration, PPT, Lab Visit
	i	Compound Microscope, Phase contrast	2	
	ii	Electron Microscopy - (Transmission and scanning), Fluorescence Microscope	3	
	iii	Subcellular fractionation	2	
	iv	Microtome- fixation, sectioning, embedding and staining - Hematoxylin and Eosin, Gimsastaining	2	
		Total Hours	**09**	
II		**Cell membrane and Cellular Communication**		Class room lecture, PPT and video lecture
	i	Cell membrane: Structure and Functions, Evolution and Experimental evidence in Fluid Mosaic Model	3	
	ii	Extra cellular matrix (ECM)	1	
	iii	Cell Adhesion , Cell Migration, Cell junctions	2	
	iv	Cell - Cell Communication (Cell Signalling): Types, Mechanism of Cellular Signalling –G- Protein Linked Surface Receptors, Steroid Hormone Receptors, Cell Signalling Through Second Messengers.	3	
		Total Hours	**09**	
III		**Cell Organelles - Structure and functions of**		Class room lecture, Charts, PPT and video lecture
	i	Mitochondria	2	
	ii	Ribosomes	1	
	iii	Endoplasmic reticulum	2	
	iv	Golgi apparatus	1	
	v	Lysosomes	1	
	vi	Cytoskeleton structure	1	
		Total Hours	**09**	
IV	i	**Nucleus and Cell division**		Class room lecture, PPT and video lecture, discussion
	ii	Structure and functions of Nucleus and Chromosome	3	
	iii	Cell cycle - G1phase and regulation of cell proliferation, S phase and DNA replication, G2 phase	2	
	iv	Cell division - Mitosis	1	
	v	Meiosis	2	
		Total Hours	**9**	
V		**Unit - V** **Cancer Biology and Stem cell Therapy**		Class room lecture, PPT and video lecture, Group discussion, Chalk and talk
	i	Cancer- Properties and Types	2	
	ii	Oncogenes, tumour supressor genes	2	
	iii	Metastatis, interaction of cancer cell with normal cells	2	
	iv	Apotosis	1	
	v	Stem cell - Types and Molecular basis of Aging and Genes for Aging.	2	
		Total Hours	**9**	

Course designed by: Dr. N. Renuga Devi, Mrs. B. Subasri

Programme	I B.Sc. Chemistry (Allied)	Programme Code	UZO
Course Code	20UZOA11	No. of Hrs per Cycle:	4
Semester	I	Max: Marks:	60
Part	III	Credit	4
Allied Course I			
Course Title	LIFE AND DIVERSITY OF NON CHORDATES		
Cognitive Level – Up to K3			

Preamble

Enhance the knowledge on diverse groups of non chordates, their structural adaptations and their interrelationship with other organisms, importance of this backbone less creatures in the world.

Unit – I: Protozoa and Porifera **12 Hours**

1. Outline classification of animals, Salient features of Non- Chordates.

Classification of protozoa upto classes and their salient features

Class 1 Flagellates	eg. Euglena
Class 2 Rhizopoda	eg. Amoeba
Class 3 Ciliophora	eg. Paramecium
Class 4 Sporozoa	eg. Plasmodium
Class 5 Mycetazoa	eg. Plasmodifera

General Topic - Nutrition in protozoa

Reproduction in protozoa

Protozoan diseases - Malaria, Amoebiasis, Trypanosomiasis, Leishmaniasis

Classification of Porifera upto classes and their salient features

Class 1 Calcarea	eg. Leucillia
Class 2 Hexactinellida	eg. Hyalonema
Class 3 Demospongia	eg. Poterion

General Topic - Histology of sponges.

Reproduction in sponges

Unit – II: Coelenterata and Platyhelminthes **12 Hours**

Classification of Coelenterata upto classes and their salient features

Class 1 Hydrozoa	eg. Obelia
Class 2 Scyphozoa	eg. Rhizostoma
Class 3 Anthozoa	eg. Metridium

General Topic - Affinities of Ctenophora and its evolutionary significance

Coral reef & its significance.l

Classification of Platy helminthes upto classes and their salient features up to classes

Class 1 Turbellaria	eg. Planaria
Class 2 Trematoda	eg. Paramphistomum
Class 3 Cestoda	eg. Echinococcus

General Topic - Platyhelminthic parasites of man

Parasitic Adaptation of Platyhelminthes

Unit – III: Aschelminthes and Annelida **12 Hours**

Classification of Aschelminthes upto classes and their salient features

Class 1 Rotifera	eg. Rotaria
Class 2 Gastrotricha	eg. Lepidodermella
Class 3 Kinorhyncha	eg. Echinoderes
Class 4 Nematomorpha	eg. Nectonema
Class 5 Nematoda	eg. Philodina

General topic – Ascaris - Life cycle, pathogenesis, symptoms, prevention and treatment

Nematode parasites in man – hookworm, guine worm, filarial worm

Classification of Annelida upto classes and their salient features

Class 1 Polychaeta	eg. Nereis
Class 2 Oligochaeta	eg. Megascolex
Class 3 Hirudinea	eg. Pontobdella
Class 4 Archiannelida	eg. Polygordius

General topic – Metamerism in annelida

Excretion in Annelida

Unit – IV: Arthropoda **12 Hours**

Classification of Arthropoda upto classes and their salient features

Class 1 Merostomata eg. Limulus
Class 2 Arachnida eg. Palamnaeus
Class 3 Crustacea eg. Prawn
Class 4 Myriapoda eg. Scolopendra
Class 5 Insecta eg. Dragonfly

General topic - Social organization of honey bee.

Peripatus and its evolutionary significance

Metamorphosis in insects

Larval forms of crustacean

Arthropod vectors 1) Housefly 2) Mosquito 3) Head louse 4) Ticks 5) Bedbug

Unit – V: Mollusca and Echinodermata **12 Hours**

1. Classification of Mollusca up to classes and their salient features

Class 1 Aplacophora eg. Chaetoderma
Class 2 Monoplacophora eg. Neopilina
Class 3 Polyplacophora eg. Chiton
Class 4 Gastropoda eg. Pila
Class 5 Scaphopoda eg. Dentalium
Class 6 Pelecypoda eg. Mytilus
Class 7 Cephalopoda eg. Loligo

General topic - Sense organs of Pila. Edible oyster culture.

2. Classification of Echinodermata up to classes and their salient features

Class 1 Asteroidea eg. Asterias
Class 2 Ophiuroidea eg. Ophiothrix
Class 3 Echinoidea eg. Echino cardium
Class 4 Holothuroidea eg. Cucumaria
Class 5 Crinoidea eg. Antedon

General topic - Pedicellariae – types and functions.

Water vascular system of starfish.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Activity based teaching, Field Study

Text Books

1. Arumugam, N. (2017) Text book of Invertebrata, Saras Publication, Kottar, Nagercoil.
2. Jordan, E.L., and Verma, P.S., (2009). Invertebrate Zoology, (Multicolor revised ed), New Delhi: S. Chand and Co.Print.

Reference Books

1. EkambarathaAyyer, M and Ananthakrishna, T.M. (2003) Manual of Zoology, Viswanathan publishers-Chennai.
2. Kotpal, R.L (2003) Echinodermata (5th Ed.,) Meerut, India: Rastogi Publications.
3. Jan A. Pechenik, (2014) Biology of the Invertebrates. McGraw-Hill McGraw-Hill Companies, 7th Revised Edition.

E-Resources

- Invertebrate Zoology Online – Lander Universityhttp://webs.lander.edu/rsfox/invertebrates/
- www.enchantedlearning.com/subjects/invertebrates/index.shtml
- www.ucmp.berkeley.edu/echinodermata/echinodermata.html
- Invertebrate Zoology – Bishop Museum www.bishopmuseum.org/research/natsci/invert/
- Invertebrates – Animal Kingdomhttp://animalkingdom.net/category/invertebrates/

Course Outcomes

At the end of the course, students would be able to:

CO1	Discuss the classification, salient features, physiology & pathology of Protozoa and Porifera.
CO2	Explain the classification, salient features, evolutionary significance, affinities and adaptations of Coelenterates & Platyhelminthes.
CO3	Illustrate the taxonomical features, life cycle, parasitology and physiology of Ashelminthes & Annelida.
CO4	Classify Arthropoda and describe the general characters, social behaviour, life cycle and vectors of Arthropoda.
CO5	Outline the taxonomy salient features, morphology, culture of Mollusca and Echinodermata.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	2	2	2	1	2	0	0	0	1	3
CO2	3	2	2	2	2	1	2	0	0	0	1	3
CO3	3	3	2	2	2	1	2	0	0	0	1	3
CO4	3	2	2	2	2	1	2	0	0	0	1	3
CO5	3	3	2	2	2	1	2	0	0	0	1	3

1 – Low **2 – Moderate** **3- High**

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K2	2	K1&K1	2(K1&K1)	1(K2)
2	CO2	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
3	CO3	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
4	CO4	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
5	CO5	Up to K3	2	K1&K1	2(K1&K1)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice
K1	10	16	-	26	26%
K2	-	24	30	54	54%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

LESSON PLAN

LIFE AND DIVERSITY OF NON CHORDATES - 20UZOA11				
Unit	**S. No.**	**Topics**	**Hours**	**Teaching mode**
I	i	**Protozoa and Porifera** Outline classification of animals. Salient features of Non- Chordates.	1	Class room lecture, Power Point Presentation, Chalk and Talk, Videos
	ii	Classification of protozoa upto classes and their salient features	2	
	iii	Reproduction in Protozoa	1	
	iv	Nutrition in Protozoa	1	
	v	Protozoan diseases - Malaria, Amoebiasis, Trypnosomiasis, Leishmaniasis.	2	
	vi	Phylum Porifera- Classification of Porifera upto classes and their salient features.	1	
	vii	Histology of Sponges	2	
	viii	Reproduction in Sponges	2	
		Total Hours	**12**	
II	i	**Coelenterata and Platyhelminthes** Classification of Coelenterates upto classes and their salient features.	2	Class room lecture, Power Point Presentation, Chalk and Talk Videos
	ii	Affinities of Ctenophora and its evolutionary significance	2	
	iii	Coral reefs and its significance	2	
	iv	Classification of Platyhelminthus and their salient features	2	
	v	Platyhelminthic parasites of man	2	
	vi	Parasitic adaptations of Platyhelminthus	2	
		Total Hours	**12**	
III	i	**Aschelminthes and Annelida** Classification of Nematode upto classes and their salient features	2	Class room lecture, Power Point Presentation, Chalk and Talk Videos
	ii	Nematode parasites in man - Hookworm, Guinea worm, Filarial worm	2	
	iii	Ascaris life cycle - Pathogenesis, symptoms, prevention and their control measures	2	
	iv	Classification of Annelida upto classes and their salient features.	2	
	v	Metamerism in Annelida	2	
	vi	Excretion in Annelida	2	
		Total Hours	**12**	
IV	i	Classification of Arthropoda upto classes and their salient features.	2	Class room lecture, Power Point Presentation, Chalk and Talk Videos
	ii	Social organization of honey bee	2	
	iii	Peripatus and its evolutionary significance	2	
	iv	Metamorphosis in insects	2	
	v	Larval forms in Crustaceans	2	
	vi	Arthopod vectors	2	
		Total Hours	**12**	
V	i	Classification of Mollusca upto classes and their salient features	2	Class room lecture, Power Point Presentation, Chalk and Talk Videos
	ii	Sense organs of Pila	2	
	iii	Edible Oyster culture	2	
	iv	Classification of Echinodermata upto classes and their salient features	2	
	v	Pedicellariae- types and functions	2	
	vi	Water- vascular system of star fish	2	
		Total Hours	**12**	

Course designed by: **Prof. A. Jeevalatha**

Programme	I B.Sc. & B.A.	Programme Code	UZO
Course Code	20UZON11	No. of Hrs per Cycle:	2
Semester	I	Max: Marks:	50
Part	IV	Credit	2
Non Major Elective (NME)– I Course			
Course Title	PISCICULTURE AND MANAGEMENT		
Cognitive Level Up to K3			

Preamble

Make the students aware of fisheries science, fish culture, feeding mechanism, pathology, disease control, preservation methods and its economic importance.

Unit –I: Edible fish culture **6 Hours**

Design and construction of fish pond; management practices of Indian major carps and prawn. Role of fertilizers in aquaculture practices. Liming and its effects on pond ecosystem.

Unit – II: Harvest and Transportation **6 Hours**

Feeding methods - frequency of feeding, fate of nutrients in feed and water quality. Harvesting methods-drainable ponds Cage & Raceway farms, Transportation. Preservation methods - Sun Drying-Salt curing - Pickling-Smoking - Freezing and Canning.

Unit – III: Fish Products **6 Hours**

Processing & Preservation of fish products and byproducts- Fish meal, Fish Oils, Fish Sauce, Fish Glue, Sanitation in Processing-Treatment & Disposal of Fish Wastes.

Unit – IV: Ornamental Fish Culture **6 Hours**

Construction of home aquarium, wooden, metal frameless tanks; aerators, filters, hand nets and other equipments; Physiochemical parameters - Water quality and Temperature control; Feeding – food types and feeding methods

Unit – V: Aquarium management **6 Hours**

Ornamental fish - freshwater and marine (example only), aquarium - maintenance of water quality, control of snail and algal growth - Common fish diseases, diagnosis and treatment.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Experience Sharing, and Activity based teaching, Field Study and Aquarium Visit.

Text Book

1. Arumugam, (2005) Text book of Aquaculture, Saras Publications.

Reference Books

1. Coffey, D.J (1977) Encyclopedia of Aquarium fishes in colour. Aero Publications.
2. Roberts, R .J. (1978) (Eds) Fish Pathology. Wiley-Blackwell Publications
3. Jhingran, V.G. (1982) Fish and Fisheries in India. Hindustan Publishing Corporation, New Delhi.

E-Resources

1. https://pdfs.semanticscholar.org/eafb/0249feac872a8a70553a1d3e1fde13ac6280.pdf
2. http://www.fao.org/3/a-i3587e.pdf
3. https://www.researchgate.net/publication/312003068_Aquaculture
4. https://onlinelibrary.wiley.com/journal/13652109

Course Outcomes

At the end of the course, students would be able to:

CO1	Plan, construct, prepare and manage various practices of carp and prawn farm.
CO2	Describe the feeding, harvesting, preserving and marketing practice in aquaculture.
CO3	Explain the various processing methods of fish product and byproducts.
CO4	Create home aquarium tank, maintain various physiochemical factors and supply feed required for ornamental fishes
CO5	Illustrate marine and freshwater ornamental fishes, maintain aquarium water quality and disease management.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (POs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO 10	PSO11	PSO12
CO1	3	1	0	2	2	1	0	3	1	1	1	2
CO2	3	1	1	0	2	1	1	3	1	1	2	2
CO3	3	1	1	2	2	1	0	3	1	1	1	2
CO4	3	1	0	1	2	0	0	2	2	1	1	2
CO5	3	1	1	1	2	1	0	2	1	1	1	2

1-Low **2-Medium** **3-High**

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A	Section B
			Either/or Choice	Open Choice
1	CO1	Up to K3	2(K1&K1)	1(K3)
2	CO2	Up to K2	2(K1&K1)	1(K2)
3	CO3	Up to K2	2(K2&K2)	1(K2)
4	CO4	Up to K3	2(K2&K2)	1(K3)
5	CO5	Up to K3	2(K2&K2)	1(K3)
No of Questions to be asked			10	05
No of Questions to be answered			05	03
Marks for each Question			03	05
Total Marks for each Section			15	15

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (Either/or)	Section B (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	12	-	12	21.8%	22%
K2	18	10	28	50.9%	51%
K3	-	15	15	27.2%	27%
Total Marks	30	25	55	100%	100%

LESSON PLAN

PISCICULTURE AND MANAGEMENT - 20UZON11				
Unit	**S. No.**	**Topics**	**Hours**	**Teaching mode**
I	i	**Edible fish culture** Design and construction of fish pond	1	Class room lecture, Power Point Presentation, Video, Aquarium Visit
	ii	Management practices of Indian major carps and prawn	2	
	iii	Role of fertilizers in aquaculture practices.	2	
	iv	Liming and its effects on pond ecosystem	1	
		Total Hours	**6**	
II	i	**Harvest and Transportation** Feeding methods - frequency of feeding, fate of nutrients in feed and water quality	2	Class room lecture, Power Point Presentation, Chalk and Talk, Assignment
	ii	Harvesting methods-drainable ponds Cage & Raceway farms, Transportation	2	
	iii	Preservation methods - Sun Drying-Salt curing - Pickling-Smoking - Freezing and Canning	2	
		Total Hours	**6**	
III	i	**Fish Products** Processing & Preservation of fish products	2	Chalk and Talk Power Point Presentation
	ii	Fish byproducts- Fish meal, Fish Oils, Fish Sauce, Fish Glue	2	
	iii	Sanitation in Processing-Treatment & Disposal of Fish Wastes	2	
		Total Hours	**6**	
IV	i	**Ornamental Fish Culture** Construction of home aquarium and equipments required	2	Class room lecture, Power Point Presentation, Assignment, Aquarium Visit
	ii	Physiochemical parameters - Water quality and Temperature control	2	
	iii	Feeding – food types and feeding methods	2	
		Total Hours	**6**	
V	i	**Aquarium management** Ornamental fish - freshwater and marine	1	Activity based class, Power Point Presentation, Chalk and Talk, Aquarium Visit
	ii	Aquarium - maintenance	2	
	iii	Common fish diseases, diagnosis and treatment.	3	
		Total Hours	**6**	

Course designed by – Dr. S. Dharaneedharan

Programme	I B.Sc. Zoology	Programme Code	UZO
Course Code	20UZOC21	No. of Hrs per Cycle:	3
Semester	II	Max: Marks:	60
Part	III	Credit	3
Core Course III			
Course Title	ANIMAL DIVERSITY – II – CHORDATES		
Cognitive Level – Up to K3 Level			

Preamble

Enhance the knowledge about the taxonomy of Chordate animals, their structure and special adaptive characters to survive in various habitats.

Unit I: Classification of Chordates **9 Hours**

Phylum: Protochordates - General characters and outline classification of chordate up to class level

Sub Phylum: Hemichordata

Class 1 Enterobneusta eg. *Balanoglossus* –External morphology
Class 2 Pterobranchia eg. Rhabdopleura
Class 3 Planctosphaeroidea eg. Dentrograpleus

General topic – *Balanoglossus* is an invertebrate chordate

Sub Phylum: Urochordata

Class 1 Larvacea eg. *Oikopleura*
Class 2 Ascidiacea eg. *Herdmenia* – External morphology
Class 3 Thaliacea eg. *Salpa*

General topic – Retrogressive metamorphosis in Ascidian

Sub Phylum: Cephalochordata eg. *Amphioxus* – External morphology, digestive system

Sub Phylum: Vertebrata – General characters and classification upto classes with their salient features.

Division 1 Agnatha – Unique characteristic features

Class 1 Ostracodermi eg. *Cephalaspis*
Class 2 Cyclostomata eg. *Petromyzon*

Division 2 Gnathostomata

Unit II: Super Class Pisces **9 Hours**

General characters and classification upto super order

Class 1 Chondrichthyes
Class 2 Osteichthyes
Sub Class I: Elasmobranchii eg. *Scoliodon* – Urino-gential system
Sub Class II: Holocephali eg. *Chimaera*
Sub Class III: Choanichthyes
Order 1 Crossopterigii eg. *Latimeria*
Order 2 Dipnoi eg. *Lepidosiren*
Sub Class Actinopterygii
Super Order 1 Chondrostei eg. *Acipencer*
Super Order 2 Holostei eg. *Amia*
Super Order 3 Teleostei eg. *Mugil*

General topic – Accessory respiratory organs in fishes Migration in fishes

Unit III: Super class Tetrapoda – Amphibia, Reptilia, Aves and Mammalia **9 Hours**

General characters, classification upto orders of Amphibia and Reptilia

Class Amphibia

Order 1 Anura eg. *Bufo*
Order 2 Urodela eg. *Amblystoma* – Paedomorphosis/nectony With special reference to axolotl larva
Order 3 Apoda eg. *Ichthyophis*

General topic – Parental care in Amphibia

Class Reptilia – Classification upto orders

Sub class I: Anapsida
Order 1 Cotylosauria eg. *Seymouria*
Order 2 Chelonia eg. *Chelone*
Sub class II: Parapsida eg. *Ichthyosaurus*
Sub class III: Diapsida
Order 1 Rhynchocephalia eg. *Sphenodon*

Order 2 Squamata eg. *Naja*
Order 3 Lacertilia eg. *Draco*
Order 4 Synapsida eg. *Cynognathus*

General topic – Identification of poisonous and non-poisonous snakes

Unit IV: Class Aves **9 Hours**

General characters and classification upto super orders

Sub class I: Archeornithes eg. *Archaeopteryx* (Affinities)
Sub class II: Neornithes
Super order I: Palaeognatha eg. *Emu*
Super order II: Neognathe eg. *Columba*

General topic – Morphological volant adaptation
Acoustic communication in birds
Respiratory system of Pigeon.

Unit V: Mammalia **9 Hours**

General characters and classification up to order with example

Sub class I: Prototheria eg. *Ornithorhynchus*
Sub class II: Metatheria eg. *Kangroo*
Sub class III: Eutheria – Salient features with example
Order 1 Insectivora eg. *Talpa*
Order 2 Dermoptera eg. *Galeopithecus*
Order 3 Chiroptera eg. *Pteropus*
Order 4 Primates eg. *Loris*
Order 5 Carnivora eg. *Panthera*
Order 6 Edentata eg. *Armadillo*
Order 7 Pholidota eg. *Manis*
Order 8 Proboscidea eg. *Elephas*
Order 9 Hydracoidea eg. *Procavia*
Order 10 Sirenia eg. *Dugong*
Order 11 Perissodactyla eg. *Rhinoceros*
Order 12 Artiodactyla eg. *Sheep*
Order 13 Lagomorpha eg. *Rabbit*
Order 14 Rodentia eg. *Rat*
Order 15 Tubulidentata eg. *Orycteropus*
Order 16 Cetacea eg. *Whales*

General topic – Dentition in mammals;
Aquatic mammals and their adaptations
Brain of Rabbit.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Activity based teaching, Field Study

Text Books

1. Arumugam, N. (2008) Text book of Chordata, Saras Publiation, Kottar, Nagercoil.
2. Jordon E.L., Verma P.S. (2013) Chordate Zoology, S. Chand & Co Ltd., New Delhi.

Reference Books

1. Kotpal R.L. (2003) Modern textbook of Zoology – Vertebrates. Rastogi Pub, Meerut.
2. Saxena R. K., and Saxena S. (2008) Comparative anatomy of Vertebrates, Viva books

E-Resources

- https://www.paulding.k12.ga.us/cms/lib010/GA01903603/Centricity/Domain/2373/CHORDATES%20and%20Vertebrates.pdf
- https://www.researchgate.net/publication/23468368_Chordate_Origins_and_Evolution
- https://www.conserveenergy.feature.com
- https://www.biologydiscussion.com
- https://www.brainkart.com

Course Outcomes

At the end of the course, students would be able to:

CO1	Explain the taxonomy, general characteristic features, evolutionary significance and adaptations of Protochordates
CO2	Describe the classification, salient features, special adaptation of Pisces
CO3	Explain the classification, general characters and parental care in Amphibia and identify the unique Reptilian defense mechanisms.
CO4	Illustrate the general characters, classification, special adaptations and communications in Aves
CO5	Relate the salient features, classification and adaptation of terrestrial and aquatic Mammals

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	2	2	2	1	2	0	1	1	1	3
CO2	3	3	2	2	2	1	2	0	1	1	1	3
CO3	3	3	2	2	2	1	2	0	1	1	1	3
CO4	3	3	2	2	2	1	2	0	1	1	1	3
CO5	3	3	2	2	2	1	2	0	1	1	1	3

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K2	2	K1&K1	2(K1&K1)	1(K2)
2	CO2	Up to K2	2	K1&K1	2(K1&K1)	1(K2)
3	CO3	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
4	CO4	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
5	CO5	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice
K1	10	16	-	26	22%
K2	-	24	30	54	58%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

LESSON PLAN

ANIMAL DIVERSITY II – CHORDATES 20UZOC21				
Unit	**S.No.**	**Topics**	**Hours**	**Teaching mode**
I	i	General characters and outline classification of chordate upto class level	2	Class room lecture, Power Point Presentation, Chalk and Talk Videos, Spotters
	ii	External morphology of *Balanoglossus*, *Balanoglossus* is an invertebrate chordate	2	
	iii	External morphology od Ascidian, Retrogressive metamorphosis in Ascidian	2	
	iv	*Amphioxus* – external morphology, digestive system	2	
	v	**Vertebrata** – General characters and classification upto classes with their salient features.	1	
		Total Hours	**9**	
II	i	**Pisces-** General characters and classification upto super order.	3	Class room lecture, Power Point Presentation, Chalk and Talk, Videos, Spotters, Field Visit
	ii	*Scoliodon* – Urino-gential system	2	
	iii	Accessory respiratory organs in fishes	2	
	iv	Migration in fishes	2	
		Total Hours	**9**	
III	i	General characters, classification upto orders of Amphibia	2	Class room lecture, Power Point Presentation, Chalk and Talk Videos, Spotters, Field Visit
	ii	Parental care in Amphibia	2	
	iii	**Reptilia –** Classification upto orders	3	
	iv	Identification of poisonous and non-poisonous snakes	2	
		Total Hours	**9**	
IV	i	**Aves-** General characters and classification upto super orders	2	Class room lecture, Power Point Presentation, Chalk and Talk, Spotters, Field Visit
	ii	*Archaeopteryx* (Affinities)	1	
	iii	Morphological volant adaptation	2	
	iv	Acoustic communication in birds	2	
	v	Respiratory system of Pigeon.	2	
		Total Hours	**9**	
V	i	General characters and classification of mammals upto order with example	3	Class room lecture, Power Point Presentation, Chalk and Talk, Spotters, Field Visit
	ii	Dentition in mammals	2	
	iii	Aquatic mammals and their adaptations	2	
	iv	Brain of Rabbit	2	
		Total Hours	**9**	

Course designed by: Prof. K. Krishnaveni, Prof. A. Jeevalatha, Dr. S. Dharaneedharan

Programme	I B.Sc. Zoology	Programme Code	UZO
Course Code	20UZOC22	No. of Hrs per Cycle:	3
Semester	II	Max: Marks:	60
Part	III	Credit	3
Core Course IV			
Course Title	EMBRYOLOGY AND HUMAN REPRODUCTIVE TECHNOLOGY		
Cognitive Level Up to K3			

Preamble

To indulge the four dimensional discerning of students to understand the developmental stages in embryonic development, experimental embryology, teratology, prenatal natal defects and diagnosis and recent technologies in assisted reproductive technology.

Unit - I: Early embryonic development **9 Hours**

Gametogenesis in mammals: Spermatogenesis, Oogenesis, types of egg and egg membranes, process of fertilization, planes and patterns of cleavage; types of Blastula, Fate map, fate mapping using vital dye and radioactive technique.

Unit - II: Later embryonic development in Chick **9 Hours**

Cleavage, Blastulation, Gastrulation, development and role of primitive streak, salient features of chick embryo - 24 Hours, 48 Hours,72 Hours and 96 Hours, neurogenesis, organogenesis - development of brain, Extra embryonic membranes in chick

Unit - III: Experimental Embryology **9 Hours**

Organizer concept - Organizer in Amphibian Embryo, Experiment, Properties and Structure of Organizer, Gradient theory - Types and Experimental evidences, Amphibian metamorphosis and its hormonal control, Regeneration - Types, Events, Factors and Wolffian Regeneration

Unit – IV: Prenatal defects and diagnosis **9 Hours**

Teratology: Teratogenesis, genetic teratogenesis in humans, Environmental teratogenesis, Developmental defects: Prenatal death (miscarriage and still birth), Intrauterine growth restriction (IUGR), Prenatal diagnosis - Amniocentesis, chorionic villi sampling, Ultra sound scanning, foetoscopy, Maternal serum alpha-fetoprotein, maternal serum beta - HCG.

Unit - V: Human Reproductive Technology **9 Hours**

Hormonal control of Reproduction, (Endocrine disruptors) Birth control measures – Contraception, Infertility, Assisted Reproductive Technology in human (ART): Artificial insemination (AI) - Gamete Intrafellopian Transfer (GIFT), In vitro fertilization Technology (IVF) - Zygote Intro fellopian Transfer (ZIFT), Test tube baby.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study

Text Books

1. Arumugam, N. (2017) Text book of Developmental Biology, Saras Publiation, Kottar, Nagercoil.
2. Verma,P.S., and Agarwal, V.K., (2010) Chordate Embryology, S. Chand and Company, New Delhi.

Reference Books

1. Balinsky, B.I., (1981), "An Introduction to Embryology", W. B. Saunders Company, Philadelphia.
2. Jonathan M. W., Slack (2012), 'Essential Developmental Biology", Wiley-Blackwell Publications, USA.
3. Gilbert, S.F. (2006). Developmental Biology, VIII edition, Sinauer Associates, inc., Publishers, Massachusetts, USA.

E Resources:

- https://www.youtube.com/watch?v=XGWzVzvOShI
- https://teachmephysiology.com/reproductive-system/embryology/gametogenesis/
- http://cnx.org/content/m44839/latest...ol11448/latest
- https://www.amboss.com/us/knowledge/Teratogenic_birth_defects
- https://www.princetonivf.com/assisted-reproduction

Course Outcomes

At the end of the course, students would be able to:

CO1	Compare the early embroynic developmental stages of various organisms
CO2	Illustrate the various embryonic stages in chick
CO3	Interpret the experimental evidences in embryology
CO4	Analyse the factors responsible for teratogenesis, prenatal death and diagnosis
CO5	Explain the causes of infertility and apply the knowledge in ART

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	3	0	3	3	0	0	1	0	1	3
CO2	3	2	3	2	3	3	0	0	1	0	1	3
CO3	3	2	3	3	3	3	0	0	1	0	1	3
CO4	3	0	3	2	3	3	0	0	2	0	1	3
CO5	3	1	3	2	3	3	0	0	2	0	1	3

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K2	2	K1&K1	2(K2&K2)	1(K2)
2	CO2	Up to K2	2	K1 &K1	2(K2&K2)	1(K2)
3	CO3	Up to K2	2	K1 &K1	2(K2&K2)	1(K2)
4	CO4	Up to K3	2	K1 &K1	2(K2&K2)	1(K3)
5	CO5	Up to K3	2	K1 &K1	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	10
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

K4 – Examining, analyzing, presentation and make inferences with evidences attain

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice
K1	10	-	-	10	10%
K2	-	40	30	70	70%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

LESSON PLAN

Embryology and Human Reproductive Technology- 20UZOC22				
Unit	**S. No.**	**Topics**	**Hours**	**Teaching mode**
I		**Early embryonic development**		Microscopic slides, Chalk & Talk, PPT & Video Microscopic slide
	i	Spermatogenesis, Oogenesis	2	
	ii	Types of egg and egg membranes	1	
	iii	Process of fertilization	2	
	iv	Planes and patterns of cleavage	1	
	v	Types of Blastula	1	
	vi	Fate map, fate mapping using vital dye and radioactive technique	2	
		Total Hours	**9**	
II		**Later embryonic development in Chick**		Microscopic slides, Chalk & Talk, PPT & Video Microscopic slide
	i	Cleavage, Blastulation	2	
	ii	Gastrulation	1	
	iii	Development and role of primitive streak, salient features of 24 Hours chick embryo	1	
	iv	48 Hours,72 Hours and 96 Hours chick embryo	2	
	v	Neurogenesis	1	
	vi	Organogenesis - development of brain	1	
	vii	Extra embryonic membranes in chick	1	
		Total Hours	**9**	
III		**Experimental Embryology**		Microscopic slides, Chalk & Talk, PPT & Video Microscopic slide
	i	Organizer concept: Organizer in Amphibian Embryo, Experiment, Properties and Structure of Organizer	2	
	ii	Gradient theory - Types and Experimental evidences	2	
	iii	Amphibian metamorphosis and its hormonal control	2	
	iv	Regeneration: Types, Events and Factors affecting	2	
	v	Wolffian Regeneration	1	
		Total Hours	**9**	
IV		**Prenatal defects and diagnosis**		Microscopic slides, Chalk & Talk, PPT & Video Microscopic slide
	i	Teratology: Teratogenesis, geneticteratogenesis in humans.	2	
	ii	Developmental defects: Prenatal death (miscarriage and still birth), Intrauterine growth restriction (IUGR)	2	
	iii	Prenatal diagnosis - Amniocentesis, chorionic villi sampling	2	
	iv	Ultra sound scanning, foetoscopy	1	
	v	Maternal serum alpha-fetoprotein, maternal serum beta - HCG	2	
		Total Hours	**9**	
V		**Human Reproductive Technology**		Microscopic slides, Chalk & Talk, PPT & Video Microscopic slide
	i	Menstrual cycle-Phases of menstruation	2	
	ii	Pregnancy, Parturition, Hormonal control of Reproduction,	2	
	iii	Birth control measures	1	
	iv	Assisted Reproductive Technology in man (ART) - Artificial insemination (AI)	2	
	v	In vitro fertilization Technology (IVF) – Test tube baby.	2	
		Total Hours	**9**	

Course designed by: **Dr. N. Renuga Devi, Mrs. B. Subasri**

Programme	I B.Sc. Chemistry (Allied)	Programme Code	UZO
Course Code	20UZOA21	No. of Hrs per Cycle:	4
Semester	II	Max: Marks:	60
Part	III	Credit	4
Allied Course II			
Course Title	LIFE AND DIVERSITY OF CHORDATES		
Cognitive Level – Up to K3 Level			

Preamble

Gather knowledge about chordates which show astonishing diversity in structure, physiology and habitats.

Unit – I: Prochrodates **12 Hours**

Outline classification of phylum Chordata up to class , General characters of Chordates, salient features of Hemichordates , Urochordates and Cephalochordates with examples, Structural Organization of - Balanoglossus, Herdmania - Notochord, Digestive system of Amphioxus, Retrogressive metamorphosis in Ascidian, Affinities of Hemichordates.

Unit – II: Pisces **12 Hours**

Classification of Pisces up to class and their salient features

Class 1 Elasmobranchi eg. Scoliodon
Class 2 Holocephali eg. Chimarea
Class 3 Dipnoi eg. Ceratodus.
Class 4 Teleostomieg eg. Latimeria

Functional anatomy - Digestive system of Shark
Lateral line sense organ and Ampulla of Lorenzini of Shark

General Topic - Accessory respiratory organs in fishes
Adaptations of deep sea fishes
Parental care in fishes
Migration in fishes

Unit – III: Amphibia and Reptilia **12 Hours**

Classification of Amphibia upto order and their salient features

Order 1 Anura eg. Bufo
Order 2 Urodela eg. Salamandra
Order 3 Apoda eg. Icthyophis

Classification of Reptilia upto subclass and their salient features

Subclass 1 Anapsida eg. Seymouria
Subclass 2 Parapsida eg. Icthyosaurus
Subclass 3 Diapsida eg. Draco
Subclass 4 Synapsida eg. Dimetrodon

Functional anatomy - Calotes - Respiratory system
Arterial system
Venous system

General topics - Paedomorphosis with special reference to Axolotl larva,
Parental care in amphibian,
Distinguishing features of non-poisonous and poisonous snake.

Unit – IV: Aves **12 Hours**

Classification of Aves upto Super order and their salient features

Sub class Archaeornithes eg .Archaeopteryx
Sub class Neornithes
Super order 1 Odontognathae eg. Ichthyornis
Super order 2 Paleognathae eg. Ostrich
Super order 3 Neognathae eg. Vulture

General topics - Archaeopteryx and its evolutionary significance of exoskeleton in birds
Salient features of Ratites and Carinates
Flight of birds - Types of flight
Flight mechanism, migration of birds
Respiratory system of *Columbia livia*

Unit – V: Mammalia **12 Hours**

General characters of mammals; Classification of Mammals upto class and their salient features

Subclass 1 Prototheria eg. Echidna

Subclass 2 Metatheria eg. Kangaroo
Subclass 3 Eutheria eg. Rabbit

Functional anatomy - Brain of rabbit
Reproductive system

General topics - Distinguish features of Cetaceans and Sirenians,
Ruminant stomach in Mammals,
Placentation in Mammals.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, and Field Study

Text Books

1. Arumugam, N. (2008) Text book of Chordata, Saras Publiation, Kottar, Nagercoil.
2. Jordon E.L., Verma P.S. (2013) Chordate Zoology, S. Chand & Co Ltd., New Delhi.

Reference Books

1. Kotpal R.L. (2003) Modern textbook of Zoology – Vertebrates. Rastogi Pub, Meerut.
2. Saxena R. K., and Saxena S. (2008) Comparative anatomy of Vertebrates, Viva books

E-Resources

- https://www.paulding.k12.ga.us/cms/lib010/GA01903603/Centricity/Domain/2373/CHORDATES%20and%20Vertebrates.pdf
- https://www.researchgate.net/publication/23468368_Chordate_Origins_and_Evolution
- https://www.conserveenergy.feature.com
- https://www.biologydiscussion.com
- https://www.brainkart.com

Course Outcomes

At the end of the course, students would be able to:

CO1	Discuss the outline classification, salient features, morphology, Anatomy and Affinities of chordates.
CO2	Explain the taxonomy, functional anatomy of various systems, special features and adaptations of Pisces.
CO3	Illustrate the salient features, classification, organ system, important life process of Amphibia and Reptilia.
CO4	Classify Aves and describe the General Characters, organ systems, special adaptations and evolutionary significance of Aves.
CO5	Infer the salient features, taxonomy, anatomy and special phenomenon of Mammals.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	2	1	2	3	2	0	1	1	1	3
CO2	3	3	2	1	2	3	2	0	1	1	1	3
CO3	3	3	3	1	2	3	2	0	1	1	1	3
CO4	3	3	2	1	2	3	2	0	1	1	1	3
CO5	3	3	2	1	2	3	2	0	1	1	1	3

1 – Low 2– Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Quesions	No. Of Questions
1	CO1	Up to K2	2	K1&K1	2(K1&K1)	1(K2)
2	CO2	Up to K2	2	K1&K1	2(K1&K1)	1(K2)
3	CO3	Up to K2	2	K1&K1	2(K1&K1)	1(K2)
4	CO4	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
5	CO5	Up to K3	2	K1&K1	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Identify compare and distinguish.

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Either/or)	Total Marks	% of Marks without choice
K1	10	24	-	34	34%
K2	-	16	30	46	46%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

Programme	I B.Sc. Zoology	Programme Code	UZO
Course Code	20UZOC2P	No. of Hrs per Cycle:	2
Semester	II	Max: Marks:	60
Part	III	Credit	2
Core Practical Course – I			
Course Title	CORE PRACTICAL – I		
Cognitive Level – Up to K3 Level			

Preamble

Develop the skill of the students to identify slides, specimens of non chordates and chordates, the mitotic stages of onion tips, display chick embryo stages, show.

Major:

1. Identification of various mitotic cell divisions in Onion root tip.
2. Chick embryo - Four Stages in embryo development.

Minor:

1. Dissection: Earthworm- Nervous system.
2. Shark- Placoid scales.
3. Collection and Identification of Spiders
4. Culture of Zooplankton
5. Squash preparation of Salivary gland of Chironomous Larva – Polytene Chromosomes
6. Sectioning of tissues samples – Microtome.

Non Chordates

Slides:

Protozoa, Paramecium-Conjugation, Euglena
Porifera, Leucoscolenia, Spicules of sponges
Helmithes, Redia larva, Cercaria larva
Arthropoda, Nauplius, Mysis larva

Spotters:

Coelenterata: Physalia.Metridium
Helminthes: Liver fluke, Ascaris-Male & Female
Annelida: Earthworm, Neries
Arthopoda: Prawn, Peripatus
Mollusca: Pila, Sepia
Echinodermata: Starfish, Sea cucumber

Chordates:

Prochordata: Amphioxus,Balanoglossus, Ascidian
Pisces: Narcine, Eel, Catla.
Amphibia: Bufo, Salamander, Icthyophis
Reptilia: Poisonous Snakes- Cobra, Krait; Non-Poisonous Snakes- Dryophis and Ptyas.
Aves: Archaeoptenyx, Pectoral and Pelvic girdle of Pigeon.
Mammals: Bat, Loris

Cell structure and Dynamics

Spotters: Mitochondria, Golgibodies, Nucleus, Endoplasmic reticulum.

Embryology and Human Reproductive Technology

Spotters:

Mammal- Sperm, Ovum, Blastula, Glastula

Course Outcomes

At the end of the course, students would be able to:

CO1	Identify and classify the non-Chordates and Chordates.
CO2	Illustrate the morphological and anatomical system of non Chordate and Chordate specimen with precision.
CO3	List the evolutionary siginificant animals
CO4	Identify the mitotic stages and cell organelles.
CO5	Find the stages of Chick embryo

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	2	3	3	1	0	0	1	0	0	3
CO2	3	3	3	3	3	1	0	0	1	0	0	3
CO3	3	3	2	3	3	1	0	0	1	0	0	3
CO4	3	1	3	3	3	1	0	0	1	0	0	3
CO5	3	1	3	3	3	1	0	0	1	0	0	3

1 – Low 2– Moderate 3- High

Programme	I B.Sc. Chemistry	Programme Code	UZO
Course Code	20UZOA2P	No. of Hrs per Cycle:	2
Semester	II	Max: Marks:	60
Part	III	Credit	2
Ancillary Practical Course I			
Course Title	ALLIED ZOOLOGY PRACTICAL - I		
Cognitive Level – Up to K3 Level			

Preamble

Develop the skill of the students to identify animals based on their systematic position and also to differentiate invertebrates from chordates.

1. Dissect and display the parts (Demo)

Cockroach - Nervous System
Digestive System

2. Virtual Dissection

Frog - Arterial System
Venous System

3. Mountings:

Mosquito - Mouth Parts
Shark - Placoid Scales

4. Slides:

Protozoa - Paramecium, Euglena
Porifera - Simple Sponge, Sponge –Spicule
Coelenterata - Obelia colony, Obelia medusa
Helminthes - Redia larva, Cercaria larva
Arthropoda - Nauplius larva Mysis larva

5. Spotters

Helminthes - Liverfluke, Ascaris (male and female)
Annelida - Neries, Earthworm
Arthtropoda - Prawn, Honeybee
Mollusca - Pila, Sepia
Echinodermata - Starfish, Seacucumber
Pisces - Eel, Catla
Amphibians - Rhacophorus, Salamander
Reptiles - Draco, Chamaeleon

6. Project

Course Outcomes

At the end of the course, students would be able to:

CO1	Demonstrate the anatomy of non Chordate and Chordate animals
CO2	Classify the non-Chordates and Chordates animals
CO3	Identify the organisms through slides
CO4	Find the specimens of non-Chordates and Chordates
CO5	List the evolutionary significant animals

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	0	3	2	2	0	0	1	1	1	3
CO2	3	3	0	2	2	2	0	0	1	1	1	3
CO3	3	3	0	2	2	2	0	0	1	1	1	3
CO4	3	2	0	2	2	2	0	0	1	1	1	3
CO5	3	1	3	3	2	2	0	0	1	1	1	3

1 – Low 2– Moderate 3- High

.

Preamble

Programme	**I B.Sc. & B.A**	**Programme Code**	**UZO**
Course Code	**20UZON21**	**No. of Hrs per Cycle:**	**2**
Semester	**II**	**Max: Marks:**	**50**
Part	**IV**	**Credit**	**2**
Non Major Elective (NME)– II Course			
Course Title	**INSECT AND PEST MANAGEMENT**		
Cognitive Level Up to K3			

Enable to understand the biology of beneficial insects and to create awareness about insect pest, their managerial methods and its agricultural significance.

Unit – I **6 Hours**

Introduction Insects development – Metamorphosis, larva and pupa types, Beneficial – Helpful & Harmful Insects.

Unit – II **6 Hours**

Plant resistance to insects – importance, types and mechanisms, relationships - phytophagous insects, Induced resistance - acquired and induced systemic resistance, Factors affecting plant resistance –biotypes.

Unit – III **6 Hours**

Economic and public health importance of insect pests in human habitation and habitats, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.

Unit – IV **6 Hours**

Methods of Pest control - Physical, Mechanical, Chemical - Insecticide – Classification, nomenclature, toxicity, mode of entry, mode of action, Biological - Parasitoids (Egg, larval, pupal and adult parasitoids) and predators – Genetic Control - Breeding insect resistance host; Ecological control – Cultural and mechanical; microbial control – Bacteria – *Bacillus thuringiensis.* Integrated Pest Management concept, methods and tools (Case study on cotton).

Unit – V **6 Hours**

Principles and methods of pest management in residential places and public buildings, insecticides for domestic use and their safety, pre- and post construction termite proofing of buildings, appliances for domestic pest control. Instrumentation and applying ,methods.

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Experience Sharing, Activity based teaching, Field Study

Text Books

1. David, B.V. (2002), Elements of Economic Entomology, Popular Book Depot, Madras.
2. Dev Bhattacharya (2017), Text Book of Entomology, Arjun Publishing House.

Reference Books

1. Ramakrishna Ayyar T.V (2011 ed) Hand book of Economic Entomology for South India, Madras, Government Press.
2. Dennis Hill, (1975) Agricultural insect pests of the tropics and their control, Cambridge University Press.
3. Metcalf. Flint & Metcalf (1998) Destructive and Useful insects, IV Edition, McGraw-Hill Book Co., NY.

E-Resources

1. https://agrimoon.com/wp-content/uploads/Insect-Ecology-Integrated-Pest-Management.pdf
2. http://ecoursesonline.iasri.res.in/course/view.php?id=597
3. http://tmnehs.gov.in/writereaddata/Chap-14.pdf

Course Outcomes

At the end of the course, students would be able to:

CO1	Find the developmental stage of insects and to compare & classify the insect.
CO2	Infer the insect resistance level in plants, phytophagous insect and biotypes.
CO3	Interpret the economic and public health importance of insect pests and their management.
CO4	Relate various pest control methods and their application along with the concept of integrated pest management.
CO5	Apply the knowledge of significance of pest control methods in residential places and public buildings, instruments and appliances used in controlling domestic pests.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	3	2	2	2	1	2	1	1	1	2
CO2	3	2	3	1	2	2	0	2	1	1	1	2
CO3	3	2	2	1	1	2	2	2	1	2	1	2
CO4	3	2	2	2	1	1	2	2	1	1	1	2
CO5	3	3	2	2	2	1	1	2	1	2	1	2

1-Low **2-Moderate** **3-High**

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K – Level**	**Section A**	**Section B**
			Either/or Choice	**Open Choice**
			No. Of Questions	**No. Of Questions**
1	CO1	Up to K2	K1&K1	K2
2	CO2	Up to K2	K1&K1	K2
3	CO3	Up to K3	K2&K2	K3
4	CO4	Up to K3	K2&K2	K3
5	CO5	Up to K3	K2&K2	K3
No of Questions to be asked			10	5
No of Questions to be answered			5	3
Marks for each Question			3	5
Total Marks for each Section			15	15

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (Either/or)**	**Section B (Open Choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	12	-	12	21.8%	22%
K2	18	10	28	50.9%	51%
K3	-	15	15	27.27%	27%
Total Marks	**30**	**25**	**55**		**100%**

LESSON PLAN

INSECT AND PEST MANAGEMENT - 20UZON21				
Unit	**S. No.**	**Topics**	**Hours**	**Teaching mode**
I	i	Introduction to Entomology	1	Class room lecture, Power Point Presentation, Video, Insect collection to study life cycle
	ii	Insects development – Metamorphosis, larva and pupa types.	2	
	iii	Beneficial – Helpful & Harmful Insects	3	
		Total Hours	**6**	
II	i	Plant resistance to insects	2	Class room lecture, Power Point Presentation, Field Visit
	ii	Phytophagous insects	1	
	iii	Induced resistance	1	
	iv	Factors affecting plant resistance –biotypes	2	
		Total Hours	**6**	
III	i	Economic and public health importance of pest	2	Chalk and Talk Power Point Presentation, Field Visit
	ii	Biology, damage and control of insects	2	
	iii	Insect pests of cattle, poultry, pet animals and their management.	2	
		Total Hours	**6**	
IV	i	Methods of Pest control - Physical, Mechanical, Chemical	2	Class room lecture, Power Point Presentation, Video, Field Visit
	ii	Biological - Parasitoids and predators, Genetic Control.	2	
	iii	Ecological control, Integrated Pest Management	2	
		Total Hours	**6**	
V	i	Pest management in residential places and public buildings	1	Activity based class, Power Point Presentation, Chalk and Talk
	ii	Insecticides for domestic use	2	
	iii	Pre- and post construction termite proofing.	1	
	iv	Instrumentation and applying methods.	2	
		Total Hours	**6**	

Course designed by – Dr. S. Dharaneedharan

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOC31	Number of Hours/Cycle		4	
Semester	III	Max. Marks		100	
Part	III	Credit		4	
Core Course V					
Course Title	Principles of Genetics and Evolutionary Biology		L	T	P
Cognitive Level		Up to K3	60		

Preamble

Brief the importance of Mendelian concepts in the development of Genetics. Elaborate how the sex is determined, inheritance of characters, importance of genetics counseling. Invoke the deep understanding of evolutionary process, Paleontological evidences**,** Speciation & Evolution of Man.

Unit I	Classical Genetics	12 Hours
	1. Mendelian Genetics and its Extension Concepts and Principles of Mendelian inheritance, non-mendelian inheritance - Incomplete dominance and co-dominance, Lethal alleles, Epistasis, Pleiotropy, Linkage and crossing over in *Drosophila*, Cytological basis of crossing over, Chromosome mapping **Sex Determination and Inheritance** Sex determination in *Drosophila* and Man, Extra chromosomal inheritance and Mitochondrial inheritance.	
Unit II	**Cytogenetics**	**12 Hours**
	Chromosomal aberrations: Numerical aberrations- Chromosomal non-disjunction, Euploidy & Aneuploidy, Syndromes - Down syndrome, Turner syndrome, Edward Syndrome , Klinefelter Syndrome, Structural aberrations- Inversion, Translocaion, Deletion, Duplication. Detection of chromosomal anomalies- Pedigree analysis, Human Karyotyping, Prenatal diagnostics – Amniocentesis, Chorionic Villus sampling.	
Unit III	**Human Genetics**	**12 Hours**
	1. Genetic Counselling History, Famous Case Studies, Theory and Practice, Psycho-social aspects for the individual and the family in connection with genetic investigations; Legal aspects related to genetics - Medical termination of pregnancy act, PC-PNDT act and other aspects of medical jurisprudence. Concepts of Eugenics & Euthenics. **2. Genetics of Human Diseases and Inheritance Pattern:** **Autosomal inheritance- Dominant** (Ex.- Adult polycystic kidney) **Autosomal inheritance- Recessive** (Ex.- Albinism and Phenylketonuria) **X-linked – Recessive:** (Ex.- Duchenne muscular dystrophy-DMD) **X-linked; Dominant** (Ex.- Xg blood group) **Y-linked inheritance** (Holandric gene Ex.- Testes determining factor - TDF)	
Unit IV	**Evolution & Natural Selection**	**12 Hours**
	Life's Beginnings: Chemogeny, Urey Miller experiment, RNA world, Biogeny, Endo-symbiotic theory, Evidences for evolution - Paleontological evidences: Fossils formation, types and dating, Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism, Adaptive radiation in Darwin's Finches, Mimicry & Colouration, Kin Selection & Group Selection, Mode of selection – Stabilization, Disruptive and Directional.	
Unit V	**Population Genetics, Speciation & Human Evolution**	**12 Hours**
	Sources of Variation, Hardy Weinberg Equilibrium- gene pool, allele frequency, genetic drift, Founder's Effect & Bottle Neck Effect. Species concept- types of speciation; Reproductive isolation – prezygotic & post zygotic isolating mechanisms. Geological time scale; Origin and Evolution of man, Unique hominid characteristics contrasted with primate characteristics, future evolution of man.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Field visit, Activity based teaching.

Text Books

1. Verma P.S. and Agarwal V.K. (2009) Genetics, 9th Edition, S. Chand and Co. New Delhi.
2. Arora M.P (2013) Text Book of Organic Evolution, Himalaya Pub.House-New Delhi

Reference Books

1. Gardner, M. J. Simmons, D. P. Snustad - Principles of Genetics, 2006, 8TH ED, Wiley India Pvt. Limited.
2. Lewis R (2020). Human Genetics : Concepts and Applications, 12th Edition, McGrawHill, Boston.
3. Gangane S D (2017) Human Genetics 5th Edition, Elsevier Science,
4. Fletcher H. and Hickey I. (2015). *Genetics.* IV Edition. GS, Taylor and Francis Group, New York and London.
5. Dobzhansky, Theodosius, Hecht, Max K., Steere, William C, Evolutionary Biology, 1968, Vol.2.
6. Campbell N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
7. Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.
8. Veer Bala Rastogi (2017) Organic Evolution (Evolutionary Biology) Medtech, New Delhi.
9. Lull R.S. 2010. Organic evolution, The Macmillan, New York.

E-Resources

https://www.coursera.org/learn/genetics-evolution

https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/

https://www.researchgate.net/publication/272420540_MTP_and_PCPNDT_Act

https://www.who.int/genomics/public/geneticdiseases/en/

https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular- biology/kin-selection

https://www.youtube.com/watch?v=x8hwt3Tg-mA

Course Outcomes

After completion of this course, the students will be able to:

CO1	Compare the patterns of Mendelian and non-Mendelian inheritance and various types of sex determination
CO2	Illustrate and apply the concepts of cytogenetics, the techniques in Human Karyotyping and Prenatal diagnostics. Identify and get acquainted with the diseases caused by genetic abnormalities.
CO3	Develop the basic understanding of Genetic Counselling, aware and competent of legal aspects related to genetics, genetics of human diseases and its inheritance. Collect data about the history of a disease in a family and arrange it into a pedigree.
CO4	Illustrate how organic evolution occurred and how the various life forms come into existenc and Compare the Theories of evolution, evidences and Natural selection , Mode of selection – Stabilization, Disruptive and Directional.
CO5	Interpret the role of genetics in evolutionary study, evolutionary history of humans and populations.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	2	1	2	1	2	3	2	-	1	-	1	2
CO2	2	1	3	3	3	3	2	2	1	-	2	3
CO3	2	1	3	2	3	3	3	-	1	-	2	3
CO4	3	1	2	-	3	2	2	-	1	2	1	2
C05	3	1	3	1	3	3	2	-	1	1	2	2

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	40	80	80	80
K3	-	-	10	10	10	10
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Classical Genetics**	**12 Hours**	**Mode**
	1. Mendelian Genetics and its Extension		Lecture, PPT and Videos, Class room activity
	a. Basic concepts, Principles of Mendelian inheritance	**1**	
	b. Incomplete dominance and co-dominance	**1**	
	c. Lethal alleles	**1**	
	d. Epistasis	**1**	
	e. Pleiotropy	**1**	
	f. Linkage and crossing over in *Drosophila*	**2**	
	g. Chromosome mapping	**2**	
	2. Environmental Sex determination		
	h. Sex determination in *Drosophila* and Man	**1**	
	i. Extra chromosomal inheritance and Mitochondrial inheritance.	**2**	
Unit II	**Cytogenetics**	**12 Hours**	**Mode**
	a. Chromosomal non-disjunction - Euploidy & Aneuploidy	**2**	Class room lecture, Case studies, PPT and Videos
	b. Down syndrome, Turner syndrome, Edward Syndrome , Klinefelter Syndrome,	**3**	
	c. Structural aberrations- Inversion, Translocaion, Deletion, Duplication.	**2**	
	d. Detection of chromosomal anomalies- Pedigree analysis,	**2**	
	e. Human Karyotyping	**1**	
	f. Prenatal diagnostics – Amniocentesis, Chorionic Villus sampling	**2**	
Unit III	**Human Genetics**	**12 Hours**	**Mode**
	Genetic Counselling **a.** History, Famous Case Studies, Theory and Practice	**1**	Class room lecture, Case studies
	b. Psycho-social aspects for the individual and the family in connection with genetic investigations	**1**	
	c. Legal aspects related to genetics - Medical termination of pregnancy act, PC-PNDT act and other aspects of medical jurisprudence.	**2**	
	d. Concepts of Eugenics & Euthenics.	**1**	
	Genetics of Human diseases **e.** Molecular genetics of Human disease, Genetic basis of various diseases like **Autosomal inheritance- Dominant** (Ex.- Adult polycystic kidney)	**1**	
	f. Autosomal inheritance- Recessive (Ex.- Albinism and Phenylketonuria)	**2**	
	g. **X-linked – Recessive:** (Ex.- Duchenne muscular dystrophy-DMD) **X-linked ; Dominant** (Ex.- Xg blood group)	**2**	
	h. **Y-linked inheritance** (Holandric gene Ex.- Testes determining factor - TDF)	**2**	
Unit IV	**Evolution & Natural Selection**	**12 Hours**	**Mode**
	a. Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Endo-symbiotic theory, Urey Miller experiment.	**3**	Class room lecture, PPT, and
	b. Evidences for evolution - Paleontological evidences:	**3**	

	Fossils formation, types and dating,		Videos
	c. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism,	**3**	
	d. Adaptive radiation in Darwin's Finches, Mimicry & Colouration	**2**	
	e. Kin Selection & Group Selection, Mode of selection – Stabilization, Disruptive and Directional.	**1**	
Unit V	**Population Genetics, Speciation & Human Evolution**	**12 Hours**	**Mode**
	a. Sources of Variation.	**1**	Lecture, PPT, and Videos, field visit
	b. , Hardy Weinberg equilibrium- gene pool, allele frequency, genetic drift, founder effect & bottle neck effect	**3**	
	c. Species concept- types of speciation;	**2**	
	d. Reproductive isolation – prezygotic & post zygotic isolating mechanisms.	**2**	
	e. Geological time scale	**1**	
	f. Origin and evolution of man, Unique hominid characteristics contrasted with primate characteristics, future evolution of man.	**3**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code	UZO		
Course Code	20UZOC41	Number of Hours/Cycle	4		
Semester	IV	Max. Marks	100		
Part	III	Credit	4		
Core Course VI					
Course Title	Molecular Biology		L	T	P
Cognitive Level	Up to K3		60		

Preamble

Elaborate the central dogma of protein synthesis, DNA replication, transcription, translation, mutation and the molecular mechanisms involved in each cellular processes

Unit I	Nucleic Acids	12 Hours
	Nucleic acids structure, DNA forms and RNA types, DNA as genetic materials, Properties of nucleic acids, DNA replication – general principles, modes of replication, DNA polymerase and its unique types. Superhelicity and supercoiling in DNA, topology and topoisomerases.	
Unit II	**Replication**	**12 Hours**
	DNA Replication, retroviral replication. DNA damage and repair – Types of DNA damage, mechanism of repair (methyl directed, excision, recombinational, SOS). Recombination – Generalized and Site-specific.	
Unit III	**Transcription & Translation**	**12 Hours**
	Transcription – general principles, RNA polymerases and different stages involved, Monocistronic and polycistronic mRNAs, Regulation of transcription – attenuation & anti-termination, Translation –post translational modifications; Operon Concept – *lac, trp* operon.	
Unit IV	**Mutation**	**12 Hours**
	Gene as a unit of mutation, mutation types and recombination, mutagens, mutagenesis – biochemical and molecular basis of mutations: spontaneous and induced, Reversion, suppression, genetic analysis of mutants, Significance of mutations.	
Unit V	**Gene Transfer**	**12 Hours**
	Genetic code – Characteristics, Gene transfer mechanisms – conjugation, transformation and transduction. Plasmids - structure of F1, Col E1. pSC 101, Ti plasmid, incompatibility. Transposons – structure, types and functions.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Experience Sharing, Activity based teaching, Field Study

Text Book

1. David Frifelder. Molecular Biology (2008) Narosa publishing house, New Delhi. 2nd edition.

Reference Books

1. Daniel L Hartl and Elizabeth W Jones (2001) Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK.
2. David Frifelder (1990) Microbial Genetics, Narosa publishing house, New Delhi.
3. George M Malacinski (2008) Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House.

E-Resources

- http://www.stet.edu.in/SSR_Report/Study%20Material/PDF/MICRO/III%20YEAR/3.pdf.
- https://www.onlinebiologynotes.com/molecular-markers-types-and-applications/.
- https://www.topperlearning.com/neet/biology/molecular-basis-of-inheritance.

Course Outcomes

After completion of this course, the students will be able to:

CO1	Associate the structure of nucleic acid and their related cellular mechanisms
CO2	Describe the different molecular mechanism involved in DNA replication.
CO3	Explain the salient features of various cellular mechanisms involved in controlling transcription and translation
CO4	Identify the molecular basis of heritable changes along with the methods to overcome
CO5	Utilize the various molecular mechanism associated with gene transfer

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	PSO 2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO 10	PSO11	PSO12
CO1	2	1	3	2	2	2	1	-	-	1	1	-
CO2	1	1	3	1	1	1	1	1	1	-	-	1
CO3	2	1	3	-	1	1	-	-	-	-	-	1
CO4	2	1	3	-	1	1	-	1	-	1	1	-
C05	1	1	3	1	1	1	-	-	1	-	1	1

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(KI&K1)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	8	-	18	18%	18%
K2	-	32	40	72	72%	72%
K3	-	-	10	10	10%	10%
Total Marks	10	40	50	100		100%

Lesson Plan

Unit	**Nucleic Acids**	**12Hours**	**Mode**

I	a. Nucleic acids as genetic material – Chemistry of Nucleic acids	2	Class room lecture, Power Point Presentation, Chalk and Talk, Videos, Specimens
	b. DNA structure., RNA Structure – types	4	
	d. Properties of nucleic acids.	1	
	e. DNA replication – general principles, modes of replication, . DNA polymerase and its unique types	2	
	g. Superhelicity in DNA	1	
	h. DNA, topology and topoisomerases.	2	
Unit II	**Replication**	**12Hours**	**Mode**
	a. Replication of ssDNA, retroviral replication.	4	Class room lecture, Power Point Presentation, Chalk and Talk
	c. DNA damage and repair – Types of DNA damage	2	
	d. DNA repair mechanism - methyl directed, excision	2	
	e. DNA repair mechanism - recombinational, SOS.	2	
	f. Recombination – Generalized and Site- specific.	2	
Unit III	**Transcription & Translation**	**12Hours**	**Mode**
	a. Transcription – general principles, basic mechanism involved	2	Class room lecture, Power Point Presentation, Chalk and Talk
	b. RNA polymerases and steps involved in transcription , Monocistronic and polycistronic mRNAs, Regulation of transcription – attenuation and antitermination	6	
	e. Regulation of heat shock proteins.	2	
	f. Translation –post translational modifications; operon concept – *lac, trp* operon.	2	
Unit IV	**Mutation**	**12Hours**	**Mode**
	a. Gene as a unit of mutation and recombination	2	Class room lecture, Power Point Presentation,
	b. Mutations, Biochemical basis of mutation	2	
	c. spontaneous and induced mutation	2	
	d. Reversion, suppression, genetic analysis of mutants, Genetic mapping of *E. coli* and yeast.	6	
Unit V	**Gene Transfer**	**12Hours**	**Mode**
	a. Genetic code.	2	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Gene transfer mechanisms - conjugation	2	
	c. Transformation and transduction	2	
	d. Plasmids - structure of F1, Col E1. pSC 101, Ti plasmid, incompatibility.	4	
	e. Transposons – structure, types and functions.	2	

Course designed by Dr. S. Dharaneedharan

Programme	B.Sc., Zoology	Programme Code			UZO
Course Code	20UZOC4P	Number of Hours/Cycle			2
Semester	III & IV	Max. Marks			100
Part	III	Credit			2
Core Practical					
Course Title	Core Practicals II		L	T	P
Cognitive Level		Up to K3			30

PRINCIPLES OF GENETICS:

1. Study of Mendelian traits among class students.
2. Study of Mendelian Laws using beeds and leaves.
3. Buccal Smear preparation and Identification of Barr Body
4. Human Karyotype: Normal male and female,
5. Klinefelter's syndrome, Down‟s syndrome and Turner‟s syndrome
6. Pedigree analysis: Symbols used in sex chromosomal (x linked) disorders.
7. Preparation of Pedigree Chart of each student's family

EVOLUTIONARY BIOLOGY:

1. Study of homology and analogy from suitable specimens.
2. Study of fossils from models/pictures.
3. Construction of cladograms based on morphological characters.
4. Study of variations in a sample human population: (a) Continuous variation:
5. Height/Weight in relation to age and sex (b) Discontinuous variation: Ability/Inability to taste Phenyl thiocarbamide (PTC).
6. Field visit – Report submission

MOLECULAR BIOLOGY:

1. Determination of absorption spectra of DNA and protein using UV-Visible spectrophotometer.
2. Estimation of DNA by diphenylamine reaction.
3. Estimation of RNA by orcinol method
4. Isolation of bacterial genomic DNA
5. Quantification of Nucleic acids

Spotters

1. PCR – Techniques
2. Blotting Techniques – Sourthern and Western blotting

Reference: Book

1. T Maniatis, E F Fritsch and J Sambrook. pp 545. Cold Spring Harbor Laboratory, New York. 1982.

Course Code	**20UZOA31**	Number of Hours/Cycle	**4**
Semester	**III**	Max. Marks	**100**
Part	**III**	**Credit**	**4**

Allied Course				
Course Title	**Zoology for Chemist – I**	**L**	**T**	**P**
Cognitive Level	**Up to K3**	**60**		

Preamble

Gain knowledge on morphology of bacteria, virus, chemistry of biomolecules, structure and functions of intestine, lungs and kidney, morphology and development of gametes, molecular interactions of genetic materials and its biotechnological applications.

Unit I	**Microbiology**	**12 Hours**
	Structure of a prokaryotic cell (E. coli) - Structure of T_4 Phage – Bacterial general features, classification based on shape and mode of nutrition. Viral disease – HIV and Corona (Pathogenesis, Symptoms, Prevention and Control).	
Unit II	**Biochemistry**	**12 Hours**
	Classification and structure of Carbohydrates.(Mono, Di, Polysaccharides with one example each) - Classification and structure of proteins with examples (primary, secondary, tertiary, and quaternary structure) - Classification and Structure of Lipids with examples;	
Unit III	**Physiology**	**12 Hours**
	Digestion of Carbohydrates, Protein, and Lipids; Respiration, Mechanism of respiration and Transport of gases; Excreation, Structure of Nephron and Formation of urine.	
Unit IV	**Developmental biology**	**12 Hours**
	Structure of sperm and ovum in Human – Fertilization; Assisted Reproductive Technology – IVF, IUF, AI, Sperm Bank, Test tube baby method.	
Unit V	**Biotechnology**	**12 Hours**
	Enzymes , Vectors - pBR 322, pUC 18, Cosmid, Recombinant DNA - Construction and applications - Transgenic animals – Dolly – Methods and Applications , DNA finger printing – Methods and Applications – Ethical issues.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Experience Sharing, Activity based teaching, Field Study

Text Books

1. Dulsy Fatima, N, Arumugam, (2009), "*Microbiology and Immunology"*, Saras Publication.
2. Arumugam, N, (2014), "*Cell Biology and Molecular Biology"*, Saras Publications.
3. Kumerasan, V, (2015), "*Text Book of Biotechnology"*, Saras Publications.

Reference Books

1. Black. J., (1999), *Microbiology – Principles and explorations*, Printice Hall International Inc, New Jersey.
2. De Robertis and De Robertis, (2006), "*Cell and Molecular Biology"*, WB Saunders Company, Philadelphia, 3rd Edition.
3. Dubey, R. C., (1995), "*Text book of Biotechnology'*, S. Chand and Company, New Delhi.

E-Resources

- https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/
- https://www.researchgate.net/publication/272420540_MTP_and_PCPNDT_Act

- https://www.who.int/genomics/public/geneticdiseases/en/
- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/kin-selection
- https://www.youtube.com/watch?v=x8hwt3Tg-mA
- http://www.stet.edu.in/SSR_Report/Study%20Material/PDF/MICRO/III%20YEAR/3.pdf.
- https://www.onlinebiologynotes.com/molecular-markers-types-and-applications/.
- https://www.topperlearning.com/neet/biology/molecular-basis-of-inheritance**.**

Course Outcomes

After completion of this course, the students will be able to:

CO1	Demonstrate the structure, classification and mode of infection and related diseases
CO2	Describe the various biochemical functions of bio-molecules.
CO3	Enumerate the Physiological functions alimentary, respiratory and excretory systems.
CO4	Explain the basics developmental principles of gametes and their applications in assisted reproductive technology
CO5	Utilize basic concepts of biotechnological principles and other important biotechnological applications

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO9	PSO 10	PSO 11	PSO 12
CO1	2	1	3	2	2	2	1	-	-	-	1	-
CO2	1	1	3	1	1	1	1	1	-	1	-	1
CO3	2	1	3	-	1	1	-	-	1	-	-	1
CO4	2	1	3	-	1	1	-	-	-	1	1	-
C05	1	1	3	1	1	1	-	-	1	-	1	1

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open choice**
			No. Of Questions	**K-Level**	**No. of Question**	
1	CO1	Up to K2	2	K1	2(KI&K1)	K2
2	CO2	Up to K2	2	K1	2(K1&K1)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	16	-	26	26%	26%
K2	-	24	40	64	64%	64%
K3	-	-	10	10	10%	10%
Total Marks	10	40	50	100		100%

Lesson Plan

Unit I	**Microbiology**	**12 Hours**	**Mode**
	a. Structure of a prokaryotic cell (E. coli) -	**3**	Class room lecture, Power Point Presentation, Chalk and Talk, Videos, Specimens
	b. Structure of T_4 Phage.	**2**	
	c. Bacterial general features, classification based on shape and mode of nutrition	**3**	
	d. Viral disease - AIDS (Pathogenesis, Symptoms, Prevention and Control).	**2**	
	e. Viral disease - Corona (Pathogenesis, Symptoms, Prevention and Control).	**2**	
Unit II	**Biochemistry**	**12 Hours**	**Mode**
	a. Classification and structure of Carbohydrates	**2**	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Mono, Di, Polysaccharides with one example each	**3**	
	c. Classification and structure of proteins with examples	**2**	
	d. Primary, secondary, tertiary, and quaternary structure)	**3**	
	Classification and Structure of Lipids with examples;	**2**	
Unit III	**Physiology**	**12 Hours**	**Mode**
	a. Digestion of Carbohydrates & Protein	**3**	Class room lecture, PPT Chalk and Talk
	b. Digestion of Lipids	**2**	
	c. Respiration – Mechanism	**2**	
	d. Transport of Gas	**2**	
	e. Structure of Nephron and Formation of urine.	**3**	
Unit IV	**Developmental biology**	**12 Hours**	**Mode**
	a. Structure of sperm.	**2**	Class room lecture, PPT Chalk &Talk
	b. Structure of human ovum	**1**	
	c. Fertilization, ART, IUF	**3**	
	d. AI, Sperm Bank - applications and importance	**3**	
	e. Test tube baby methods	**3**	
Unit V	**Biotechnology**	**12 Hours**	**Mode**
	a. Enzymes and Vectors	**2**	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Recombinant DNA	**3**	
	c. Transgenic animals, Dolly – Methods and Applications	**2**	
	d. rDNA Construction and applications	**3**	
	e. DNA finger printing – Methods and Applications – Ethical issues.	**2**	

Course designed by Dr. S. Dharaneedharan

Programme	B.Sc., Chemistry	Programme Code		UZO	
Course Code	20UZOA41	Number of Hours/Cycle		4	
Semester	IV	Max. Marks		100	
Part	III	Credit		4	
Allied Course					
Course Title	Zoology for Chemist – II		L	P	T
Cognitive Level		Up to K3	60		

Preamble

Provide a comprehensive idea on various thrust areas to start profitable business. Develop a dynamic and successful entrepreneur skill which includes poultry, aquaculture, vermiculture, apiculture and sericulture techniques.

Unit I	**Poultry farming**	**12 Hours**
	Indian and Exotic breeds, construction of poultry house, Equipments - Brooder, Waterer and feeder, Rearing of broiler, layers and nutritive value of eggs; Lighting, Summer and winter management.	
Unit II	**Aquaculture**	**12 Hours**
	Marine and freshwater fishes, Biological value of fish and Economy of ornamental fishes, Commercial values of shell fish, prawn, edible oyster, pearls, crab.	
Unit III	**Vermiculture**	**12 Hours**
	Introduction to Vermitechnology, Earthworm - structure and types , Endemic and Exotic species, Ecological classification of Earthworms, Epigeic, Aneic, Endogeic; Roll of earthworm in soil fertility and sustainable agriculture, Earthworm as an alternative protein source in poultry and fish farming.	
Unit IV	**Apiculture**	**12 Hours**
	Apiculture: Bees – social organization, queen, drones, worker, royal jelly, life history, hive – primitive and modern hive types – Newton's hive and nutritional value of Honey	
Unit V	**Sericulture**	**12 Hours**
	Mulberry sericulture: Silk Industry in India, Central Silk Board, Mulberry cultivation, Life history of *Bombyx mori*. rearing appliances, rearing of silk worm, Silk reeling, reeling appliances and Commercial value of silk - Non mulberry sericulture: Tasar, Muga, Erisilk	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Experience Sharing, Activity based teaching, Field Study

Text Books

1. Jayasurya R., Arumugam N, Leelavathy S., Soundara Pandian N., Murugan T., Thangamani A., Prasannakumar S., Narayanan L.M., Johnson Rajeshwar J., Nair N.C. (2013) Economic Zoology, Saras Publication, Nagercoil.
2. Seethalakshmi, M., Shanthi, R. Vermitechnology, (2012), Saras Publication, Nagercoil.

Reference Books

1. Ganga G., Sulochana chetty (1977) J. An Introduction of Sericulture. Oxford, New Delhi.
2. Gnanamani R. (2003) Modern aspects of commercial poultry keeping, Giri Pub, Madurai.
3. Gupta C. B., Srinivasan N. P. (1997) Entrepreneurship development in India, Sultan Chand and Sons, Educational Publishers, New Delhi.

Course Outcomes

After completion of this course, the students will be able to:

CO1	Enumerate the practice of farming in poultry birds
CO2	Demonstrate the principles aquaculture, farming practice, fish species
CO3	Describe the principles and technologies vermiculture and its applications
CO4	Explain the culture of honey bee, their life cycle and their benefits for human
CO5	Utilize basic of ideas in sericulture and mulberry farming

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	2	1	3	2	2	2	1	-	-	-	1	-
CO2	1	1	3	1	1	1	1	1	-	1	-	1
CO3	2	1	3	-	1	1	-	-	1	-	-	1
CO4	2	1	3	-	1	1	-	-	-	-	1	-
C05	1	1	3	1	1	1	-	-	-	1	1	1

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Any three
			No. Of Questions	K-Level	No. Of Question	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open)**	**Total Marks**	**% of Marks without Choice**	**Consolidated (Rounded off)**
K1	10		-	10	10%	10%
K2	-	40	40	80	80%	80%
K3	-	-	10	10	10%	10%
Total Marks	10	40	50	100		100%

Lesson Plan

Unit I	**Poultry farming**	**12 Hours**	**Mode**
	a. Indian and Exotic breeds, construction of poultry house	**3**	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Equipments - Brooder, Waterer and feeder	**2**	
	c. Rearing of broiler, layers and nutritive value of eggs, **.** Lighting	**4**	
	d. Summer and winter management	**3**	
Unit II	**Aquaculture**	**12 Hours**	**Mode**
	a. Marine and freshwater fishes -	**2**	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Biological value of fish and Economy of ornamental fishes	**2**	
	c. Commercial values of shell fish, prawn, edible oyster, pearls, crab	**3**	
	d. Commercial values of edible oyster, pearls, crab, Commercial values of pearls, crab	**5**	
Unit III	**Vermiculture**	**12 Hours**	**Mode**
	a. Introduction to Vermitechnology,	**2**	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Earthworm - structure and types	**2**	
	c. - Endemic and Exotic species	**3**	
	d. Ecological classification of Earthworms-Epigeic, Aneic, Endogeic.	**2**	
	e. Earthworm as an alternative protein source in poultry and fish farming.	**3**	
Unit IV	**Apiculture**	**12 Hours**	**Mode**
	a. Apiculture: Bees – social organization	**3**	Class room lecture, Power Point Presentation, Chalk&Talk
	b. queen, drones, worker, royal jelly	**3**	
	c. life history, hive – primitive	**2**	
	d. Modern hive types and their advantages	**2**	
	e. Newton's hive and nutritional value of Honey	**2**	
Unit V	**Sericulture**	**12 Hours**	**Mode**
	a. Mulberry sericulture: Silk Industry in India, Mulberry cultivation	**2**	Class room lecture, Power Point Presentation, Chalk and Talk
	b. Life history of *Bombyx mori.* Seed production	**2**	
	c. rearing appliances, rearing of silk worm, Silk reeling	**3**	
	d. reeling appliances and Commercial value of silk	**2**	
	e. Non mulberry sericulture: Tasar, Muga, Erisilk and commercial value	**3**	

Course designed by Dr. S. Dharaneedharan

Programme	B.Sc., Chemistry	Programme Code			UZO
Course Code	20UZOA4P	Number of Hours/Cycle			4
Semester	IV	Max. Marks			100
Part	III	Credit			2
Allied Practical					
Course Title	Allied Zoology Practical – II		L	T	P
Cognitive Level		Up to K3			60

List of Practicals:

1. Preparation of Onion root tip and observe the mitotic stages.
2. Preparation of bacterial smear from curd.
3. Gram's staining of positive and negative strains.
4. Qualitative test for ammonia, urea, and uric acid.
5. Qualitative test for Carbohydrates, protein and lipid.
6. Identification of Queen, Male and Drone bees
7. Collection of silkworm eggs, caterpillar, pupa and adult month
8. Field Visit to any two of the following farms: Dairy, Poultry & Aquaculture farm

List of Spotters:

1. Different morphological appearance of Bacteria.
2. Structure of Sperm and ovum - slides
3. Dolly
5. IVF techniques – Test Tube Baby
6. Plasmid – pUC 18, pBR322
7. Transgenic plants – Golden Rice, Bt cotton
8. Following stages of Frog embryo: i) Egg ii) Sperm iii) Blastula iv) Gastrula.
9. Sheep placenta.
10. Poultry breeds and importance of native breeds

Course design by Dr. S. Dharaneedharan

Extra Credit Value Added Courses

Programme	B. Sc., Zoology	Programme Code		UZO	
Course Code	20CZOO31	Number of Hours/Semester		2	
Semester	III	Max. Marks		30	
Part	IV	Credit			
Value Added Course I					
Course Title	Sericulture		L	T	P
Cognitive Level		Up to K3	30		

Preamble

This course is designed with an aim to provide scope, significance and entrepreneurial skill to the students in the field of sericulture. It will help the students to understand the biology of silkworms and its nutritional requirement to secrete quality silk. The course would clarify the techniques of silkworm rearing, reeling of silk and various measures to be taken to maximize the benefits.

Unit I	**Introduction & Life cycle of Silkworm:**	**6 Hours**
	History and present status; Silk route. Types of silkworms, Distribution and Races, Exotic and indigenous races, Life cycle of Bombyx mori.- Metamorphosis, Moulting, Voltinism Morphology of egg, larva, pupa and moth of Mulberry Silkworm – Sexual dimorphism.	
Unit II	**Anatomy of silkworm:**	**6 Hours**
	Digestive system, Excretory system and Reproductive system. Anatomy and physiology of silk glands, secretion of silk.	
Unit III	**Rearing of Silkworm:**	**6 Hours**
	Selection of mulberry variety and establishment of mulberry garden. Rearing house and rearing appliances, Uses of Disinfectants: Formalin, bleaching powder, etc. Silkworm rearing technology: Early age and Late age rearing, Spinning, methods of mounting, harvesting and storage of cocoons.	
Unit IV	**Entrepreneurship in Sericulture:**	**6 Hours**
	Cocoon reeling, Appliances used for reeling. Marketing of cocoons- Physical and commercial characters and defective cocoons. Prospectus of Sericulture in India: Sericulture industry in different states. Employment opportunities in mulberry and non-mulberry sericulture, scope for women entrepreneurs in sericulture sector.	
Unit V	**Diseases and Pests**	**6 Hours**
	Silkworm diseases: Protozoan disease –pebrine, Viral disease –Grasserie , Bacterial disease -flacheri, Fungal disease –Muscardine, Pest of silk worm –Uzifly, Red ant.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Field visit, Activity based teaching

Text Book

1. Johnson M.and Kesary M., (2008) Sericulture Saras Publiation, Kottar, Nagercoil.
2. Ganga G and Sulochana Chetty J, (2017) (2nd reprint) An Introduction to Sericulture, Oxfordand IBH Publishers, New Delhi.

Reference Books

1. M. Madan Mohan Rao (2019). An Introduction to Sericulture, BS Publications BSP Books.

2. Tukaram Vithalrao Sathe, Adhikrao D Jadhav (2001) Sericulture and Pest Management, Daya publishing house, New Delhi.
3. Abhay Shankar and Rajendra Reddy (2008) Sericulture, Commonwealth, New Delhi,

E-Resources

- **http://agrobiosonline.com/book_detail.php**
- **https://www.youtube.com/watch?v=RzNopX1qSOg**
- **https://www.youtube.com/watch?v=31ThpIKVhIw**
- **https://agritech.tnau.ac.in/sericulture/seri_silkworm4_lateage%20rearing.html**
- **https://www.biologydiscussion.com/animals-2/lifecycle-of-silkworm-with-diagram/2655**

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the history of sericulture and silk route. Recognize various species of silk moths in India, and exotic and indigenous races.
CO2	Demonstrate the Anatomy of silkworm.
CO3	Develop and apply the knowledge about the techniques involved in silkworm rearing and silk reeling.
CO4	Identify the quality of cocoons, apply the entrepreneurial skills necessary for self-employment , make use of the opportunities and employment in sericulture industry-in public, private and government sectors.
CO5	Apply the knowledge to identify the pathogenesity and make use of the disease and pest management in sericulture.

Course designed by: Dr. N. Renuga Devi

Programme	B. Sc., Zoology	Programme Code		UZO	
Course Code	20CZOO41	Number of Hours/Semester		30	
Semester	IV	Max. Marks		30	
Part	IV	Credit			
Value Added Course II					
Course Title	Nutrition and dietetics		L	T	P
Cognitive Level		Up to K2	30		

Preamble

Brief the importance of nutrients, principles of nutrition, deficiency diseases and dietetics management.

Unit I	**Nutritional Programme**	**6 Hours**
	Macronutrients and their function – Carbohydrates, Fats, Proteins, Water, Micronutrients and their function – Vitamins and Minerals, Nutritive value of the foodstuff – Cereals – Pulses – Vegetables – Fruits – Milk – Egg – Meat – Fish.	
Unit II	**Principles of nutrition**	**6 Hours**
	Parboiling of rice – process of parboiling and uses of parboiled rice. Germination of cereals – process of germination and uses of sprouts & its nutritive value, Effect of cooking on protein, carbohydrate and fat content – Menu planning and meal pattern – vegetarian and non-vegetarian – (calories chart)	
Unit III	**Nutritional Statistics**	**6 Hours**
	Role of fibres in nutrition. Determination of energy content of food – Bomb Calorimeter, BMR – Determination of BMR – using direct caloriemeter and Benedict Methods. Both basal metabolie apparatus – Factors affecting BMR.	
Unit IV	**Nutritional deficiency disease**	**6 Hours**
	Balanced diet – Nutritional requirements of different age groups – Diet - Children growth diet - Adolescents – Pregnant, lactating women and Aged people. Nutritional diseases – causes and prevention and dietary management of malnutrition, under nutrition and obesity. Common nutritional deficiency diseases in India – Kwashiorkor – Marasmas – Anaemia Goitre.	
Unit V	**Dietetics Management**	**6 Hours**
	Therapeutic diet and its importance, diet planning, symptoms, causes, prevention and dietary management for diabetes mellitus, ulcer, cardiac disease, hepatitis, hypertension, gastro-intestinal disorders, constipation.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Field Study

Text Book

1. Sumathi,R. Mudambi and M.V.Rajagopal Fundamentals of Foods, Nutrition and Diet , 2020, New Age International Publishers (5th Edition).

Reference Books :

1. Swaminathan, M. Principles of Nutrition and Dietetics, 2018, Banglore Press.
2. Rajalakshmi, R. Applied Nutrition. 1974, Oxford and IBH Publishing

e- Resources:

- https://www.youtube.com/watch?v=RzNopX1qSOg
- https://www.youtube.com/watch?v=31ThpIKVhIw

- https://agritech.tnau.ac.in/sericulture/seri_silkworm4_lateage%20rearing.html

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the nutrients of various food
CO2	Compare the importance of parboiled rice, cereals and their calorific values
CO3	Interpret the statistical values of nutritional diets
CO4	Classify the diet charts and nutritional deficiency diseases
CO5	Illustrate the importance of therapeutic diet management.

Course designed by: Mrs. B. Subasri

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOC51**	**Number of Hours/Cycle**		**4**	
Semester	**V**	**Max. Marks**		**100**	
Part	**III**	**Credit**		**4**	
Core Course VII					
Course Title	**Biostatistics and Research Methodology**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**60**		

Preamble

Acquire wide range of knowledge on bio statistical skills, including problem solving, project work and thesis writing and enable to take prominent roles in a wide spectrum of employment and research.

Unit I	**Collection and Presentation of Data**	**12 Hours**
	Collection of Primary and Secondary data, Classification of data: Objectives, types, and Methods of Classification. Methods of Sampling, (Experimental, Census and Sampling methods) Variable: Types of Variables. Tabulation; Parts of a table. Diagrammatic Presentation: Line diagram, Bar diagram, Multiple bar diagram, Component bar diagram, Percentage bar diagram, Pie diagram, Pictograms and Cartograms. Graphical Presentation: Graph, Time Series Graphs: Graph of one variable, Graph of two (or) more variables, Range Chart, Band graph. Frequency Distribution, Histogram, Frequency Polygon, Frequency Curve, Ogives.	
Unit II	**Measures of Central Tendency and Dispersion**	**12 Hours**
	Mean - individual, discrete & continuous series. (problems) Median -individual, discrete & continuous series. (problems) Mode - individual, discrete & continuous series. (problems) Measures of dispersion: range, quartile deviation, standard deviation, variance. (problems)	
Unit III	**Chi–Square Test, Correlation and Regression**	**12 Hours**
	Chi – Square Test (Problems). **Correlation** – Uses, Types of correlation, Methods of Studying Correlation – 1. Graphic Methods, (Scatter diagram, Simple graph) 2.MathematicalMethods (Karl Pearson's co- efficient of correlation, Spearman's Rank co- efficient of correlation). **Regression Analysis** – Types of Regression Analysis, Uses, Regression Equations.	
Unit IV	**Research Methodology**	**12 Hours**
	Research methods: Features of research, Type of research, steps in scientific methods and formulating research hypothesis, Basic elements of scientific methods. Research Process – problem	

	identification, Literature review, Selection of research design, subjects, and data collection techniques, Data processing and analysis, Implications, conclusions, and recommendations.	
Unit V	**Animal Collection and Thesis Writing**	**12 Hours**
	Animal collection Tools and Techniques: Sampling techniques: Quadrat, line transect. Measurements: Density abundance, Frequency. Biodiversity indices – concepts, Simpson index, Shannon wiener index. Collection methods, techniques and equipment – Insects. Thesis Writing: Features of PhD thesis, Publishing a Research Paper, Project proposal writing, research report writing, Plagiarism.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Field visit, Activity based teaching.

Text Books

1. Er. Gopi A, Er. Meena, Sharmila A, Sundaralingam R. Biostatistics, Computer Applications and Bioinformatics (2019) Saras publication Nagercoil.

2. Vikas Dhikav Fundamentals of Biomedical Research, CBS Publishers, New Delhi.

Reference Books

1. Pranab Kumar Banerjee, Introduction to Biostatistics (2011) S. Chand & Company, New Delhi.
2. Khan I.A and Khanum A, (2004).Fundamentals & Biostatistics, 2nd ed., Ukaaz Publications, Hyderabad.
3. N. Gurumani, (2010). An Introduction to Biostatistics, MJP Publishers, Chennai.
4. Satguru Prasad, (2012). Elements of Biostatistics, Rastogi publications, Meerut.
5. P.Ramakrishnan, (2010). Biostatistics, Saras publication, Nagercoil, Tamil Nadu.
6. N. Gurumani Research Methodology for Biological Sciences, (2011) MJP Publishers, Chennai.

E-Resources

https://www.formpl.us/blog/primary-data
https://www.vedantu.com/commerce/presentation-of-data
https://testbook.com/learn/maths-measures-of-central-tendency/
https://byjus.com/maths/dispersion/
https://www.5staressays.com/blog/thesis-and-dissertation/thesis-writing

Course Outcomes

After completion of this course, the students will be able to:

CO1	Illustrate the methods of collection of data and their classification, Construct tables,

	charts and graphs to infer about the collected data.
CO2	Interpret the collected data by employing various measures of central tendency and measures of dispersion.
CO3	Predict the expected values and their significance.
CO4	Understand the various methods of research and their possible interpretation.
CO5	Choose suitable statistical methods depending up on problems and knowledge about thesis writing.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	**PSO2**	**PSO3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**	**PSO 10**	**PSO 11**	**PSO 12**
CO1	1	-	-	3	3	3	-	2	2	-	1	1
CO2	1	-	-	3	3	3	-	2	2	-	1	1
CO3	1	-	-	3	3	3	-	2	2	-	1	1
CO4	1	-	-	3	3	3	-	2	2	-	2	2
C05	1	-	-	3	3	3	-	2	2	-	2	2

1. Low 2. Moderate; 3. High;

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K3	2	K1	2(K3&K3)	K3
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10 %	10 %
K2	-	32	30	62	62 %	62 %
K3	-	8	20	28	28 %	28 %
Total Marks	10	40	50	100	100 %	100%

Lesson Plan

Unit I	**Collection and Presentation of Data**	**12 Hours**	**Mode**
	1.Collection of Primary and Secondary data	1	Class room Lecture, PPT, Videos and Class room activity
	Classification of data	1	
	2.Methods of Sampling, (Experimental, Census and Sampling methods)	1	
	3.Tabulation; Parts of a table.	1	
	4.Diagrammatic Presentation: Line diagram, Bar diagram, Multiple bar diagram, Component bar diagram, Percentage bar diagram, Pie diagram, Pictograms and Cartograms.	4	
	5.Graphical Presentation: Graph, Time Series Graphs: Graph of one variable, Graph of two (or) more variables, Range Chart, Band graph. Frequency Distribution, Histogram, Frequency Polygon, Frequency Curve, Ogives.	4	
Unit II	**Measures of Central tendency and Dispersion**	**12 Hours**	**Mode**
	1.Mean - Individual, Discrete & Continuous Series. (Problems)	3	Class room Lecture, PPT, Videos and Class room Activity.
	2.Median -Individual, Discrete & Continuous Series. (Problems)	3	
	3.Mode - Individual, Discrete & Continuous Series. (Problems)	3	
	4.Measures of Dispersion: Range, Quartile deviation, Standard deviation, Variance. (Problems)	3	
Unit III	**Chi–Square Test, Correlation and Regression**	**12 Hours**	**Mode**
	1.Chi – Square Test (Problems).	1	Class room lecture, PPT Videos and Class room Activity.
	2.Correlation – Definition, Uses, Types of correlation.	2	
	3.Methods of Studying Correlation – Graphic Methods, (Scatter diagram, Simple graph).	1	
	4.Mathematical Methods (Karl Pearson's co-	3	

	efficient of correlation		
	5.Spearman's Rank co- efficient of correlation).	1	
	6.Regression Analysis – Types of Regression Analysis, Uses.	2	
	7. Regression Equations.	2	
Unit IV	**Research methodology**	**12 Hours**	**Mode**
	1. Research methods: Features of research.	1	Class room lecture, PPT, and Videos.
	2. Type of research.	2	
	steps in scientific methods and formulating research hypothesis - problem identification,	1	
	3.Literature review	2	
	4.Selection of research design, subjects, and data collection techniques,	2	
	5.Data processing and analysis,	2	
	6.Implications,conclusions,and recommendations.	2	
Unit V	**Animal collection and thesis writing**	**12 Hours**	**Mode**
	1.Animal collection Tools and Techniques**:**Sampling techniques: Quadrat, line transect	1	Class room lecture, PPT, and Videos
	2. Measurements: Densityabundance, Frequency.	1	
	3. Biodiversity indices – concepts, Simpson index, Shannon wiener index.	2	
	4.Collection methods, techniques and equipment – Insects	2	
	5.Thesis Writing: Features of PhD thesis	1	
	6.Publishing a Research Paper	1	
	7.Project proposal writing,	2	
	8.Research report writing	1	
	9. Plagiarism.	1	

Course designed by: Dr. K. Krishnaveni

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOC52	Number of Hours/Cycle		4	
Semester	V	Max. Marks		100	
Part	III	Credit		4	
Core Course VIII					
Course Title	Human Anatomy and Physiology		L	T	P
Cognitive Level		Up to K3	60		

Preamble

This course deals with principles and basic facts of Human Anatomy and Physiology. It emphasizes the complex organisation, structure, diverse functions and physiology of digestive, respiratory, circulatory, excretory, Nervous and Musculo Skeletal system and their related disorders.

Unit I	Digestive System	12 Hours
	Structure and Functions of digestive system, Buccal glands, Gastric, Intestinal glands, Liver and their functions, Pancreas and their functions, Mechanical and Chemical digestion of food: Buccal, Gastric and Intestinal digestion, Important digestive enzymes for Carbohydates, Protein, lipids, Absorption of Carbohydrates, Proteins and Lipids, Hormonal control of secretion of enzymes in gastrointestinal tract, Symptoms and causes of: Peptic ulcer, Gastroparesis, Colon Cancer, Irritable Bowel Syndrome (IBD), Hemorrhoids.	
Unit II	**Respiratory System**	**12 Hours**
	Structure and function of trachea and lung, Mechanism of Respiration: Pulmonary Respiration, Respiratory pigment: Haemoglobin structure, Transport of gases: O_2 Transport, Oxygen dissociation curve and Bohr effect, Transport of CO_2, Chloride Shift, Carbon Monoxide poisoning, Rate & Control of Respiration: BMR, RQ Respiratory disorder: Tuberculosis, Chronic Obstructive Pulmonary Disease (COPD), Asthma, SARS – COV- 2	
Unit III	**Cardiovascular and Lymphatic System**	**12 Hours**
	Composition of Blood: Plasma and Corpuscles, Blood clotting structure, Blood products and their uses, Structure and functions of human heart, Haemodynamic principle: Cardiac Cycle, Circulation of blood, Blood pressure, ECG, Symptoms and Causes of: Stroke-Arterial block, angiogram, angioplasty Coronary heart disease, Hypertension, Myocardial infarction, Lymphatic System: Composition of lymph Lymphatic vessels and disorders.	
Unit IV	**Excretory and Nervous System**	**12 Hours**
	Excretory System: Structure and function of Kidney, Renal function, Mechanisms of urine formation, Micturition, Hormonal control, Ornithine Cycle, Renal disorders – nephritis, haematurea, Urinary Tract Infection , dialysis and kidney transplantation **Nervous System:** Structure and functions of Brain and Neuron, Conduction of nerve impulse, Synapse, Neuromuscular junction, Reflex Action, Reflex Arc, Autonomic Nervous System: Sympathetic and Para Sympathetic, Cranial Nerves and Spinal nerves, Nervous disorders: Epilepsy, Alzheimer's disease, Parkinson's disease	
Unit V	**Musculo Skeletal System**	**12 Hours**
	Muscular System: Structure and Properties of Muscle: Skeletal, Non-striated & Cardiac, Physiology of skeletal muscle contraction: Electro kinematic theory and Sliding Filament theory, Properties of muscle: Tetanus, Fatigue and Rigor mortis, Muscular disorder: Muscular dystrophy, Fibromyalgia. Skeletal System: Structure of bones, Axial skeleton: Skull, Vertebral column,	

	Ribs and Sternum, Appendicular skeleton: Shoulder girdle, Upper limb, Pelvic girdle, Lower limb, Joints, Skeletal Disorders: Bone cancer, Rheumatoid Arthritis, Osteoporosis.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Field visit, Activity based teaching.

Text Books

3. Sarada Subrahmanyam., Madhavan Kutty, K., & Singh H.D., (2018) *Text Book of Human Physiology*, Reprint, S. Chand & Co., New Delhi.
4. Raganathan, T.S. (2000). *Text Book of Human Anatomy*, S. Chand & Co., New Delhi.

Reference Books

1. Kashyap, V., (2019). *A text book of Animal Physiology and Biochemistry*. KedarNath Ram Nath, Meerut.
2. Silverthorn D.U., (2016). *Human Physiology an Integrated Approach*. 6th edition, Pearson Education Services, Pvt. Limited.
3. Suresh R., (2012). *Essentials of Human physiology*. Regional Institute of Medical Sciences, Imphal, Manipur.
4. Sherwood L., (2009). *Principles of Human Physiology*. 3rd edition, Cengage Learning India private Limited, New Delhi.
5. Jibi Sebestian., (2019). *Anatomy and Physiology for Nurses*, AITBS Publishers, New Delhi.
6. Vijaya D.J., (2018). *Prep Manual for Undergraduates Physiology*. 2nd edition, Churchill Livingstone, New Delhi.
7. Krishna Garg, Medha Joshi., (2018). *Anatomy and Physiology for GNM*. CBS Publishers &Distribuutors, Pvt. Ltd., New Delhi.

E-Resources

- https://d3bxy9euw4e147.cloudfront.net/oscms-
- https://www.oercommons.org/courses/anatomy-and-physiology-i/view
- https://www.youtube.com/watch?v=X3TAROotFfM
- https://www.drnaitiktrivedi.com/index.php/notes/anatomy-physiology-notes/
- https://www.youtube.com/watch?v=j3x8PD-VNOU
- https://brooksidepress.org/anatomy/?page_id=23

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the structure and functions of human digestive system, its assisted glands, digestion and absorption of carbohydrates, proteins and lipids and reasons for digestive disorders.
CO2	Illustrate the structure and function of respiratory system, mechanism of respiration and its related respiratory disorders.
CO3	Interpret the Composition of blood and lymph, structure and function of cardiovascular system, Cardiac Cycle, and identify the symptoms and causes of cardiovascular diseases and lymphatic disorders.
CO4	Apply the knowledge about the complex aspects of Excretory and Nervous System and Sensory Organs, their physiological functions and related disorders.
CO5	Identify the organization of Musculo Skeletal System, their inter relationship in normal functioning of human body and their related disorders.

Mapping of Course Outcomes (COs) withProgramme Specific Outcomes

	PSO 1	PSO 2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	1	3	2	3	3	2	-	1	-	2	3
CO2	3	1	3	2	3	3	2	-	1	-	2	3
CO3	3	1	3	2	3	3	2	-	1	-	2	3
CO4	3	1	2	2	3	2	2	-	1	-	1	3
C05	3	1	3	2	3	3	2	-	1	-	2	3

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K3	2	K1	2(K2&K2)	K3
4	CO4	Up to K3	2	K1	2(K2&K2)	K3
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	20	60	60	60
K3	-	-	30	30	30	30
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Digestive System**	**12 Hours**	**Mode**
	a.Structure and Functions of digestive system	**2**	Lecture, Group discussion, PPT, Charts, Models and Videos
	b.Buccal glands, Gastric, Intestinal glands, Liver and their functions, Pancreas and their functions	**2**	
	c. Mechanical and Chemical digestion of food: Buccal, Gastric and Intestinal digestion	**2**	
	d.Important digestive enzymes for Carbohydates, Protein, lipids	**1**	
	e.Absorption of Carbohydrates, Proteins and Lipids	**1**	
	f. Hormonal control of secretion of enzymes in gastrointestinal tract	**2**	
	g. Symptoms and causes of: Peptic ulcer, Gastroparesis	**1**	
	h. Colon Cancer, Irritable Bowel Syndrome (IBD) Hemorrhoids	**1**	
Unit II	**Respiratory System**	**12 Hours**	**Mode**
	a. Structure and function of trachea and lung	**2**	
	b.Mechanism of Respiration: Pulmonary Respiration	**1**	Class room lecture, Group discussion, PPT, Charts, Models and Videos
	c.Respiratory pigment – Haemoglobin structure,	**1**	
	d.Mechanism of Respiration, Transport of O2	**2**	
	e.Oxygen dissociation curve and Bohr effect, Transport of CO2	**1**	
	f.Transport of gases: O2 Transport, Oxygen dissociation curve and Bohr effect,	**1**	
	g.Transport of CO2, Chloride Shift, Carbon Monoxide poisoning,	**1**	
	h.Rate& Control of Respiration, BMR, RQ	**1**	
	i. Respiratory disorder: Tuberculosis, Chronic Obstructive Pulmonary Disease (COPD), Asthma, SARS – COV- 2	**2**	
Unit III	**Cardiovascular System and Lymphatic System**	**12 Hours**	**Mode**
	a. Structure and functions of human heart	**2**	Lecture, Group discussion, PPT, Charts, Models and Videos
	b. Composition of Blood: Plasma and Corpuscles	**1**	
	c. Blood clotting structure	**1**	
	d. Blood products and their uses	**1**	
	e. Haemodynamic principle: Cardiac Cycle	**1**	
	f. Circulation of blood, Blood pressure, ECG	**1**	

	g. Symptoms and Causes of: Stroke - Arterial block, angiogram, angioplasty	**1**	
	h.Coronary heart disease	**1**	
	i. Hypertension, Myocardial infarction	**1**	
	j.Lymphatic System: Composition of lymph, Lymphatic vessels and disorders.	**2**	
Unit IV	**Excretory System and Nervous System**	**12 Hours**	**Mode**
	a. Excretory System: Structure and function of Kidney and Nephron	**1**	Lecture, Group discussion, PPT, Charts, Models and Videos
	b. Ureter, Urinary bladder, Urethra	**1**	
	c. Renal function,Mechanisms of urine formation, Micturition	**1**	
	d. Hormonal control, Ornithine Cycle	**1**	
	e.Renal disorders – nephritis, haematurea	**1**	
	f.Urinary tract infection, dialysis and kidney transplantation	**1**	
	g.Nervous System: Structure and functions of Brain and Neuron	**1**	
	h.Conduction of nerve impulse, Synapse, Neuromuscular junction, Reflex Action, Reflex Arc	**1**	
	i. Autonomic Nervous System: Sympathetic and Para Sympathetic	**1**	
	j.Cranial Nerves and Spinal nerves	**1**	
	k.Nervous disorders: Epilepsy, Alzheimer's disease, Parkinson's disease	**1**	
	l. Special Senses: Structure and Physiology- Eye, Ear, Nose, Tongue,	**1**	
Unit V	**Musculo Skeletal System**	**12 Hours**	**Mode**
	a. Muscular System: Structure and Properties of Muscle: Skeletal, Non-striated & Cardiac	**2**	Lecture, Group discussion, PPT, Charts, Models and Videos
	b.Physiology of skeletal muscle contraction: Electro kinematic theory and Sliding Filament theory	**1**	
	c.Properties of muscle: Tetanus, Fatigue and Rigor mortis	**1**	
	d. Muscular disorder: Muscular dystrophy, Fibromyalgia	**1**	
	e. Skeletal System: Structure of bones	**1**	
	f. Axial skeleton: Skull, Vertebral column,	**2**	
	g. Ribs and Sternum	**1**	
	h. Appendicular skeleton: Shoulder girdle, Upper limb	**1**	
	i. Pelvic girdle, Lower limb, Joints	**1**	
	j. Skeletal Disorders: Bone cancer, Rheumatoid Arthritis, Osteoporosis	**1**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc .,Zoology	Programme Code		UZO	
Course Code	20UZOC53	Number of Hours/Cycle		3	
Semester	V	Max. Marks		100	
Part	III	Credit		4	
Core Course IX					
Course Title	Biotechnology and rDNA Technology		L	T	P
Cognitive Level		Up to K3	60		

Preamble: Enable knowledge on various biotechnological tools, genetic engineering principles, molecular mechanism involved and its beneficial application to society.

Unit – I	**Basic Concepts**	12 Hours
	Overview of Recombinant DNA technology – Scope and History, General steps involved in gene cloning; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA - Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques - Northern, Southern and Colony hybridization, Fluorescence in situ hybridization, DNA-Protein Interactions- Electromobility shift assay; DNase I footprinting; Methyl interference assay.	
Unit – II	**Gene Cloning Vectors**	12 Hours
	Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vector: Human Artificial Chromosome; Animal Virus derived vector: SV-40; Expression vectors: pMal; pET-based vectors; Vectors for downstream Protein purification: His-tag, GST-tag, MBP-tag and Intein tag based vectors; Plant based vectors: Ti and Ri as vectors; Yeast vectors; Shuttle vectors; Applications of Cloning vectors.	
Unit – III	**Gene delivery and DNA libraries**	12 Hours
	Insertion of foreign DNA into host cells; Chemical and physical methods, Gene Gun. Transformation; Blue white screening, reporter genes; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Phage display; Principles in maximizing gene expression	
Unit – IV	**PCR based Techniques**	12 Hours
	PCR in gene recombination; Deletion, addition, Overlap extension and SOEing; Site specific mutagenesis, PCR in molecular diagnostics, Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, DGGE, RFLP; Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test), Genome sequencing methods (DNA Sequencing: Automated sequencing, Next-generation sequencing (basic concepts	

	only).	
Unit – V	**Applications of Genetic Engineering**	12 Hours
	Gene silencing techniques - Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors - Principle and application of gene silencing; Gene knockouts and Gene Therapy, Creation of knockout mice, Disease model, Somatic and germ-line therapy- in vivo and ex-vivo, Suicide gene therapy; Gene replacement; Gene targeting, Gene disruption; FLP/FRT and Cre/Lox recombination. Stem cell therapy. DNA and RNA vaccines, Gene editing; CRISPR-Cas rating transgenic animals; Terminator Gene technology, Examples of Biotechnological applications in Bioremediation - superbug, Bioleaching; Disadvantages of GMOs	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Activity based teaching

Text Books

1. Kumaresan V, (2007), Biotechnology, Saras Publication, A.R.P. Camp Road, Periavilai, Kottar P.O., Nagercoil, K.K. Dist., - 629002.
2. Dubey R. C., (2006), Text Book of Biotechnology, S. Chand & Company, Ram Nagar, New Delhi.

Reference Books

1. Sambrook, Joseph. & Russell, David W. & Cold Spring Harbor Laboratory. (2001). Molecular cloning : a laboratory manual. Cold Spring Harbor, N.Y : Cold Spring Harbor Laboratory
2. Brown, T. A., 2017, Genomes 4, CRC Press, FL, USA
3. Dale, Jeremy W and Schantz, Malcom V. 2002, From Gene to Genomes. John Wiley and Sons Ltd, NY, USA
4. Daniel L. Hartl and Bruce C, 2017, Genetics: Analysis of Genes and Genomes, Jones and Bartlett Publishers, MA, USA
5. Gardner E.J. and Snustand D.P., 2011, Principles of Genetics, John Wiley & Sons New York, USA
6. Kumar, H. D., 2003, Genomics and Cloning, EWP, New Delhi
7. Leland Hartwell et al, 2017, Genetics: From Genes to Genomes, McGraw Hill, NY, USA
8. Lewin B, 2017, Genes (12th ed), Jones and Barlett Publishers Inc., MS, USA
9. Robert H. Tamarin, 2017, Principles of Genetics, McGraw Hill, NY, USA
10. Singh .B.D. 2006, Biotechnology, Kalyani Publishers, New Delhi

E-Resources

https://www.khanacademy.org/science/biology/biotech-dna-technology
https://www.khanacademy.org/science/biology/cellular-molecular-biology
https://www.khanacademy.org/science/biology/dna-as-the-genetic-material
https://www.khanacademy.org/science/biology/gene-expression-central-dogma
https://www.khanacademy.org/science/biology/gene-regulation

Course Outcomes

At the end of the course, students would be able to:

CO1	Explain the basic concepts in Biotechnology, various enzymes and their applications in several biotechniques.
CO2	Describe the gene cloning vectors, types and their role in the production rDNA techniques
CO3	Illustrate various gene delivery methods, screening techniques of recombinants and the production cDNA libraries
CO4	Demonstrate several PCR based techniques involved in the rDNA technologies
CO5	Describe the possible applications of genetic engineering and recent trends in gene therapies

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	2	2	2	1	2	1	1	1	2	1
CO2	3	3	2	3	2	1	2	2	1	0	2	1
CO3	3	2	1	2	2	1	2	1	1	1	2	1
CO4	3	2	1	2	2	1	2	2	1	0	1	1
CO5	2	3	1	1	2	1	2	1	1	0	1	1

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K2	2	K1	2(K1,K1)	K2
2	CO2	Up to K2	2	K1	2(K1,K1)	K2
3	CO3	Up to K2	2	K1	2(K2,K2)	K2
4	CO4	Up to K3	2	K1	2(K2,K2)	K3
5	CO5	Up to K3	2	K1	2(K2,K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Either/or)**	**Total Marks**	**% of Marks without choice**
K1	10	16	-	26	22%
K2	-	24	30	54	58%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

LESSON PLAN

Biotechnology and rDNA Technology- 20UZOC53				
	S. No.	**Topics**	**12Hours**	**Teaching mode**
Unit I		**Basic Concepts**		Chalk & Talk, PPT & Animation Videos
	a	Overview of Recombinant DNA technology – Scope and History, General steps involved in gene cloning	2	
	b	Restriction Enzymes; DNA ligase, Klenow enzyme	1	
	c	T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase.	2	
	d	Cohesive and blunt end ligation	1	
	e	Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA - Nick translation.	1	
	f	Random priming, Radioactive and non-radioactive probes.	2	
	g	Hybridization techniques - Northern, Southern and Colony hybridization	1	
	h	Fluorescence in situ hybridization, DNA-Protein Interactions- Electromobility shift assay.	1	
	i	DNase I footprinting; Methyl interference assay.	1	
Unit II		**Total Hours**		
		Gene Cloning Vectors	**12Hours**	Class Lecture, PPT Presentation, Animation Videos
	a	Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors.	1	
	b	Phagemids; Lambda vectors; Insertion and Replacement vectors.	1	
	c	Cosmids; Artificial chromosome vector: Human Artificial Chromosome; Animal Virus derived vector: SV-40.	3	
	d	Expression vectors: pMal; pET-based vectors,	1	
	e	Vectors for downstream Protein purification: His-tag, GST-tag.	2	
	f	MBP-tag and Intein tag based vectors.	1	
	g	Plant based vectors: Ti and Ri as vectors.	1	
	h	Yeast vectors; Shuttle vectors; Applications of Cloning vectors.	2	
Unit III		**Total Hours**		
		Gene delivery and DNA Libraries	**12Hours**	Class Lecture, PPT Presentation, Animation Videos
	a	Insertion of foreign DNA into host cells	2	
	b	Chemical and physical methods, Gene Gun.	2	
	c	Transformation; Blue white screening, reporter genes	2	
	d	Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries;	2	
	e	cDNA and genomic cloning;	1	
	f	Expression cloning; Jumping and hopping libraries	2	
	g	Phage display; Principles in maximizing gene expression	1	
		Total Hours		
		PCR based Techniques		Chalk & Talk, PPT & Animation Videos
	a	PCR in gene recombination; Deletion, addition, Overlap extension and SOEing;	2	

Unit IV	b	Site specific mutagenesis, PCR in molecular diagnostics, Viral and bacterial detection	2	
	c	PCR based mutagenesis, Mutation detection: SSCP, DGGE	2	
	d	RFLP; Oligo Ligation Assay (OLA)	1	
	e	MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test)	2	
	f	Genome sequencing methods (DNA Sequencing: Automated sequencing	2	
	g	Next-generation sequencing (basic concepts only).	1	
		Total Hours	**12**	
Unit V		**Applications of Genetic Engineering**		Class Lecture, PPT Presentation, Animation Videos
	a	Gene silencing techniques - Introduction to siRNA; siRNA technology;	2	
	b	Micro RNA; Construction of siRNA vectors - Principle and application of gene silencing;	2	
	c	Gene knockouts and Gene Therapy, Creation of knockout mice, Disease model	1	
	d	Somatic and germ-line therapy- in vivo and ex-vivo	2	
	e	Suicide gene therapy	1	
	f	Gene replacement; Gene targeting, Gene disruption; FLP/FRT and Cre/Lox recombination.	1	
	g	Stem cell therapy. DNA and RNA vaccines, Gene editing; CRISPR-Cas rating transgenic animals	1	
	h	Terminator Gene technology, Examples of Biotechnological applications in Bioremediation - superbug, Bioleaching; Disadvantages of GMOs	2	
		Total Hours	**12**	

Course designed by: Dr. S. Dharaneedharan

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOE51**	Number of Hours/Cycle		**3**	
Semester	**V**	Max. Marks		**100**	
Part	**III**	**Credit**		**3**	
Core Elective I					
Course Title	**Endocrinology**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**45**		

Preamble

To develop the ability to integrate the functions of various endocrine glands, aware of hormonal disorders ,diagnosis and treatment .

Unit I	**Endocrine system& Hormones**	**9 Hours**
	Scope of Endocrinology, Exocrine gland ,Endocrine gland – Definition, Differences , Origin, development, Classification ,Salient features of hormones , Functions of Hormones ,Chemical nature of hormones, Mechanism of hormone action , Transportation of hormones,Concepts of Neurosecretion.	
Unit II	**Hormonal Control of Metamorphosis** & **Pituitary Gland**	**9 Hours**
	Neuro endocrine System in Insects, Endocrine System - Crustaceans , Echinodermates -Tunicates - Cephalo chordates , Endocrine Control of Moulting , Hormonal control of Metamorphosis in insects , Endocrine Control of Reproduction insects , Hormonal control of Metamorphosis in Amphibians. **Pituitary Gland** – Structure , Adenohypophyseal hormones, Secretion , functions , Neurohypophyseal hormones , Secretion , Functions, Disorders of Pituitarygland , Diagnosis, Symptoms ,Treatment, Prevention, Feed back mechanism of hormones, Hypothalamo - hypophyseal interaction.	
Unit III	**Thyroidgland & Parathyroid gland**	**9 Hours**
	Thyroidgland - Structural Organization, Causes and symptoms of thyroid disease ,Hyper thyroidism - symptoms,Diagnosis ,Prevention, Treatment Hypothyroidism-Symptoms,Diagnosis ,Prevention, Treatment,Synthesis of Thyroxine , Physiological effects of Thyroid hormone , Thyroid hormone and Reproduction , Feedback mechanism of hormone regulation. **Parathyroid gland**- Structure, functions of parathhormone , Hyperparathyroidism-causes ,Symptoms,Diagnosis,Treatment. Hyperparathyroidism - Symptoms,Diagnosis, Treatment.	
Unit IV	**Pancreas& Adrenal Gland**	**9 Hours**
	Pancreas -structure and functions- pancreatic hormones and metabolic regulation, physiological action of Insulin and physiological action of Glucagon,Diabetes mellitus-Types,Symptoms,Prevention,Treatment . **Adrenal gland**- Structural Organization,functions of Adrenaline ,Non -	

	Adrenaline , Adrenal medulla disorders-Physiologicalrole of Cortisol in the body ,Aldosterone , Addisions disease ,Cushings syndrome-Congenital adrenal hyperplasia, Symptoms,Treatment.	
Unit V	**Reproductive Endocrinology**	**9 Hours**
	Structure of Mammalian Testis- functions of Testerone , functions of Androgen , Structure of Mammalian Ovary, Physiological role of Estrogen , Physiological role of Progesterone ,Menstrual cycle, Hormonal control of Menstrual cycle ,Hormones of Pregnancy, Human chorionic gonado tropin, Relaxin, Hormonal control of Parturition ,Role of Oxytocin ,Effects of Relaxin ,Hormonal Control of Lactation ,Bioassays of hormones using RIA and ELISA.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Activity based teaching

Text Books

1. Sarada Subrahmanyam., Madhavan Kutty ,K., & Singh H.D (2018) *Text Book of Human Physiology*, Reprint, S. Chand & Co., New Delhi.

Reference books:

1.Molina PE.2013.Endocrine Physiology. McGraw Hill Lange.

2.Neal JM.2000 .Basic Endocrinology ;an Interactive approach.Blackwell science

3.Strauss JF ,Barbieri RL .2014.Yen & Jaffe's Reproductive Endocrinology .Elsevier sounders

4.Goodman HM.2000. Basic medical endocrinology .Academic press

5. Bentley, P.J. 1985. Comparative Vertebrate Endocrinology, 2nd Edition, Cambridge University Press.

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https://www.healthline.com/human-body-maps/pituitary-gland#symptoms
https://teachmephysiology.com/endocrine-system/thyroid-parathyroid-gland/thyroid-gland/
https://www.vedantu.com/biology/insulin-and-glucagon
http://www.jiwaji.edu/pdf/ecourse/zoology/Neurosecretary%20system%20in%20insecta.pdf
https://opentextbc.ca/biology/chapter/24-4-hormonal-control-of-human-reproduction/

Course Outcomes

At the end of the course, students would be able to:

CO1	Classify endocrine glands and describe the functions and mechanism of hormone action.
CO2	Illustrate the role of hormones in metamorphosis in insects and amphibians and explain the structure and hormonal functions of pituitary gland .
CO3	Explain the structure , hormonal secretions of thyroid and para thyroid gland .
CO4	Discuss the physiological role of hormones of pancreas and adrenal gland.
CO5	Interpret the importance of hormones involved in reproductive process and bioassays of hormones.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	2	--	2	2	2	2	1	2	1	--	--	2
CO2	2	--	2	2	2	2	1	2	1	--	--	2
CO3	2	--	2	2	2	2	1	2	1	--	--	2
CO4	2	--	2	2	2	2	1	2	1	--	--	2
CO5	2	--	2	2	2	2	1	2	1	--	--	2

1 – Low **2 – Moderate** **3- High**

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Either/or Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K2	2	K1	2(K1&K1)	K2
2	CO2	Up to K3	2	K1	2(K2&K2)	K3
3	CO3	Up to K3	2	K1	2(K2&K2)	K3
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K2	2	K1	2(K1&K1)	K2
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Either/or)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	10	16		26	26%	26%
K2		24	30	54	54%	54%
K3	-		20	20	20%	20%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

	Endocrine system& Hormones	**9 Hours**	**Mode**
	Scope of Endocrinology, Exocrine gland ,Endocrine gland , Definition and Differences .	**2**	Class room lecture, Group discussion, PPT and Videos
	Endocrine gland Origin, development.	**1**	
	Classification ,Salient features of hormones.	**1**	
	Functions of Hormones ,Chemical nature of hormones	**1**	
	Mechanism of hormone action .	**2**	
Unit I	Transportation of hormones, Concepts of Neurosecretion.	**2**	
	Hormonal Control of Metamorphosis & **Pituitary Gland**	**9Hours**	**Mode**
	Endocrine System in Crustaceans, Echinodermates Endocrine System in Tunicates,Cephalo chordates.	**1**	
	Endocrine Control of Moulting, Hormonal control of Metamorphosis in insects. Endocrine Control of Reproduction.	**2**	Class room lecture, Group discussion, PPT and Videos
Unit II	Hormonal control of Metamorphosis in Amphibians.	**1**	
	Pituitary Gland –Structure, Adenohypophyseal hormones, Secretion and functions .	**2**	
	Neurohypophyseal hormones -Secretion and functions,Disorders of Pituitarygland-Diagnosis, Symptoms,Treatment and Prevention	**2**	
	Feedback mechanism of hormones, Hypothalamo - hypophyseal interaction.	**1**	
	Thyroidgland & Parathyroid gland	**9Hours**	**Mode**
	Thyroidgland - Structural Organization, Causes and symptoms of thyroid disease.	**1**	Class room lecture, Group discussion, PPT and Videos
	Hyper thyroidism- symptoms,Diagnosis,Prevention, Treatment.	**2**	
	Hypothyroidism-symptoms, Diagnosis,Prevention, Treatment.	**1**	
Unit III			
	Synthesis of Thyroxine, Physiological effects of Thyroid hormone.	**1**	
	Thyroid hormone and Reproduction, Feed back mechanism of hormone regulation.	**1**	
	Parathyroid gland-Structure, functions of parathhormone, Hyperparathyroidism-causes ,Symptoms,Diagnosis and Treatment.	**2**	
	Hyperparathyroidism –Symptoms,Diagnosis and Treatment.	**1**	
	Pancreas& Adrenal Gland	**9Hours**	**Mode**
	Pancreas -structure and functions, pancreatic hormones and metabolic regulation of Insulin . Physiological action of Glucagon.	**2**	Class room lecture, Group discussion, PPT and Videos
Unit IV	Diabetes mellitus-Types,Symptoms, Prevention,Treatment	**1**	
	Structural Organization-functions of Adrenaline, Non - Adrenaline, Adrenal medulla disorders.	**2**	

	Adrenal medulla disorders- Physiological role of Cortisol in the body.	**2**	
	Aldosterone - Addisions disease, Cushings syndrome Congenital adrenal hyperplasia,Symptoms,Treatment.	**2**	
Unit V	**Reproductive Endocrinology**	**9Hours**	**Mode**
	Structure of Mammalian Testis, functions of Testosterone, functions of Androgen.	**2**	Class room lecture, Group discussion, PPT and Videos
	Structure of Mammalian Ovary, Physiological role of Estrogen, Physiological role of Progesterone.	**2**	
	Menstrual cycle, Hormonal control of Menstrual cycle-Hormones of Pregnancy.	**2**	
	Human chorionic gonado tropin,Relaxin, Hormonal control of Parturition ,Role of Oxytocin , Effects of Relaxin .	**2**	
	Hormonal Control of Lactation,Bioassays of hormones using RIA and ELISA.	**1**	

Course designed by: Dr. A .Jeevalatha

Course Code	**20UZOE52**	Number of Hours/Cycle		**3**	
Semester	**V**	Max. Marks		**100**	
Part	**III**	**Credit**		**3**	
Core Elective II					
Course Title	**Nanobiology**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**45**		

Preamble

This course imparts basic knowledge about Nanotechnology and its Applications in various fields. It also elaborates the various methods of synthesis and characterization of nanomaterials, and nanomaterials with high application potential, tools used in characterization techniques , its biomedical applications and health and environmental impacts.

Unit I	**Nanomaterials: Scale Scope and Future**	**9 Hours**
	Introduction and History of Nanotechnology, Feynman's hypothesis, scales of nano systems, Moore's Law, Fundamental concepts, Scope and Application, Properties of nanomaterials, Bulk Materials Vs Nanomaterials, Classification of Nanomaterials.	
Unit II	**Synthesis Routes**	**9 Hours**
	Synthesis and characterization of nanomaterials: Metal oxide Nanoparticles, Metal Nanoparticles, Ceramic Nanoparticles, Quantum Dots, Core Shell Quantum Dots, Top-down and bottom-up approaches and their biological relevance : Ball Milling, Co-Precipitation and Sol-Gel Method, Electrodeposition, Chemical Vapour Deposition, Synthesis of Nanoparticles using Natural resources	
Unit III	**Nanostructured Materials with High Application Potential**	**9 Hours**
	Structure, Synthesis, Properties and Applications of: Quantom Dots, Fullerene, Nanotubes, Carbon Nanotubes, Q-Carbon, Carbon Nanofiber, Nanomotors	
Unit IV	**Tools to Characterize Nanomaterials**	**9 Hours**
	1. Nanomaterial Characterization by Microscopy: i) Scanning Electron Microscope (SEM), ii) Energy Dispersive X-Ray Analysis (EDX), iii) Transmission Electron Microscope (TEM), iv) High Resolution Transmission Electron Microscope (HRTEM), v) Atomic Force Microscope (AFM), vi) Scanning Tunelling Microscope (STM) 2. Nanomaterial Characterization by Spectroscopy: vii) Raman Spectroscopy, viii) Ultra Violet Visible (UV-Vis) Spectroscopy 3. Nanomaterial Characterization by X Ray: ix) Wide Angle X-Ray diffraction, x) X-ray Crystallography Measurement Techniques for Nanomaterials.	
Unit V	**Nanotechnology in Biomedical Applications and its Health and Environmental impacts**	**9 Hours**
	1. Silver nanoparticles (Ag NPs): Antimicrobial agents. 2. Gold nanoparticles (Au NPs): antibacterial and anticancer theranostic agents. 3. Copper nanoparticles (Cu NPs): antimicrobial agent. 4. Zinc Oxide (ZnO) nanoparticles: Biological application. 5. Titanium dioxide TiO2 nanoparticles: Nontoxic TiO2 in human food, drugs, cosmetics, 6. Cadmium oxide (CdO) nanoparticles, 7. Calcium oxide nanopparticles (CaO NPs): Antimicrobial action and synaphic delivery of drugs, 8. Magnesium oxide nanoparticles (MgO NPs): MgO nanoflakes as cancer drug carrier, 9. Carbon nanotubes: Drug delivery and thermal treatment of cancer, 10. Exosomes:	

	Therapeutic drug carriers and delivery vehicles, Toxological Health effects caused by Nanoparticles.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Lab visit, and Activity based teaching.

Text Books

1. Subbiah Balaji, (2021).*Nanobiotechnology*,MJP Publisher, Chennai.
2. Arumugam, N, (2016).*Nanotechnology*,Saras Publication, Nagercoil.

Reference Books

1. Thomas Varghese &Balakrishna K.M., (2012,)*Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials* Atlantic publishers, Chennai.
2. Choudhary K. K., (2016). *NanoscienceAndNanotechnology*,Narosa Publishing House Pvt. Ltd. - New Delhi.
3. Das A., (2020). *An Introduction To Nanomaterials And Nanoscience*, CBS Publishers, New Delhi
4. ChattopadhyayK.K ., (2009). *Introduction to Nanoscience and Nanotechnology*, Prentice Hall India Learning Private Limited, New Delhi.

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- **https://www.hindawi.com/journals/jnt/2012/816184/**
- **https://www.nano.gov/nanotech-101/what/definition**
- **https://www.twi-global.com/technical-knowledge**
- **https://en.wikipedia.org/wiki/Nanomaterials**
- **https://www.researchgate.net/publication/8585365_Applications_of_Nanoparticles_in_Biology_and_Medicine**
- **https://www.researchgate.net/publication/349103002_Application_of_Nanomaterials_in_Medicine_Drug_delivery_Diagnostics**
- **http://nopr.niscair.res.in/bitstream/123456789/2019/1/IJFTR%2033%283%29%20304-317.pdf**

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain about history, scale scope and future of Nanotechnology, properties and applications of Nanoparticles.
CO2	Interpret the various approaches and methods in the synthesis of Nanoparticles.
CO3	Characterize the Structure, Synthesis, Properties and Applications of various Nanoparticles with high application potentials
CO4	Apply the knowledge to characterize nanoparticles through various tools and techniques. Analyze the available tools to synthesize and characterize the Nanoparticles and Nanomaterials
CO5	Conclude Nanotechnology in Biomedical Applications and its Health and Environmental impacts

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	-	-	2	2	3	2	-	1	-	1	2
CO2	3	-	-	3	3	3	2	-	1	-	1	3
CO3	3	-	-	2	3	3	3	-	1	-	2	2
CO4	3	-	-	3	3	2	2	-	1	-	2	2
C05	3	-	-	3	3	3	3	-	1	-	3	3

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K3	2	K1	2(K2&K2)	K3
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	30	80	80	80
K3	-	-	20	10	10	10
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Nanomaterials: Scale Scope and Future**	**9 Hours**	**Mode**
	a.Introduction and History of Nanotechnology	**1**	Class room lecture, PPT, Videos and Group Discussion
	b.Feynman's hypothesis, scales of nanosystems, Moore's Law	**1**	
	c. Fundamental concepts	**1**	
	d.Scope and Application	**1**	
	e.Properties of nanomaterials	**2**	
	f. Bulk Materials Vs Nanomaterials	**1**	
	g. Classification of Nanomaterials	**2**	
Unit II	**Synthesis Routes**	**9 Hours**	**Mode**
	1. Synthesis and characterization of nanomaterials:		Class room lecture, PPT, Videos and Group Discussion
	a. Metal oxide Nanoparticles	**1**	
	b. Metal Nanoparticles	**1**	
	c. Ceramic Nanoparticles	**1**	
	d. Quantum Dots, Core Shell Quantum Dots	**1**	
	2. Top-down and bottom-up approaches and their biological relevance :		
	e. Ball Milling	**1**	
	f. Co-Precipitation and Sol-Gel Method	**1**	
	g. Electrodeposition,	**1**	
	h. Chemical Vapour Deposition,	**1**	
	i. Synthesis of Nanoparticles using Natural resources	**1**	
Unit III	**Nanostructured Materials with High Application Potential**	**9 Hours**	**Mode**
	a. Structure, Synthesis, Properties and Applications of: Quantom Dots	**2**	Class room lecture, PPT, Videos and Group Discussion
	b. Fullerene	**1**	
	c. Nanotubes	**1**	
	d. Carbon Nanotubes	**2**	
	e. Q-Carbon	**1**	
	f. Carbon Nanofiber	**1**	
	g. Nanomotors	**1**	
Unit IV	**Tools to Characterize Nanomaterials**	**9 Hours**	**Mode**
	1. Nanomaterial Characterization by Microscopy:		Class room lecture, PPT, Videos, Lab visit and Group Discussion
	a. i) Scanning Electron Microscope (SEM),	**1**	
	b. ii) Energy Dispersive X-Ray Analysis (EDX),	**1**	
	c. iii) Transmission Electron Microscope (TEM)	**1**	
	d.iv) High Resolution Transmission Electron Microscope (HRTEM)	**1**	
	e.v) Atomic Force Microscope (AFM)	**1**	
	f.vi) Scanning Tunelling Microscope (STM)	**1**	
	2.Nanomaterial Characterization by Spectroscopy:		
	g.vii) Raman Spectroscopy	**1**	
	h.viii) Ultra Violet Visible (UV-Vis) Spectroscopy	**1**	
	3.Nanomaterial Characterization by X Ray:		
	g.ix) Wide Angle X-Ray diffraction,	**1**	
	f.x) X-ray Crystallography Measurement Techniques for Nanomaterials.	**1**	
	Nanotechnology in Biomedical Applications and its Health and Environmental impacts	**9 Hours**	**Mode**
	a.1. Silver nanoparticles (Ag NPs): Antimicrobial agents.	**1**	
	b.2. Gold nanoparticles (Au NPs): antibacterial and	**1**	

Unit V	anticancer theranostic agents.		Class room lecture, PPT, Videos, Lab visit and Group Discussion
	c.3. Copper nanoparticles (Cu NPs): antimicrobial agent.	**1**	
	d. 4. Zinc Oxide (ZnO) nanoparticles: Biological application	**1**	
	e. 5. Titanium dioxide TiO2 nanoparticles: Nontoxic TiO2 in human food, drugs, cosmetics	**1**	
	f. 6. Cadmium oxide (CdO) nanoparticles, 7. Calcium oxide nanopparticles (CaO NPs):Antimicrobial action and synaphic delivery of drugs	**1**	
	g. 8. Magnesium oxide nanoparticles (MgO NPs):MgOnanoflakes as cancer drug carrier	**1**	
	h. 9. Carbon nanotubes: Drug delivery and thermal treatment of cancer	**1**	
	i. 10. Exosomes: Therapeutic drug carriers and delivery vehicles, Toxological Health effects caused by Nanoparticles	**1**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOE53	Number of Hours/Cycle		3	
Semester	V	Max. Marks		100	
Part	III	Credit		3	
Core Elective III					
Course Title	Biodiversity and Conservation Biology		L	T	P
Cognitive Level		Up to K3	45		

Preamble

The course aims to provide students a broad foundation in Biodiversity and Conservation Biology with the ability to acquire extensive subject knowledge in the discipline. It emphasis the value and significance of Biodiversity and how to assess it with different methodologies. It imparts the knowledge about the Wild Life Protection Act, Conservation of biodiversity and Role of NGOs in conservation.

Unit I	**Basics of Biodiversity**	9 Hours
	Introduction, concepts, components, Patterns and process of local and regional biodiversity, Conceptual framework of Biodiversity, Constraints of biodiversity, Genetic, Species, Ecosystem biodiversity, Measuring biodiversity: Alpha, Beta and Gamma Diversity, Species richness, Evenness, Dominance, Approaches to estimating diversity and dominance, Shannon and Simpson's index, India as a mega-diversity nation, Hotspots of Biodiversity.	
Unit II	**Value and significance of biodiversity**	**9 Hours**
	Tangible benefits: Food, fiber, fodder, medicines, and construction material, Intangibles: pollination, pest control, soil development and maintenance of soil fertility, soil and water conservation, nutrient cycling, Human animal conflicts, Existing Conservation Projects: Tiger, Rhino, Elephant, Turtles, Crocodiles, Birds, Coral reefs and Mangroves.	
Unit III	**Threats to biodiversity and wild life conservation**	**9 Hours**
	Identification and prioritization of ecologically sensitive area (ESA),Loss of Biodiversity and its causes, Patterns of losses, Causes and factors of mass extinction, Listing of Threatened biodiversity including vulnerable, rare, threatened, Endangered and extinct plant and animal species, Wildlife Trade and Laws, Wildlife protection Act of India, CITES - TRAFFIC - RED Data Book, IUCN, Measures to control poaching and wildlife trade.	
Unit IV	**Conservation of biodiversity**	**9 Hours**
	Aim for conservation, Current practices, Conservation of Genetic, Species and Ecosystem biodiversity, International conventions on conservation, Treaties on nature & conservation, Ex situ & In situ conservation, Vavilovin seed bank, Institutions and their role in conservation, Zoos, Natural history museums & collections, Zoological survey of India, Botanical survey of India, Forest research Institutes, Central Marine Fisheries research Institutes.	
Unit V	**Role of NGOs in conservation**	**9 Hours**
	International NGOs, UNEP, GEF, WCS, Bird Life International, Important NGOs in India and their contributions: WWF, ATREE, BNHS, WTI and Kalpavriksha, Important NGO movements: Chipko movement, Silent valley, Narmada Bachao Aandholan, Pani Panchayats, Seed Movement, Social Activists in conservation of Bio Diversity.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Visit to Zoos, Sanctuaries and National park,

Text Books

1. Krishnamurthy KV., (2009). An Advanced Textbook on Biodiversity Principles and practice. Oxford & IBH publishing Co Pvt. Ltd., New Delhi.

Reference Books

1. Ghosh, A.K. (2009). Biodiversity Conservation, APH Publications, New Delhi.
2. Sharma, P. D., & Sharma, P. D. (2012). Ecology and environment. Rastogi Publications.
3. Dutta, A. (2001). Biodiversity and Ecosystem Conservation. Kalpaz Publications, New Delhi.
4. Hunter, M.L, Gibbs, J.B. and Sterling, E.J.(2008)ProblemsolvinginConservation Biology andWildlifeManagement:ExercisesforClass,Field,andLaboratory.Blackwell Publishing.
5. Ladle, RJ (2009) Biodiversity and Conservation: Response to biodiversity loss. Taylor and Francis, UK.

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- https://forestrypedia.com/biodiversity-importance-types-
- https://www.researchgate.net/publication/317313069_Biodiversity-Threats_and_Conservation
- https://www.ncbi.nlm.nih.gov/books/NBK224412/
- https://www.iucn.org/theme/species/our-work/sustainable-use-and-trade/iucntraffic-analyses-cites-proposals
- https://www.idc-america.org/wp-content/uploads/2011/10/Environment-and-NGOs.pdf

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the concepts biodiversity and its measurement.
CO2	Illustrate the values and significance of biodiversity
CO3	Indentify the threats to biodiversity and wild life conservation
CO4	Assess the role of various institutions and agencies in biodiversity conservation
CO5	Analyze the role of NGOs and various environmental movements in biodiversity conservation.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	1	3	2	3	3	2	-	1	-	2	3
CO2	3	1	3	2	3	3	2	-	1	-	2	3
CO3	3	1	3	2	3	3	2	-	1	-	2	3
CO4	3	1	2	2	3	2	2	-	1	-	1	3
C05	3	1	3	2	3	3	2	-	1	-	2	3

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Question	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K3	2	K1	2(K2&K2)	K3
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	30	80	80	80
K3	-	-	20	10	10	10
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Basics of Biodiversity**	**9 Hours**	**Mode**
	a.Introduction, concepts, components, Patterns and process of local and regional biodiversity	**1**	Class room lecture, Group discussion, PPT and Videos
	b.Conceptual framework of Biodiversity	**1**	
	c. Constraints of biodiversity, Genetic, Species, Ecosystem biodiversity	**1**	
	d.Measuring biodiversity: Alpha, Beta and Gamma Diversity	**1**	
	e.Species richness, Evenness, Dominance	**1**	
	f. Approaches to estimating diversity and dominance, Shannon and Simpson's index	**2**	
	g. India as a mega-diversity nation	**1**	
	h. Hotspots of Biodiversity	**1**	
Unit II	**Value and significance of biodiversity**	**9 Hours**	**Mode**
	a. Tangible benefits: Food, fiber, fodder, medicines, and construction material	**2**	
	b. Intangibles: pollination, pest control	**1**	Class room lecture, Group discussion, PPT, Videos and Field visit
	c. Soil development and maintenance of soil fertility, soil and water conservation	**2**	
	d. Nutrient cycling	**1**	
	e. Human animal conflicts	**1**	
	f. Existing Conservation Projects: Tiger, Rhino, Elephant, Turtles, Crocodiles, Birds, Coral reefs and Mangroves	**2**	
Unit III	**Threats to biodiversity and wild life conservation**	**9 Hours**	**Mode**
	a. Identification and prioritization of ecologically sensitive area (ESA)	**1**	Class room lecture, Group discussion, PPT and Videos
	b. Loss of Biodiversity and its causes, Patterns of losses	**1**	
	c. Causes and factors of mass extinction	**1**	
	d. Listing of Threatened biodiversity including vulnerable, rare, threatened	**1**	
	e. Endangered and extinct plant and animal species	**1**	
	f. Wildlife Trade and Laws		
	f. Wildlife protection Act of India, CITES - TRAFFIC - RED Data Book, IUCN	**2**	
	g. Measures to control poaching and wildlife trade	**2**	
Unit IV	**Conservation of biodiversity**	**9 Hours**	**Mode**
	a.Aim for conservation, Current practices	**1**	Class room lecture, Group discussion, PPT, Videos and Field visit
	b. Conservation of Genetic, Species and Ecosystem biodiversity	**1**	
	c. International conventions on conservation	**1**	
	d. Treaties on nature & conservation, Ex situ & In situ conservation	**1**	
	e. Vavilovin seed bank, Institutions and their role in conservation	**1**	
	f. Zoos, Natural history museums & collections	**2**	
	g. Zoological survey of India, Botanical survey of India	**1**	
	h. Forest research Institutes, Central Marine Fisheries research Institutes	**1**	

	Role of NGOs in conservation	9 Hours	Mode
Unit V	**a.** International NGOs, UNEP, GEF, WCS, Bird Life International, Important NGOs in India and their contributions	**2**	Class room lecture, Group discussion, PPT and Videos
	b. WWF, ATREE, BNHS, WTI and Kalpavriksha	**1**	
	c.Important NGO movements: Chipko movement, Silent valley,	**1**	
	d. Narmada BachaoAandholan,PaniPanchayats, Seed Movement	**1**	
	e. Social Activists in conservation of Bio Diversity	**1**	
	f. Axial skeleton: Skull, Vertebral column,	**2**	
	g. Ribs and Sternum	**1**	
	h. Appendicular skeleton: Shoulder girdle, Upper limb	**1**	
	i. Pelvic girdle, Lower limb, Joints	**1**	
	j. Skeletal Disorders: Bone cancer, Rheumatoid Arthritis, Osteoporosis	**1**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOS51	Number of Hours/Cycle		2	
Semester	V	Max. Marks		50	
Part	IV	Credit		2	
Skill based Course I					
Course Title	Aquaculture		L	T	P
Cognitive Level		Up to K3	30		

Preamble

To impart knowledge on various self-employment opportunities acquiring in the field of Aquaculture.

Unit I	**Aquaculture Systems for Fishes**	**6 Hours**
	Definition, Objectives of aquaculture, Aquaculture in India. Aquaculture Systems for Fishes – Monoculture, Polyculture, Pen culture, Sewage fed fish culture, Paddy cum fish culture.	
Unit II	**Prawn and Pearl Culture**	**6 Hours**
	Prawn Culture – Commercial Prawns, Culture in Freshwater and Marine water Pearl Culture – Pearl producing Molluscs, Pearl formation, Artificial pearl formation.	
Unit III	**Culture of Aquarium Fishes**	**6 Hours**
	Culture of Aquarium fishes - Introduction, Breeding of Gold fish, Bubble Nest Builders, Tetras &Barbs, Live Bearers and Guppies.	
Unit IV	**Fish preservation and products**	**6 Hours**
	Biochemical Composition of Raw Fish, Nutritional Value of Fish, Principles of Fish Preservation, Methods of Fish Preservation – Drying, Canning. Fish Liver Oil, Fish Body Oil, Fish Meal, Fish Silage, Fish Glue, Isinglass, fish leather, Fish Cavier, Fish Marconi, Shark Fin Soup, Fish Protein Concentrate, Fish Pulp, Fish Paste or Dough, Fish Sauce, Ensilage.	
Unit V	**Aquaculture and Genetic Engineering**	**6 Hours**
	Introduction, Genetic Engineering Methods in Aquaculture – Gene transfer (Indirect and Direct Method), Transgenic Fish, Applications of Genetic Engineering Methods in Aquaculture for Improvement of Fish Stock.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Field visit, Activity based teaching.

Text Books

1. Arumugam, N, (2008) Text book of Aquaculture, Saras Publications, Nagercoil.

2. Zade, S.B., Khune, C.J., Sitre, S.R., Tijaare, R.V., Principles of Aquaculture (2011) Himalaya Publishing House, Mumbai.

Reference Books

1. Jhingran V.G, (2009), "Fish and Fisheries of India", Hindustan Publishing Corp. Delhi.
2. Pandey and Shukla, (2005), "Fish and Fisheries", Rastogi Publications, Meerut.
3. Jhingran, V.G. (1982) Fish and Fisheries in India, Hindustan Publishing Corporation, New Delhi.
4. Robert R.(2000)Stickney Encyclopedia of Aquaculture, A Wiley – Interscience Publication, New York.
5. Khanna S.S, Singh H.R, (2014), "A Text Book of Fish Biology & Fisheries", Published by Narendra Publishing House.

E-Resources

1.https://www.agrifarming.in/aquaculture-in-india-types-of-aquaculture-a-full-guide
2.https://www.pearl-guide.com/articles/pearl-education/449313-pearl-producing-mollusks
3.https://www.notesonzoology.com/india/fishery/17-important-by-products-of-fish/826
4.n.search.yahoo.com/search?fr=mcafee&type=E211IN826G91648&p=transgenic+fish

Course Outcomes

After completion of this course, the students will be able to:

CO1	Gain knowledge on different Aquaculture systems and its scope for Self Employment.
CO2	Illustrate various types of commercial Prawn and Pearl culture.
CO3	Select suitable Aquarium fishes and their culture.
CO4	Identify and adopt suitable processing and preservation methods of fish.
CO5	Analyze the importance of genetic engineering methods in Aquaculture

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	**PSO2**	**PSO3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**	**PSO 10**	**PSO 11**	**PSO 12**
CO1	3	3	3	2	3	2	2	3	-	2	1	2
CO2	3	3	1	2	3	2	1	3	-	2	1	2
CO3	3	3	2	1	2	2	1	3	-	2	1	2
CO4	1	1	1	1	3	2	1	3	-	1	1	2
C05	3	2	2	3	3	2	1	3	-	1	1	2

1. **Low 3. High; 2. Moderate; 3. High;**

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K-Level	Section A	Section B
			Either/ or Choice	Open Choice
			No. Of Question	
1	CO1	Up to K2	2(K1&K1)	K2
2	CO2	Up to K2	2(K1&K1)	K2
3	CO3	Up to K2	2(K2&K2)	K2
4	CO4	Up to K3	2(K2&K2)	K3
5	CO5	Up to K3	2(K2&K2)	K3
No of Questions to be asked			10	05
No of Questions to be answered			05	03
Marks for each Question			03	05
Total marks for each Section			15	15

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (Either/or)	Section B (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	12	-	12	21.8 %	22 %
K2	18	15	33	60 %	60 %
K3	-	10	10	18.1 %	18 %
Total Marks	30	25	55	100 %	100%

Lesson Plan

Unit I	**Aquaculture Systems for Fishes**	**6Hours**	**Mode**
	1.Definition, Objectives of aquaculture, Aquaculture in India.	1	Class room Lecture, PPT and Videos.
	2. Aquaculture Systems for Fishes – Monoculture	1	
	3. Polyculture	1	
	4. Pen culture	1	
	5. Sewage fed fish culture	1	
	6. Paddy cum fish culture	1	
Unit II	**Culture of Aquarium Fishes**	**6 Hours**	**Mode**
	1.Prawn Culture – Commercial Prawns	1	Class room lecture, PPT, Videos and Field visit
	2.Prawn Culture in Freshwater	1	
	3.Prawn Culture in Marine water	1	
	4.Pearl Culture – Pearl producing Molluscs	1	
	5. Pearl formation	1	
	6. Artificial pearl formation.	1	
Unit III	**Fish preservation and products**	**6 Hours**	**Mode**
	1.Culture of Aquarium fishes - Introduction	1	Class room lecture, PPT, Videos and Field visit
	2.Breeding of Gold fish,	1	
	3.Bubble Nest Builder	1	
	4. Tetras & Barbs	1	
	5. Live Bearers	1	
	6**.** Guppies	1	
Unit IV		**6 Hours**	**Mode**
	1.Biochemical Composition of Raw Fish	1	Class room lecture, PPT, Videos and Field visit
	2.Nutritional Value of Fish	1	
	3.Principles of Fish Preservation,	1	
	4.Methods of Fish Preservation – Drying, Canning.	1	
	5.Fish Liver Oil, Fish Body Oil, Fish Meal, Fish Silage, Fish Glue, Isinglass, fish leather, Fish Cavier, Fish Marconi, Shark Fin Soup, Fish Protein Concentrate, Fish Pulp, Fish Paste or Dough, Fish Sauce, Ensilage.	2	
Unit V	**Aquaculture and Genetic Engineering**	**6 Hours**	**Mode**
	1.Introduction, Genetic Engineering Methods in Aquaculture	1	Class room lecture, PPT, and Videos
	2.Gene transfer (Indirect and Direct Method)	1	
	3. Transgenic Fish	2	
	4.Applications of Genetic Engineering Methods in Aquaculture for Improvement Fish Stock	2	

Course designed by: Dr. K. Krishnaveni

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOS52	Number of Hours/Cycle		2	
Semester	V	Max. Marks		50	
Part	IV	Credit		2	
Skill Based Course II					
Course Title	Biofertilizer and Organic Farming		L	T	P
Cognitive Level		Up to K3	30		

Preamble

This course will provide a broad outline on biofertilizer screening, isolation, scaling up and their applications. Student demonstrates exceptional ability to work well with others, lead educational initiatives, and show leadership qualities in professional settings.

Unit I	Nitrogen Fixation	6 Hours
	General account about the microbes used as biofertilizer – Biological Nitrogen Fixation- Non Symbiotic Nitrogen Fixation -Nitrogenase – Symbiotic Nitrogen Fixation, Rhizobium- Isolation, Identification, Mass multiplication, Carrier based inoculants.	
Unit II	**Isolation and Mass Cultivation of Biofertiliser**	**6 Hours**
	Azotobacter -Isolation, identification, Mass multiplication, Carrier based inoculants, Azospirillum – Isolation, identification, Mass multiplication, Carrier based inoculants, Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, mass cultivation and field application.	
Unit III	**VAM-Mass Multiplication**	**6 Hours**
	Vesicular – Arbuscular Mycorrhizal Fungi (VAM Fungi) – Isolation, Mass production, Field application – Phosphate Biofertilizer- Isolation, Mass production, Field application – Biological control of pests – Bacterial pesticides – Viral pesticides.	
Unit IV	**Organic Farming**	**6 Hours**
	Definition -scope and concepts of organic farming. Green manuring, Composting - Principle, composting methods. Vermicompost- Bed preparation - Role of earthworms in soil fertility – Socio-economic constraints in organic farming.	
Unit V	**Production Technology of Biofertiliser**	**6 Hours**
	Methods of quality control assessment in respect to biofertilizer. ISI standard specified and estimating the viable bacterial count in career based biofertilizer, Storage of biofertilizer pockets, Production technology- Strain selection, sterilization, growth and fermentation, mass production. Biofertilizer storage, shelf life, quality control and marketing.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Activity based teaching

Text Books

1. Dr.Annie Ragland. (2010), Plant Physiology & Environmental Biology – Saras Publication
2. Dubey, R.C. (2005), A Text book of Biotechnology S.Chand & Co, New Delhi.
3. Kumaresan, V.(2005), Biotechnology, Saras Publications, New Delhi.

Reference Books

1. R.C.Dubey and Dr.D.K.Maheswari. (2013), A Text book of Microbiology, S.Chand & Co, New Delhi.
2. Motsara, M.R., Bhattacharya, P and Beena Srivastava, (1995). Biofertilizer technology, marketing and usage, Fertilization Development and consultation organization, New Delhi-48

E-Resources

- **https://spark.adobe.com/page/ks5iA9qApIBew/**
- **https://spark.adobe.com/page/SKnytegdyotjg/**
- **http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Introduction-and-Structure-of-Biofertilizers.pdf**
- **https://spark.adobe.com/page/ks5iA9qApIBew/**

Course Outcomes

At the end of the course, students would be able to:

CO1	Explain the basic concepts of bio-fertilizer and their applications
CO2	Illustrate the different forms of biofertilizers and their appropriate uses
CO3	Generalize the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM)
CO4	Interpret the concept of organic farming and explain the role of earthworms in soil fertility
CO5	Explain the components of quality control assessment in bacterial growth for crop production.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO 10	PSO 11	PSO 12
CO 1	3	0	0	3	3	2	0	3	1	3	2	3
CO 2	2	1	2	3	3	2	1	3	1	3	1	1
CO 3	1	0	0	3	2	2	0	3	1	2	1	2
CO 4	2	0	1	3	2	2	0	3	1	3	2	3
CO 5	1	1	1	3	2	2	1	3	1	1	1	3

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A	Section B
			Either/or Choice	Open Choice
			No. Of Questions	No. Of Questions
1	CO1	Up to K2	2(K1&K1)	K2
2	CO2	Up to K3	2(K2&K2)	K3
3	CO3	Up to K2	2(K1&K1)	K2
4	CO4	Up to K3	2(K2&K2)	K3
5	CO5	Up to K2	2(K2&K2)	K2
No of Questions to be asked			10	05
No of Questions to be answered			05	03
Marks for each Question			03	05
Total marks for each section			15	15

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A	Section B	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	12	-	12	12%	22%
K2	18	15	33	33%	51%
K3	-	10	10	10%	27%
Total Marks	30	25	55	55	100%

Lesson Plan

Unit I	**Nitrogen Fixation**	**6 Hours**	**Mode**
	a.General account about the microbes used as biofertilizer	**1**	Class room lecture, PPT, Videos and Group Discussion
	b. Biological Nitrogen Fixation - Non Symbiotic Nitrogen Fixation - Nitrogenase	**2**	
	c. Symbiotic Nitrogen Fixation	**1**	
	d. Rhizobium- Isolation, Identification, Mass multiplication, Carrier based inoculants.	**2**	
Unit II	**Isolation and Mass Cultivation of Biofertiliser**	**6 Hours**	**Mode**
	a.Azotobacter - Isolation, identification, Mass multiplication, Carrier based inoculants	**2**	Class room lecture, PPT, Videos and Group Discussion
	b.Azospirillum – Isolation, identification, Mass multiplication, Carrier based inoculants	**2**	
	c.Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, mass cultivation and field application.	**2**	
Unit III	**VAM-Mass Multiplication**	**6 Hours**	**Mode**
	Vesicular – Arbuscular Mycorrhizal Fungi (VAM Fungi) – Isolation, Mass production, Field application	**2**	Class room lecture, PPT, Videos and Group Discussion
	– Phosphate Biofertilizer- Isolation, Mass production, Field application.	**2**	
	Biological control of pests – Bacterial Pesticides – Viral Pestisides.	**2**	
Unit IV	**Organic Farming**	**6 Hours**	**Mode**
	Definition -scope and concepts of organic farming.	**1**	Class room lecture, PPT, Videos, Lab visit and Group Discussion
	Green manuring	**1**	
	Composting - Principle, composting methods.	**1**	
	Vermicompost- Bed preparation	**1**	
	Role of earthworms in soil fertility – Socio-economic constraints in organic farming.	**2**	
Unit V	**Production Technology of Biofertiliser**	**6 Hours**	**Mode**
	Methods of quality control assessment in respect to biofertilizer	**1**	Class room lecture, PPT, Videos, Lab visit and Group Discussion
	ISI standard specified and estimating the viable bacterial count in career based biofertilizer, Storage of biofertilizer pockets.	**2**	
	Production technology- Strain selection, sterilization, growth and fermentation, mass production.	**2**	
	Biofertilizer storage, shelf life, quality control and	**1**	

	marketing.		

Course designed by: B. Subasri

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOC61**	Number of Hours/Cycle		**4**	
Semester	**VI**	Max. Marks		**100**	
Part	**III**	**Credit**		**4**	
Core Course X					
Course Title	**Biochemistry**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**60**		

Preamble

To gain knowledge about various biomolecules essential for body building and various functions of living beings.

Unit I	**Carbohydrates**	**12 Hours**
	Classification, chemical properties of carbohydrates, Chemistry and biological roles of homo and hetero polysaccharides. Structure and biological importance of Glucose, Sucrose, Fructose, Starch, Glycogen, Chitin, Peptidoglycan and Agarose. **Metabolism:** Glycogenesis, glycogenolysis, gluconeogenesis, and pentose phosphate pathway.	
Unit II	**Proteins**	**12 Hours**
	Amino acids: Structure, classification (based on polarity), physical properties and chemical reactions. **Proteins:** Classification, properties and biological importance, structural organization of protein - primary, secondary, tertiary and quarternary structure. **Metabolism:** Deamination, transamination, transmethylation, decarboxylation.	
Unit III	**Lipids**	**12 Hours**
	Lipids: Classification of Lipids, Biological significance of lipids, Fatty acids and their physiochemical properties. Structure and properties of Prostaglandins. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids,sulpholipids, sphingolipids and sterols. **Metabolism:** Beta oxidation	
Unit IV	**Enzymes & Vitamins**	**12 Hours**
	Enzymes: Properties,Classification and mechanism of enzyme action (lock and key and induced fit hypothesis), enzyme inhibition, factors influencing enzyme activity, Regulation of enzyme activity, Biological Role of enzymes, coenzymes, mechanism of coenzyme action and isoenzymes. **Vitamins:**Water soluble Vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid -sources, structure, biochemical functions and deficiency diseases. Fat soluble Vitamins - vitamin A, vitamin D, vitamin E and vitamin K - sources, structure, biochemical functions and deficiency diseases.	
Unit V	**Instrumentation**	**12 Hours**
	Principle, Procedure and Applications - pH Meter, Colorimeter, Paper Chromatography, Electrophoresis, Centrifuge, Electro cardiogram, Haemoglobinometer.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Field visit, Activity based teaching.

Text Books

1. Ambika Shanmugam, K. Ramadevi, Fundamentals of Biochemistry for Medical Students (2016) Lippincott Williams & Wilkins, Hyderabad.

2. Dr. Jain, Dr. Sunjay Jain, Nitin Jain Fundamentals of Biochemistry, (2008) S. Chand Publication, New Delhi.

Reference Books

1. Dr. Deb A. C. Fundamentals of Biochemistry, (1998) New Century Book Agency, Calcutta.
2. StryerLubert, (1975). Biochemistry. Freeman & Company, San Francisco.
3. Devlin T M,(2002)Text Book of Biochemistry with clinical correlations. Wiley-Liss, New York.
4. Donald Voet, Judith G. Voet,(2004). Biochemistry. Wiley, New York.
5. David L.Nelson, Michael M.Cox, (2007). Lehninger. Principles of Biochemistry, Fourth edition.

E-Resources

https://www.nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-03.pdf
https://www.khanacademy.org/science/biology/macromolecules/proteins-and-amino-acids/a/orders-of-protein-structure
https://courses.lumenlearning.com/suny-ap2/chapter/lipid-metabolism/
https://www.slideshare.net/rakhiadarsh/classification-of-enzymes
https://byjus.com/chemistry/vitamins-types/
https://microbiologynote.com/ph-meter-definition-principle/
https://www.vedantu.com/chemistry/colorimeter

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain about the carbohydrates and its types, structural elucidation of polysaccharides, their metabolism and biological importance.
CO2	Identify the composition of proteins, classification, metabolism and their significance.
CO3	Understand the structure and classification of lipids, Fatty acids and their physiochemical properties and their biological significance.
CO4	Discuss about characteristics, properties, classification, mechanism and various factors affecting the enzyme activities, along with structure and functions of vitamins.
CO5	Infer knowledge about the biochemical apparatus.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	3	3	1	1	1	1	1	-	1	1
CO2	3	2	3	3	1	1	1	1	1	-	1	1
CO3	3	2	3	3	1	1	1	1	1	-	1	1
CO4	3	2	3	3	1	1	1	1	1	-	1	1
C05	3	1	2	3	3	1	1	1	1	-	1	1

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Question	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K3	2	K1	2(K2&K2)	K3
4	CO4	Up to K2	2	K1	2(K2&K2)	K2
5	CO5	Up to K3	2	K1	2(K3&K3)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10 %	10 %
K2	-	32	30	62	62 %	62 %
K3	-	08	20	28	28 %	28 %
Total Marks	10	40	50	100	100 %	100%

Lesson Plan

	Carbohydrates	**12 Hours**	**Mode**
Unit I	1. Classification of Carbohydrates	1	Class room Lecture, PPT and Videos.
	2.Chemical properties of Carbohydrates	1	
	3.Chemistry and biological roles of homo and heteropolysaccharides. Structure and biological importance of Glucose, Sucrose, Fructose, Starch, Glycogen, Chitin, Peptidoglycan and Agarose.	6	
	4.Metabolism: Glycogenesis, glycogenolysis, gluconeogenesis, and pentose phosphate pathway.	4	
	Proteins	**12 Hours**	**Mode**
	1.Amino acids: Structure, classification (based on polarity), physical properties and chemical reactions.	4	Class room Lecture,

Unit II	2.Proteins: Classification, properties and biological importance, structural organization of protein - primary, secondary, tertiary and quarternary structure.	4	PPT and Videos**.**
	3.Metabolism: Deamination, transamination, transmethylation, decarboxylation.	4	
Unit III	**Lipids:**	**12 Hours**	**Mode**
	1.Classification of Lipids and Biological significance of lipids.	2	Class room lecture, PPT and Videos.
	2.Fatty acids and their physiochemical properties	2	
	3.Structure and properties of Prostaglandins.	1	
	4.Storage lipids – triacyl glycerol and waxes.	2	
	5.Structural lipids in membranes – glycerophospholipids, galactolipids, sulpholipids, sphingolipids and sterols.	4	
	6.Metabolism: Beta oxidation	1	
Unit IV	**Enzymes:**	**12 Hours**	**Mode**
	1.Properties and Classification of Enzymes	1	Class room lecture, PPT, and Videos
	2.Mechanism of enzyme action (lock and key and induced fit hypothesis)	1	
	3.Factors influencing enzyme activity	1	
	Regulation of enzyme activity, Biological 4.Role of enzymes	1	
	5. Coenzymes, mechanism of coenzyme action and isoenzymes.	2	
	6.Water soluble Vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid sources, structure, biochemical functions and deficiency diseases	3	
	7. Fat soluble Vitamins - vitamin A, vitamin D, vitamin E and vitamin K - sources, structure, biochemical functions and deficiency diseases.	3	
Unit V	**Instrumentation**	**12 Hours**	**Mode**
	1.Principle, Procedure and Applications – pH Meter	2	Lecture, PPT, and Demo.
	2.Principle, Procedure and Applications – Colorimeter	2	
	3.Principle, Procedure and Applications - Paper Chromatography	2	
	4.Principle, Procedure and Applications – Electrophoresis	2	
	5.Principle, Procedure and Applications - Centrifuge	2	
	6. Principle, Procedure and Applications - Electro cardiogram, Haemoglobinometer.	2	

Course designed by: Dr. K. Krishnveni

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOC62	Number of Hours/Cycle		4	
Semester	V	Max. Marks		100	
Part	III	Credit		4	
Core Course XI					
Course Title	Applied Microbiology		L	T	P
Cognitive Level		Up to K3	60		

Preamble

This course is designed to promote the interest of basic and applied areas of microbiology. It deals with detailed classification of bacteria, fungi and viruses. It imparts knowledge of microorganisms in industrial, food and agricultural microbiology. The course also deals with medically important microbes, diseases and control measures in terms of public health.

Unit I	Microbial Taxonomy and Morphology	12 Hours
	History and scope of Microbiology, contributions of eminent scientists- Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Alexander Fleming and Winogradsky Binomial nomenclature –taxonomic hierarchy- Whittaker's five kingdom and Carl Woese's three kingdom classification **Morphology and host specificity:** Bacteria: Shapes, classification, ultra structure, Virus: Enveloped (Herpes) and non-enveloped virus (Tobacco Mosaic Virus) and bacteriophages (Morphology and structure of T4 Bacteriophage). Fungi –Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae.*	
Unit II	**Isolation and Culture of Microbes**	**12 Hours**
	Sterilization and disinfections: physical and chemical methods, Culture media: Types, preparation, minimal requirements, Culture techniques: Batch, Continuous, Synchronous and Fed-batch, Methods of culturing bacteria: Isolation of bacteria by Pure culture techniques, Microbial Growth: Growth measurement, parameters of growth, growth in continiuous culture, growth in batch culture, synchronous growth and diauxic growth Identification of Bacteria: Staining (Simple & Gram), Phenol red & Lipid hydrolysis Tests and Motility test	
Unit III	**Dairy and Food Microbiology**	**12 Hours**
	Dairy Microbiology: Microbiology of Milk, Milk products, Biotechnology of dairy products **Food Microbiology:** Microbial Contamination and spoilage of Meat, Poultry, Fish and Sea food, Food Preservation Methods: Physical and Chemical, **Oriental Foods:** Mycoprotein, Food – feed Source, Food toxic indicators. Microbes in kitchen	
Unit IV	**Industrial and Environmental Microbiology**	**12 Hours**
	Industrial Microbiology: Microorganisms used in industry, Fermentation technology: Fermentor – Types, Production of microbial products through fermentor: Production of Antibiotics (Penicillin, Streptomycin &Tetracyclines), Organic acids (Citric acid & Acetic acid), Solvents (Ethyl alcohol & Glycerol), Yeast (Brewer's and Baker's), Single cell proteins (Bacterial proteins). **Environmental Microbiology:**	

	Waste as a resource: i) Organic Compost, ii) Biogas, Sewage (Waste water)Treatment: Small scale and Large Scale, Microbial Leaching, Biodegradation: Petroleum, Xenobiotics, Heavy metals, Water Pollution Management: Bioaugumentation, Use of Enzymes, Use of Immobilised cells, Biofiltration, Biodeterioration, Microbial plastics.	
Unit V	**Agricultural and Medical Microbiology**	**12 Hours**
	Agricultural Microbiology: Plant growth promoting bacteria, Biofertilizers: Symbiotic (*Bradyrhizobium, Frankia, Mycorrhizae, AM fungi*), Non Symbiotic (Phosphate solubilizers, potash solubilizer , algae), Novel combination of microbes as biofertilizers, Plant Growth-Promoting Rhizobacteria (PGPR). Microorganisms used as bio control agents against plant pathogens, insects, weeds. Recycling of agriculture waste, Role of microbes in composting process **Medical Microbiology:** Causative agents, Mode of transmissions, Pathogenicity, Symptoms and prophylaxis **Viraldiseases:** SARS COV 2, Dengue fever, Viral Hepatitis, Rabies, AIDS, **Bacterial Diseases:** Tuberculosis, Meningitis, Shigellosis, Leprosy, Gonorhoea and Syphilis, **Fungal Diseases:** Candidiasis, Dermatophytosis.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Field visit, Activity based teaching.

Text Books:

1. Dubey, R.C. and Maheswari, D.K. (2006). A Text Book of Microbiology, S. Chand and Company Ltd., New Delhi.
2. SundaraRajan, S, (2002). College Microbiology – Vol. I to IV, Vardhana Publications, Bangalore.
3. Mani, A., Selvaraj, A.M., Narayanan, L.M. and Arumugam, N. (2016). Microbiology – General and Applied, Saras Publications, Nagercoil.

Reference Books:

1. Anandhanarayanan. R and Panicker C.K., (2016). Text book of Microbiology, 8th Edition, Universities Press (India) Private Limited.
2. Pelczar, M.J., Chan, E.C.S and Krieig N.R.,(2008). Microbiology, 5th Edition, Tata McGraw Hill Edition. United States.
3. Tortora G.J, Funke B.R and Case C.L., (2009).Microbiology: An Introduction,11th Edition, United States.
4. Prescott L.M. Harley J.P and Klein D.A., (2010) Microbiology, 8th Edition. New Delhi.
5. Patel A.H. (2008).Industrial microbiology, Macmillan India LTD, Chennai
6. Powar, C.B. and Daginawala, H.F., (2001). General Microbiology, Himalaya Publishing House, New Delhi.

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the historical events, diversity and scope of microbiology and morphological structure of bacteria and virus
CO2	Explain various sterilization techniques, bacterial growth media, and growth curve
CO3	Apply the knowledge of food microbiology in preparation and preservation of foods
CO4	Analyze the applications of microbes in Industries, and apply the knowledge of environmental microbiology
CO5	Evaluatetheroleofmicroorganismsinepidemicandcommunicablediseasesinglobal perspectives

	and its preventive measures

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	2	1	-	-	3	3	2	-	1	-	2	2
CO2	2	1	-	3	3	3	2	-	1	-	2	3
CO3	2	1	3	2	3	3	3	-	1	-	2	3
CO4	3	1	2	-	3	2	2	-	1	2	1	2
C05	3	1	3	1	3	3	2	-	1	1	2	2

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K3	2	K1	2(K2&K2)	K3
4	CO4	Up to K3	2	K1	2(K2&K2)	K3
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	20	60	60	60
K3	-	-	30	30	30	30
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Microbial Taxonomy and Morphology**	**12 Hours**	**Mode**
	1. History and scope of Microbiology: **a.** contributions of eminent scientists- Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Alexander Fleming and Winogradsky	**2**	Lecture, PPT, Video, Scientist images, Microscopic observation in Lab
	b. Applications of Microbiology	**1**	
	2. Microbial Diversity: **c.** Binomial nomenclature –taxonomic hierarchy- Whittaker's five kingdom and Carl Woese's three kingdom classification	**2**	
	3. Morphology of Microbial cells: **d. Bacteria:** Shapes, classification	**2**	
	e. Ultra structure	**1**	
	f.Virus: Virus: Classification (LTH system) Enveloped (Herpes) and	**1**	
	g. non-enveloped virus (Tobacco Mosaic Virus) and bacteriophages (Morphology and structure of T4 Bacteriophage).	**2**	
	h. Fungi –Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae.*	**1**	
Unit II	**Isolation and Culture of Microbes**	**12 Hours**	**Mode**
	a.Sterilization techniques: Sterilization and disinfections: physical and chemical methods	**2**	Class room lecture, PPT, Demo Videos and Microscopic observation in Lab
	b. Culture media: Types, preparation, minimal requirements	**2**	
	c. Culture techniques: Batch, Continuous, Synchronous and Fed-batch	**2**	
	d. Methods of culturing bacteria: Isolation of bacteria by Pure culture techniques	**3**	
	e. Microbial Growth: Growth measurement, parameters of growth, growth in continuous culture, growth in batch culture, synchronous growth and diauxic growth	**1**	
	f. Identification of Bacteria: Staining (Simple & Gram), Phenol red & Lipid hydrolysis Tests and Motility test	**2**	
Unit III	**Dairy and Food Microbiology**	**12 Hours**	**Mode**
	a. Microbiology of Milk and Dairy Industries: Microbiology of Milk	**1**	Class room lecture, PPT, Demo Videos and Microscopic observation in Lab
	b. Milk products,	**2**	
	c. Biotechnology of dairy products	**1**	
	d. Microbiology of Food Industries: Microbial Contamination and spoilage of Meat, Poultry, Fish and Sea food,	**2**	
	e. Food Presevation Methods: Physical and	**2**	

	Chemical,		
	f. Oriental Foods: Mycoprotein	**2**	
	f. Food – feed Source	**1**	
	g.Food toxic indicators	**1**	
Unit IV	**Industrial Microbiology and Environmental Microbiology**	**12 Hours**	**Mode**
	a. Industrial Microbiology: Microorganisms used in industry, Fermentation technology: Fermentor – Types	**1**	Class room lecture, PPT, Demo Videos and Microscopic observation in Lab
	b. Organic acids (Citric acid & Acetic acid), Solvents (Ethyl alcohol & Glycerol)	**1**	
	c. Production of microbial products through fermentor: Production of Antibiotics (Penicillin, Streptomycin &Tetracyclines)	**1**	
	d. Yeast (Brewer's and Baker's), Single cell proteins (Bacterial proteins)	**2**	
	e.Environmental Microbiology: Waste as a resource: i) Organic Compost, ii) Biogas	**1**	
	f. Sewage (Waste water)Treatment: Small scale and Large Scale,	**1**	
	g. Microbial Leaching	**1**	
	h.Biodegradation: Petroleum, Xenobiotics, Heavy metals,	**2**	
	i.Water Pollution Management: Bioaugumentation, Use of Enzymes, Use of Immobilised cells,	**1**	
	j. Biofiltration, Biodeterioration, Microbial plastics.	**1**	
Unit V	**Agricultural and Medical Microbiology**	**12 Hours**	**Mode**
	Agricultural Microbiology: **a.**Plant growth promoting bacteria, Biofertilizers: Symbiotic (*Bradyrhizobium, Frankia,* Mycorrhizae, AM fungi),	**2**	Class room lecture, PPT, Demo Videos, Microscopic observation in Lab, field visit, Clinical Lab visit
	b.Non Symbiotic (Phosphate solubilizers, potash solubilizer, algae),	**2**	
	c.Novel combination of microbes as biofertilizers, PGPRs	**1**	
	d. Microorganisms used as bio control agents against plant pathogens, insects, weeds	**1**	
	e. Recycling of agriculture waste, Role of microbes in composting process	**1**	
	g. Medical Microbiology: Causative agents, Mode of transmissions, Pathogenicity, Symptoms and prophylaxis **Viraldiseases:** SARS COV 2, Dengue fever, Viral Hepatitis, Rabies, AIDS	**2**	
	h. Bacterial Diseases: Tuberculosis, Meningitis, Shigellosis, Leprosy, Gonorhoea and Syphilis,	**2**	
	i.Fungal Diseases: Candidiasis, Dermatophytosis.	**1**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOC63	Number of Hours/Cycle		3	
Semester	VI	Max. Marks		100	
Part	III	Credit		4	
Core Course XII					
Course Title	Immunology and Immunotechnology		L	T	P
Cognitive Level		Up to K3	45		

Preamble:

Enable to understand about various aspects immunity and the techniques involved in the diagnosis of autoimmune diseases.

Unit I	Introduction to immunology	9 Hours
	History of immunology–Structures and functions of cells and organs involved in immune system, Lymphocytes: T and B cells, natural killer cells, memory cells, macrophages, Lymphoid organs- Primary – Thymus and Bone marrow, Secondary lymphoid organs - lymph nodes and spleen. Types of immunity – Innate and acquired, Acquired immunity – humoral and cell mediated immune response, Clonal selection theory. Mechanisms of innate immunity - barriers, inflammation, phagocytosis.	
Unit II	**Immune Components**	**9 Hours**
	An overview, components of mammalian immune system, Cytokines – Properties and functions, Immunoglobulins – structure, types and function. Immunogenicity – Immunogens, adjuvants, epitopes, haptens and carriers, complement system – classical and alternate pathway. T lymphocytes -cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, B-lymphocyte differentiation, Antibody affinity, maturation class switching.	
Unit III	**Immuno Stimulant**	**9 Hours**
	Antigens – types, chemical nature, antigenic determinants – Factors affecting antigenicity. Major histocompatibility complex (MHC) – structure and its interaction with peptide, Toll-like receptors, Immune response to infectious diseases – bacterial, viral, protozoan and helminthes. Autoimmune disorders, and Cancer immunotherapy (elementary details only).	
Unit IV	**Transplantation Immunology**	**9 Hours**
	Transplantation immunity – Organ transplantation and HLA tissue typing, Hypersensitivity Reactions – Type I, II, III and IV, Congenital and Acquired Immunodeficiencies, Inflammation, Hybridoma and monoclonals. Immunization – active and passive.	
Unit V	**Immunotechniques – Principles and applications**	**9 Hours**
	Principles involved in antigen-antibody interactions, characteristics features. Precipitation techniques - immunodiffusion and immuno electrophoresis. Agglutination techniques - haemagglutination, ABO blood grouping & Rh typing. Tagged assays – RIA, ELISA, immunofluorescence and immunoblotting. Isolation of pure antibodies, Assays for complement, FACS, Flow cytometry. Antibody engineering – Hybridoma technology – polyclonal and monoclonal antibody production and their applications. Recombinant antibody production.	

	Vaccine production - types of vaccines, principles and production of vaccine production, new vaccine strategies and vaccines under development. Adjuvants – types and properties.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Activity based teaching, Field Study

Text Books

1. Madhavee Latha P. (2012) Textbook of Immunology, 1stedition, S. Chand Publishers.
2. Annadurai B (2008). Text Book of Immunology and Immunotechnology, S. Chand & Company, Ram Nagar, New Delhi.
3. Ashim K. Chakravarty (2006) Immunology and Immunotechnology 1st Edn. Oxford University Press, India.

Reference Books

1. Goldsbyet al. (2018) Kuby Immunology. WH Freeman & Co. 8 thEdn. New York
2. Abbas et al. (2017) Cellular and Molecular Immunology. Elsevier 9th ed. India
3. Janeway, C. (Ed), Paul Travers. (2016) Immunobiology 8th ed. Garland Publ.
4. Ivan Lefkovits Benvenuto Pernis (2010) Immunological Methods 1st Ed, Academic press, Switzerland 39
5. Xian C. Li, M. Jevnikar Anthony (2015) Transplant Immunology 1st Ed, Wiley, USA.
6. Abbas A. K. (2015) AHH Lichtman, S Pillai Basic Immunology. 5th Ed, Elsevier, India
7. Gupta S.K. (2017) Essentials of Immunology 2nd Ed, Arya Publications, 2017. India

E-Resources

https://www.khanacademy.org/science/biology/bacteria-archaea
https://www.khanacademy.org/science/biology/biology-of-viruses
https://www.google.com/url?q=https://www.khanacademy.org/science/biology/humanbiology/immunology
https://www.mdpi.com/2076-393X/4/2/12/pdf https://www.historyofvaccines.org/content/articles/passive-immunization
https://www.ncbi.nlm.nih.gov/books/NBK27129/
https://nptel.ac.in/content/storage2/courses/102103038/download/modulel
https://www.medicine.mcgill.ca/physio/vlab/immun/backg.htm

Course Outcomes

At the end of the course, students would be able to:

CO1	Identify and describe the types, organs, cells of immunity and immunological processes
CO2	Describe the immunological responses, Antigen – antibody reactions, antibody maturity, class switching and T cell gene expressions.
CO3	Illustrate the general characters and significance of immunostimulants, MHC complex and immune system related diseases.
CO4	Explain the immune mechanisms behind autoimmunity, hypersensitivity, hybridomas, and transplantation immunotechnology
CO5	Describe about the principles of various immunological techniques and their recent trends.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	3	0	0	2	1	2	1	1	0	1	1
CO2	2	3	0	0	2	1	2	1	0	1	0	1
CO3	3	2	0	0	2	1	2	1	1	0	1	1
CO4	3	2	0	0	2	1	2	0	1	0	0	1
CO5	2	3	0	0	2	1	2	1	1	1	1	1

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K2	2	K1	K1,K1	K2
2	CO2	Up to K2	2	K1	K1,K1	K2
3	CO3	Up to K2	2	K1	K2,K2	K2
4	CO4	Up to K3	2	K1	K2,K2	K3
5	CO5	Up to K3	2	K1	K2,K2	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Either/or)**	**Total Marks**	**% of Marks without choice**
K1	10	16	-	26	22%
K2	-	24	30	54	58%
K3	-	-	20	20	20%
Total Marks	10	40	50	100	100%

Lesson Plan

Immunology and Immunotechnology - 20UZOC63				
Unit	**S. No.**	**Topics**	**Hours**	**Teaching mode**
I		**Introduction to immunology**		Chalk & Talk, PPT & Animation Videos
	i	History of immunology–Structures and functions of cells and organs involved in immune system,	2	
	ii	Lymphocytes: T and B cells, natural killer cells, memory cells, macrophages, Lymphoid organs-	1	
	iii	Primary – Thymus and Bone marrow,	2	
	iv	Secondary lymphoid organs - lymph nodes and spleen.	1	
	v	Types of immunity – Innate and acquired,	1	
	vi	Acquired immunity – humoral and cell mediated immune response,	2	

	vii	Clonal selection theory.	1	
	viii	Mechanisms of innate immunity - barriers	1	
	ix	Inflammation, phagocytosis.	1	
		Total Hours	**12**	
II		**Immune Components**		Class Lecture, PPT Presentation, Animation Videos
	i	An overview, components of mammalian immune system	1	
	ii	Cytokines – Properties and functions,	1	
	iii	Immunoglobulins – structure, types and function.	3	
	iv	Immunogenicity – Immunogens, adjuvants,	1	
	v	epitopes, haptens and carriers, complement system – classical and alternate pathway.	2	
	vi	T lymphocytes -cytotoxic T-cell, helper T-cell	1	
	vii	suppressor T-cells, T-cell receptors,	1	
	viii	B-lymphocyte differentiation, Antibody affinity, maturation class switching.	2	
		Total Hours	**12**	
III		**Immuno Stimulant**		Class Lecture, PPT Presentation, Animation Videos
	i	Antigens – types, chemical nature, antigenic determinants – Factors affecting antigenicity.	2	
	ii	Major histocompatibility complex (MHC) – structure and its interaction with peptide	2	
	iii	Toll-like receptors,	2	
	iv	Immune response to infectious diseases – bacterial, viral	2	
	v	Protozoan and helminthes.	1	
	vi	Autoimmune disorders	2	
	vii	Cancer immunotherapy (elementary details only).	1	
		Total Hours	**12**	
IV		**Transplantation Immunology**		Chalk & Talk, PPT & Animation Videos
	i	Transplantation immunity	2	
	ii	Organ transplantation and HLA tissue typing	2	
	iii	Hypersensitivity Reactions – Type I and II	2	
	iv	Hypersensitivity Reactions – Type III and IV	1	
	v	Congenital and Acquired Immunodeficiencies, Inflammation	2	
	vi	Hybridoma and monoclonals	2	
	vii	Immunization – active and passive.	1	
		Total Hours	**12**	
V		**Immunotechniques – Principles and applications**		Class Lecture, PPT Presentation, Animation Videos
	i	Principals involved in antigen-antibody interactions, characteristics features.	2	
	ii	Precipitation techniques - immunodiffusion and immuno electrophoresis. Agglutination techniques - haemagglutination, ABO blood grouping & Rh typing.	2	
	iii	Tagged assays – RIA, ELISA,	1	
	iv	Tagged assays - immunofluorescence and	2	

		immunoblotting		
	v	Isolation of pure antibodies,	1	
		Assays for complement, FACS, Flow cytometry. Antibody engineering – Hybridoma technology – polyclonal and monoclonal antibody production and their applications.	2	
		Recombinant antibody production.	1	
		Vaccine production - types of vaccines, new vaccine strategies and vaccines under development. Adjuvants – types and properties.	2	
		Total Hours	**12**	

Course designed by: Dr. S. Dharaneedharan

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOC6P**	Number of Hours/Cycle		**2**	
Semester	**VI**	Max. Marks		**100**	
Part	**III**	**Credit**		**2**	
Core Practical III					
Course Title	**Core Practical III**		**L**	**T**	**P**
Cognitive Level		**Up to K3**			**30**

BIOSTATISTICS

1. Data Collection
2. Frequency distribution
3. Presentation of data- Bar Diagram, Pie Diagram, Histogram
4. Calculation of Mean, Median, Mode
5. Calculation of Standard Deviation and Coefficient of Variation

BIOCHEMISTRY

1. Qualitative analysis of carbohydrates, protein and lipids in the given samples
2. Estimation of haemoglobin by Haemoglobinometer.
3. Testing the pH of different solutions.
4. Instrumentation - Principle and uses of
    i) pH meter
    ii) Electrophoresis – Paper Electrophoresis
    iii) Chromatography – Paper chromatography
    iv) Colorimeter
    v) Centrifuge

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOC6Q**	Number of Hours/Cycle		**2**	
Semester	**VI**	Max. Marks		**100**	
Part	**III**	**Credit**		**2**	
CORE PRACTICAL IV					
Course Title	**Core Practical IV**		**L**	**T**	**P**
Cognitive Level		**Up to K3**			**30**

HUMAN ANATOMY AND PHYSIOLOGY:

1. Amylase activity in human saliva in relation to Temperature and pH.
2. Estimation of dissolved Oxygen in various water samples.
3. Qualitative analysis of excretory products – Ammonia, Urea, Uric acid
4. Analysis of human blood - total and differential count of RBC, WBC
5. Plasticity of pulse rate and heart beat
6. Effect of insulin level on human blood glucose
7. Spotters - Hormonal disorders – Gigantism, Cretinism, Diabetes &Goitre

MICROBIOLOGY

1. Laboratory Bio safety Measures
2. Sterilization – Working Principle and Applications of Autoclave, Laminar Air Flow, Incubator, Hot Air Oven
3. Preparation of medium–nutrient agar, nutrient broth
4. Serial Dilution Technique
5. Isolation of Single Colony using Pour plate, Streak plate, Spread plate
6. Simple staining of bacteria
7. Gram staining technique
8. Microscopic examination of living bacteria - hanging drop method.
9. Comparative study of soil bacterial diversity inside the college campus
10. Assessment of bacterial diversity in dye effluent samples in and around Chinnalapatti, Dindigul
11. Assessment of bacterial diversity in Dindigul Tannery effluent samples.
12. Cultivation and identification of unknown Fungi from various sources
13. Determination of microbiological quality of milk using MBR (Methylene Blue Reductase) Test
14. Antibiotic sensitivity Test
15. Medical Microbiology :Viral disease: COVID 19, Bacterial Diseases: Tuberculosis and Gonorrhea.
16. Agriculture Microbiology: Symbiotic nitrogen fixation in *Rhizobium*, Non Symbiotic: *Azospirillum*
17. Biomanure: Azolla.
18. Visit to Industry/Hospital/Clinical laboratory – A report to be submitted

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZO6CR	Number of Hours/Cycle		2	
Semester	VI	Max. Marks		100	
Part	III	Credit		2	
CORE PRACTICAL - V					
Course Title	Core Practical – V		L	T	P
Cognitive Level					30

Biotechnology and rDNA Technology

1. Isolation of genomic and Plasmid DNA from Living cells.
2. Estimation of DNA by diphenylamine method
3. Estimation of RNA by orcinol method
4. Preparation of Competent Plasmid.
5. Restriction digestion of λ-phage DNA
6. Screening of recombinants.
7. Polymerase Chain Reaction (Demo).
8. SDS-PAGE (Group).
9. RFLP (Demo).
10. RAPD (Demo).

Immunology and Immunotechnology

1. Fractionation and characterization of human salivary proteins by column chromatography
2. Agglutination: ABO blood grouping, Rh Typing,WIDAL test, CRP and ASO.
3. Precipitation -Immune diffusion: Double immuno diffusion and Radial immuno diffusion.
4. Electrophoresis: pre-counter immuno electrophoresis, single immuno electrophoresis and Rocket immuno electrophoresis.
5. Enumeration of blood cells: RBC, WBC, platelets and its sub types.
6. Differential staining of Blood cells
7. Labeled assay- Demonstration of ELISA and RIA.
9. Demonstration of Lymphoid organs in rat (Virtual)
10. Blotting Techniques – Western (Demo)

Course designed by: S. Dharaneedharan

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOE61	Number of Hours/Cycle		3	
Semester	VI	Max. Marks		100	
Part	III	Credit		3	
Core Elective I					
Course Title	Clinical Pathology and Laboratory Techniques		L	T	P
Cognitive Level		Up to K3	45		

Preamble

Elaborate the structure and functions of digestive, respiratory, circulatory, urinogenital, neuromuscular system and sense organs and its related disorders.

Unit I	Essential pre – requisites of a medical laboratory	9 Hours
	Safety measures in the laboratory: Personal cleanliness and care, Maintenance of Laboratory records and preparation of reports, Types of sterilization, disinfection, antisepsis, Disposal of specimens and infected materials, Safety precautions against infection by microbiological specimens. Disposal of bio-medical wastes **Laboratory instruments:** Method of measuring liquids and weighing solids, General laboratory equipments-Principle, use and maintenance of the following instruments/apparatus – Balance, centrifuge, cold centrifuge, homogenizer, desiccators, vortex mixer, magnetic stirrer, Glucometer, Sphygmomanometer Albuminometer, Urinometer, Haemoglobinometerand Haemocytometer. Spectrophotometer.	
Unit II	**Clinical Biochemistry**	**9 Hours**
	Definition and scope of clinical biochemistry in diagnosis, collection and preservation of biological fluids: blood, urine & CSF, normal values of important constituents of blood, CSF and urine. **Carbohydrates:** Estimation of glucose, glycosurias, GTT's, hyper &hypoglycemia, blood glucose regulation and role of hormones, diabetic coma **Lipids:** Lipid profile estimation, hypercholesterolemia, hyper lipoproteinemia, atherosclerosis and it risk factors **Proteins:** albumin, hypo albuminemia, hypo proteinemia, Bence Jones proteins, proteins in CSF and their estimation, **Hormones:** Types, Thyroid hormone and their mechanism of action; Pituitary hormones and their role in biological systems, Role of insulin in modulating blood glucose level	
Unit III	**Clinical Pathology**	**9 Hours**
	Types of clinical specimens: blood, urine, feces, sputum, CSF, Semen. Methods of collection, transportation, handling. Physical, chemical, microscopical and microbiological examination of clinical specimens. Urine Analysis: Urine composition, volume, appearance, color, collection and preservation. Physical and chemical examination of urine Reaction specific gravity, sugar, albumin, bile salts, bile pigment, urea, uric acid, creatinine and ketones - Microscopic examinations – deposits – RBC, casts, pus cells crystals, Brief account on U.T.I Faeces: Specimen collection – microscopic examination – ova, cysts occult blood, microbe and parasitic infestation (Examination of faeces ova and cysts of *Entamoeba coli, E. histolytica, Giardia lambia, Enterobius vermicularis)* Sputum: Examination of normal and pathological sputum, Examination of throat swab. Semen analysis: microscopic examination, motility, counting, STD: syphilis, gonorrhea.	
Unit IV	**Clinical Haematology**	**9 Hours**

	Blood and its constituents, Collection of blood: capillary and venous blood collection, various anticoagulants and their uses. Bleeding time, clotting time, Principles of blood groups and antigen antibody reactions, Total count of RBCs, WBC. Estimation of Haemoglobin – Principles, techniques. Haemoglobin estimation by Sahl's method. Erythrocyte Sedimentation Rate (ESR) (Wintrobe and Westergren method), Anemia and its types, Leukemia, blood banking. Clinical significance of ESR and PCV	
Unit V	**Histopathology**	**9 Hours**
	Introduction to histology and instruments: Microtomes: Types and uses, Knives, Embedding bath, Tissue flotation bath, Automated tissue processor. Tissue processing for paraffin section and Microscopic observation: Types and Selection of tissues, Responsibility of a technician, Tissue preparation, Tissue Processing Steps: Fixation - Aims and function of a fixative, Classification, Dehydration, Embedding Media: Paraffin wax. Technique of impregnation: Embedding, Blocking, Moulding. Decalcification: Decalcifying agents, deparaffinization, staining and Mounting.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Lab visit, Activity based teaching and Internship Programme.

Text Books

Godkar, P. B. Godkar D. P (2002). A Text Book for Medical Lab Technology, 2nd edition, Bhalami Publishing House, Mumbai.

Reference Books

1. Mukherjee, K.L (1989). Medical Laboratory Technology (Vol –I to III) Tata McGraw Hill, New Delhi.
2. Sood, R (1996). Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, New Delhi
3. Carman, Robert H.(2016).Hand Book of CMAI Medical Laboratory Technology, CMAI Publication, New Delhi.
4. Talib VH. (2015). A Hand Book of Medical Laboratory Technology.2nd Ed. CBS Publishers Pvt Ltd, New Delhi.

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- **http://mt-lectures.blogspot.com/2019/02/impregnation.html**
- **http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Histo/Introduction.pdf**
- **https://www.leicabiosystems.com/en-in/knowledge-pathway/an-introduction-to-specimen-processing/**
- **https://www.slideshare.net/zahoor061/histological-techaniques**
- **https://www.slideshare.net/ananthatiger/anatomy-2948812**
- **https://en.wikipedia.org/wiki/Clinical_pathology**
- **http://rajswasthya.nic.in/RHSDP%20Modules.htm**

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the general safety regulations governing clinical laboratories, Comparethe functions of older and modern instruments and Identify methods in safety disposal and sterilization of biohazards.
CO2	Analyzethe significance of diabetic profile, lipid, protein and renal profile of clinical samples and its related disorders.
CO3	Apply laboratory investigations on blood, urine, stool, sputum and semen samples. Analyze clinical samples for physical, chemical and microscopic examination to observe various diseases.
CO4	Demonstratethe principle, requirements, procedure and interpretation of routine hematology.
CO5	Experiment the techniques involved in histopathological analysis of various tissue samples for microscopic observations.

Mapping of Course Outcomes (COs) withProgramme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	2	1	2	1	2	3	2	-	1	-	1	2
CO2	2	1	3	3	3	3	2	2	1	-	2	3
CO3	2	1	3	2	3	3	3	-	1	-	2	3
CO4	3	1	2	-	3	2	2	-	1	2	1	2
C05	3	1	3	1	3	3	2	-	1	1	2	2

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Question**	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K3
3	CO3	Up to K3	2	K1	2(K2&K2)	K3
4	CO4	Up to K3	2	K1	2(K2&K2)	K3
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	10	50	50	50
K3	-	-	40	40	40	40
Total Marks	10	40	50	100	100	100%

Lesson Plan

	Essential pre – requisites of a medical laboratory	**9 Hours**	**Mode**
Unit I	**1. Safety measures in the laboratory**		Class Room Lecture, PPT and Videos, Lab visit, Hands on Training
	a.Personal cleanliness and care, Maintenance of Laboratory records and preparation of reports,	**2**	
	b.Types of sterilization, disinfection, antisepsis	**2**	
	c. Disposal of specimens and infected materials (bio-medical wastes), Safety precautions against infection by microbiological specimens	**1**	
	2. Laboratory instruments		
	d.General laboratory equipments-Principle, use and maintenance of the following instruments/apparatus – Balance, centrifuge, cold centrifuge, homogenizer	**1**	
	e.desiccators, vortex mixer, magnetic stirrer, Gluco meter, Sphygmomanometer Albuminometer,	**1**	
	f. Urinometer, haemoglobinometer and haemocytometer. Spectrophotometer.	**2**	
Unit II	**Clinical Biochemistry**	**9 Hours**	**Mode**
	a. Carbohydrates: Estimation of glucose, glycosurias, GTT's, hyper & hypoglycemia	**1**	Class Room Lecture, PPT and Videos, Hands on Training
	b. blood glucose regulation and role of hormones, diabetic coma	**1**	
	c. Lipids: Lipid profile estimation	**1**	
	d.hypercholesterolemia, hyperlipoproteinemia, atherosclerosis and it risk factors	**1**	
	e. Proteins: Albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins	**1**	
	f. proteins in CSF and their estimation	**1**	
	g. Hormones: Types, Thyroid hormone and their mechanism of action;	**1**	
	h. . Pituitary hormones and their role in biological systems, Role of insulin in modulating blood glucose level	**2**	
	Clinical Pathology	**9 Hours**	**Mode**
	a. Urine Analysis: Urine composition, volume, appearance, color, collection and preservation.	**1**	Class Room Lecture, PPT and Videos, Lab visit, Hands on Training
	b. Physical and chemical examination of urine Reaction specific gravity, sugar, albumin, bile salts, bile pigment, urea, uric acid, creatinine and ketones	**1**	
	c. Microscopic examinations – deposits – RBC, casts, pus cells crystals, Brief account on U.T.I	**2**	

Unit III	**d.** Faeces: Specimen collection – microscopic examination – ova, cysts occult blood,	**1**	
	e. microbe and parasitic infestation (Examination of faeces ova and cysts of Entamoeba coli, E. histolytica, Giardia lamblia, Enterobiusvermicularis)	**2**	
	f. Sputum: Examination of normal and pathological sputum, Examination of throat swab	**1**	
	f. Semen analysis: microscopic examination, motility, counting, STD: syphilis, gonorrhea.	**1**	
Unit IV	**Clinical Haematology**	**9 Hours**	**Mode**
	a. Blood and its constituents	**1**	Class Room Lecture, PPT and Videos, Lab visit, Hands on Training
	b. Collection of blood: capillary and venous blood collection, various anticoagulants and their uses, Bleeding time, clotting time, blood banking	**2**	
	c. Principles of blood groups and antigen antibody reactions,	**1**	
	d. Total count of RBCs, WBC. Estimation of Haemoglobin – Principles, techniques. Haemoglobin estimation by Sahli‟s method.	**2**	
	e.Erythrocyte Sedimentation Rate (ESR) (Wintrobe and Westergren method),	**1**	
	f. Clinical significance of ESR and PCV	**1**	
	g. Anemia and its types, Leukemia,	**1**	
Unit V	**Histopathology**	**9 Hours**	**Mode**
	a.Introduction to histology and instruments: Microtomes: Types and uses, Knives, Embedding bath, Tissue flotation bath, Automated tissue processor	**1**	Class Room Lecture, PPT and Videos, Lab visit, Hands on Training
	b.Tissue processing for paraffin section and Microscopic observation: Types and Selection of tissues, Responsibility of a technician, Tissue preparation	**2**	
	c.Tissue Processing Steps: Fixation - Aims and function of a fixative , Classification, Dehydration	**2**	
	d. Embedding Media: Paraffin wax, Technique of impregnation : Embedding, Blocking: Type of molds, technique of moulding	**2**	
	e. Decalcification: Decalcifying agents, deparaffinization	**1**	
	f. Staining, Mounting	**1**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOE62	Number of Hours/Cycle		3	
Semester	VI	Max. Marks		100	
Part	III	Credit		3	
Core Elective II					
Course Title	Food Nutrition and Public Health		L	T	P
Cognitive Level		Up to K3	45		

Preamble

Emphasis the importance of food nutrients, antoxidants, nutrigenomics, nutritional deficiency diseases, organ health, food hygiene and community health .

Unit I	Nutritional Biochemistry	9 Hours
	Carbohydrate ,Proteins, Lipids- Definition , Classification and Dietary sources, Fat and water soluble vitamins- Dietary sources and its importance , Micro minerals– Iodine, Flourine , Macro minerals -Calcium, Phosphorus ,Magnesium ,Iron- sources and functions .	
Unit II	**Antioxidants and Nutrigenomics**	**9 Hours**
	Antioxidants- Definition , Need of Antioxidants, Sources of nutrient antioxidants, Antioxidants and Disease ,Principles of nutrigenomics, Basis of nutrigenomics,Interaction between nutrient and gene, Chronic disease and nutritional genomics, Nutraceuticals - Types ,sources,role of Nutraceuticals in human health,Food supplement -SCP.	
Unit III	**Food components and Food nutrients**	**9 Hours**
	Balanced diet ,Nutrient needs and dietary patterns of various groups ,Adults ,Pregnancy ,nursing mothers,Infants ,Children ,Adolescents and Elderly Causes ,Symptoms ,prevention and dietary patterns for Obesity ,Diabetes Hypothyroidism ,Jaundice.	
Unit IV	**Health**	**9 Hours**
	Introduction to health, Fortified foods-importance-Benefits, disadvantages, Macro nutrient deficiency diseases -Kwashiorkar ,Marasmus ,Micro nutrient deficiency disorders -Osteoporosis,Osteomalacia ,Xeropthalmia, Cardiovascular disease,Anaemia, Goitre -Causes ,Symptoms, Treatment and prevention ,Organ Health –Bone health ,Eye health ,Skinhealth.	
Unit V	**Food hygiene and Community health**	**9 Hours**
	Potable water - Sources and Methods of purification, **Communicable disease -Bacterial disease** – Cholera , Typhoid – **Viral disease** - Cold ,Influenza ,**Protozoan disease** --Amoebiasis , Giardiasis ,**Fungal disease**– Ring worm, Cryptococosis **Vector borne diseases**- Malaria,Dengue - Causative agent ,symptoms, transmission and prevention, **Non-Communicable diseases**-Types of NCDS,Causes and risk factors,Symptoms ,Diagnosis,Treatment,Prevention.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Activity based teaching and Internship Programme.

Text Book

1. Srilakshmi B.Food science ;Fourth ED;2007;New age International; P ltd

Reference Books

1 .Gibney et al.Public Health Nutrition;2004;Blackwell publishing
2. Lakra P,Singh MD.Textbook of nutrition and health;First ED;2008;Academic Excellence.
3 .Mudambi,SR and Rajagopal,MV. Fundamentals of foods,Nutrtion and diet therapy;5th ED;New age international publishers
4. Srilakshmi B.Nutrtion Science ;2007; New age International ;P ltd

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- https://www.webmd.com/women/features/pregnant-daily-diet
- https://www.healthline.com/nutrition/foods-with-minerals#3.-Cruciferous-vegetables
- https://www.hsph.harvard.edu/nutritionsource/antioxidants/
- https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease-prevention/art-20046502
- https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases

Course Outcomes

At the end of the course, students would be able to:

CO1	Classify nutrients and list the dietary sources and importance of vitamins and minerals.
CO2	Explain the need and sources of antioxidants ,principles of nutrigenomics and importance of food supplement.
CO3	Discuss about food components ,dietary patterns of various groups and diseases.
CO4	Illustrate the major nutritional deficiency diseases,fortified foods and maintainance of various organ health.
CO5	Outline the causes and preventive measures of communicable and non –communicable diseases.

Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	--	1	---	2	1	2	3	1	---	--	2
CO2	3	--	1	---	2	1	2	3	1	--	---	2
CO3	3	--	1	--	2	1	2	3	1	---	---	2
CO4	3	--	1	---	2	1	2	3	1	--	--	2
CO5	3	--	1	---	2	1	2	3	1	---	---	2

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Either/or Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K2	2	K1	2(K1&K1)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K3	2	K1	2(K2&K2)	K3
4	CO4	Up to K2	2	K1	2(K1&K1)	K2
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	10	16		26	26%	26%
K2		24	30	54	54%	54%
K3	-		20	20	20%	20%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	**Nutritional Biochemistry**	**9 Hours**	**Mode**
	Classification of Carbohydrates and its Dietary sources. Proteins – Classification and Dietary sources.	**2**	Lecture, Group discussion, PPT andVideos
	Lipids– Classification and Dietary sources.	**1**	
	Fat soluble vitamins -- Dietary sources and its importance.	**1**	
	water soluble vitamins-- Dietary sources and its importance	**1**	
	Microminerals– Iodine--Flourine – sourcesand function.	**2**	
	Macro minerals , –Calcium ,Phosphorus ,Magnesium Iron – sources and functions	**2**	
Unit II	**Antioxidants and Nutrigenomics**	**9 Hours**	**Mode**
	Antioxidants -Definition, Need of Antioxidants, Sources of nutrient antioxidants.	**2**	
	Antioxidants and Disease , Principles of nutrigenomics	**2**	Lecture, Group discussion, PPT and Videos
	Basis of nutrigenomics, Interaction between nutrient and gene**.**	**1**	
	Chronic disease and nutritional genomics.	**1**	
	Nutraceuticals-Types and sources, Role of Nutraceuticals in human health.	**2**	
	Foodsupplement**,**SCP Production , importance and Applications ,	**1**	
Unit III	**Food components and Food nutrients**	**9 Hours**	**Mode**
	Balanced diet, Nutrient needs and dietary patterns of Adults.	**1**	Lecture, Group discussion, PPT and Videos
	Nutrient needs and dietary patterns of Pregnancy, nursing mothers. infants and Children	**1**	
	Nutrient needs and dietary patterns of Adolescents and Elderly people.	**1**	
	Obesity -Causes, Symptoms, Prevention and dietary patterns.	**2**	
	Hypothyroidism - Causes, Symptoms, Prevention and dietary patterns.	**2**	
	Jaundice- Causes,Symptoms,Prevention and dietary patterns.	**2**	
Unit IV	**Health**	**9 Hours**	**Mode**
	Introduction to health– Fortified foods-importance,	**2**	

	Benefits, disadvantages.		Lecture, Group discussion, PPT and Videos
	Macro nutrientdeficiency diseases-Kwashiorkar, Marasmus.	**1**	
	Micro nutrient deficiency disorders – Osteoporosis,Osteomalacia, Xeropthalmia, Causes ,Symptoms ,Prevention and Treatment .	**2**	
	Micro nutrient deficiency disorders- Cardiovascular disease – Anaemia, Goitre - Causes, Symptoms, Treatment and Prevention.	**2**	
	Organ Health- Bone health ,Eye health ,Skin & Nail health.	**2**	
Unit V	**Food hygiene and Community health**.	**9 Hours**	**Mode**
	Potable water - Sources and Methods of purification.	**1**	
	Communicable disease- Bacterial disease – Cholera, Typhoid,. Viral disease- Cold, Influenza.	**2**	Lecture, Group Discussion, PPT and Videos
	Viral disease - Cold ,Influenza ,Protozoan disease ,Amoeabiasis and Giardiasis ,Fungal disease–Ring worm, Cryptococosis	**2**	
	Vector borne diseases - Malaria,Dengue- Causative agent ,Symptoms, Transmission and prevention	**2**	
	Non-Communicable diseases-Types of NCDS,Causes and Risk, Symptoms ,Diagnosis,Treatment,Prevention	2	

Course designed by: Dr. A. Jeevalatha

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOE63**	Number of Hours/Cycle		**3**	
Semester	**VI**	Max. Marks		**100**	
Part	**III**	**Credit**		**3**	
Core Elective III					
Course Title	**Insect Diversity**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**45**		

Preamble

This course is designed to familiarize students with the basics of insect morphology, physiology and taxonomy. It is aimed to impart knowledge on the ecology, abundance and their role in ecosystem. It will help to develop strong foundation in entomology by understanding the importance of insects to human society, concern related to disease, insecticide, their use in forensics and in biotechnology.

Unit I	**Insect Morphology, Taxonomy and Physiology**	**9 Hours**
	Insect Morphology, Taxonomy and Physiology External morphology of insect- head, thorax, abdomen, appendages - function. Insect taxonomy – principles of systematics, classification, apterygotes, exopterygotes, endopterygotes. Digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive system and endocrine glands.	
Unit II	**Insect Ecology and Biotechnology**	**9 Hours**
	Population dynamics, factors, dispersal, migration, seasonality, diapause, prey–predator interaction, mimicry, coloration, life history strategies, bees, butterflies - Pollinators, decline, conservation, attracting native pollinators. Genetic engineering in insects, insect vectors, transgenic mosquitoes, rDNA technology in sericulture.	
Unit III	**Agricultural and Forest Entomology**	**9 Hours**
	Pest- biology, damage, life history, control - paddy, sugarcane, cotton, vegetables. Insects and trees - diet, defence, coevolution, outbreak, pest of forest seed, nursery, standing trees and timber.	
Unit IV	**Industrial, Medical and Forensic Entomology**	**9 Hours**
	Sericulture, apiculture, lac culture, insects as human food, predators, diseases, stored product pest. Medically important insects - Diptera, Anoplura, Mallophaga, Hemiptera, biology & ecology of mosquitoes - control. Insects of forensic importance - life cycle.	
Unit V	**Insect Toxicology and Pest Management**	**9 Hours**
	Insect growth regulators, microbial-botanical insecticides, insect resistance, Probit analysis, evaluvation of insect toxicity, pesticide appliance, toxicity to beneficial insects. Biological control, biodiversity of biocontrol agents, parasitoids, predators and advances in IPM.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Insect observation and collection.

Text Book

David BV and N Ramamurthy (2016) Elements of Economic Entomology, 8th Edition, Brillion Publishing.

Reference Books

1. Chapman (1998) The Insects Structure and Function, 4th Edition Cambridge University Press London.

2. David BV and Kumarasamy T (1982) Elements of Economic Entomology, Popular Book Depot Chennai.

3. Fennermore PG and Alkaprakash (1992) Applied Entomology, Wiley Eastern Ltd New Delhi.

4. Kunte K (2000) Butterflies of Peninsular India, University Press, Hyderabad.

5. Richards OW and Davies RG (2013) Imms General Textbook of Entomology Vol. 1 & 2, 10th Edition, Springer Science & Business media.

6. Srivastava KP and Dhaliwal N (2015) Textbook of Applied Entomology, Kalyani Publications New Delhi.

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- https://extension.oregonstate.edu/sites/default/files/documents/9591/external-morphology.pdfhttps://www.researchgate.net/publication/317313069_
- https://onlinelibrary.wiley.com/doi/10.1002/9781118945568.ch2#:~:text=Insects%20create%20the%20biological%20foundation,food%20source%20for%20other%20taxa.
- https://www.researchgate.net/publication/324481404_The_Importance_of_Insects_in_Agricultural_Ecosystems
- https://www.researchgate.net/publication/340862422_Role_of_biotechnology_in_insect-pests_management
- https://pubmed.ncbi.nlm.nih.gov/19284791/
- https://www.youtube.com/watch?v=to70pg38vAM

Course Outcomes

After completion of this course, the students will be able to:

CO1	Outline the morphology and physiology of insects
CO2	Identify the role of insects in an ecosystem
CO3	Analyze the importance of agricultural and forest pests
CO4	Examine and apply the procedures following in industrial entomology
CO5	Evaluate the role of pesticides, regulators, parasitoids in pest management

Mapping of Course Outcomes (COs) withProgramme Specific Outcomes

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	1	3	2	3	3	2	-	1	-	2	3
CO2	3	1	3	2	3	3	2	-	1	-	2	3
CO3	3	1	3	2	3	3	2	-	1	-	2	3
CO4	3	1	2	2	3	2	2	-	1	-	1	3
C05	3	1	3	2	3	3	2	-	1	-	2	3

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Question	
1	CO1	Up to K2	2	K1	2(K2&K2)	K2
2	CO2	Up to K2	2	K1	2(K2&K2)	K2
3	CO3	Up to K2	2	K1	2(K2&K2)	K2
4	CO4	Up to K3	2	K1	2(K2&K2)	K3
5	CO5	Up to K3	2	K1	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	10	-	-	10	10	10
K2	-	40	30	80	80	80
K3	-	-	20	10	10	10
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Insect Morphology, Taxonomy and Physiology**	**9 Hours**	**Mode**
	a.External morphology of insect- head, thorax, abdomen, appendages - function.	**2**	Class room lecture, Group discussion, PPT, Videos and Field visit
	b.Insect taxonomy – principles of systematics, classification, apterygotes, exopterygotes, endopterygotes.	**2**	
	c. Digestive system and circulatory system	**1**	
	d.Respiratory system and excretory system	**1**	
	e.Nervous system and sensory organs	**1**	
	f. Reproductive system and endocrine glands.	**2**	
Unit II	**Insect Ecology and Biotechnology**	**9 Hours**	**Mode**
	a.Population dynamics, factors, dispersal, migration, seasonality, diapause	**2**	Class room lecture, Group discussion, PPT, Videos and Field visit
	b.Prey–predator interaction, mimicry, coloration, life history strategies,	**1**	
	c.Bees, butterflies - Pollinators, decline, conservation, attracting native pollinators.	**2**	
	d.Genetic engineering in insects, insect vectors, transgenic mosquitoes	**1**	
	e.rDNA technology in sericulture.	**1**	
Unit III	**Agricultural and Forest Entomology**	**9Hours**	**Mode**
	a. Pest- biology, damage	**2**	Class room lecture, Group discussion, PPT, Videos and Field visit
	b. Life history, control - paddy, sugarcane, cotton, vegetables.	**3**	
	c. Insects and trees - diet, defence, coevolution, outbreak	**2**	
	d. Pest of forest seed, nursery, standing trees and timber	**2**	
Unit IV	**Industrial, Medical and Forensic Entomology**	**9 Hours**	**Mode**
	a.Sericulture, apiculture, lac culture	**3**	Class room lecture, Group discussion, PPT, Videos and Field visit
	b. Insects as human food	**1**	
	c. Predators, diseases, stored product pest	**1**	
	d.Medically important insects - Diptera, Anoplura, Mallophaga, Hemiptera	**2**	
	e. Biology &ecology of mosquitoes - control	**1**	
	f. Insects of forensic importance - life cycle.	**1**	
Unit V	**Insect Toxicology and Pest Management**	**9 Hours**	**Mode**
	a.Insect growth regulators, microbial-botanical insecticides	**2**	Class room lecture, Group discussion, PPT, Videos and Field visit
	b.Insect resistance, Probit analysis,evaluvation of insect toxicity	**2**	
	c.Pesticide appliance, toxicity to beneficial insects	**2**	
	d.Biological control, biodiversity of biocontrol agents,	**1**	
	e. Parasitoids, predators and advances in IPM.	**1**	

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20UZOS61	Number of Hours/Cycle		2	
Semester	VI	Max. Marks		50	
Part	IV	Credit		2	
Skill Based Course III					
Course Title	Intellectual Property Rights		L	T	P
Cognitive Level		Up to K3	30		

Preamble

Enhance the knowledge of intellectual property right (IPR), its genesis, steps involved in filling and publication of patent, trademark and copyright rules.

Unit I	Introduction to Intellectual Property Right (IPR)	6 Hours
	IPR and Copyright Act and its importance. IPR in India and world, IPR – objectives and Rights. Genesis and scope, some important examples, IPR and WTO (TRIPS, WIPO)	
Unit II	Patents	6 Hours
	Protocol of obtaining patents, Industrial Application – Non –Patentable Subject Matter – Registration Procedure, Rights and Duties of patentee, Licence: infringement of patents.	
Unit III	Copyrights and Trademarks	6 Hours
	Type of work protected under copyright laws, Rights, Transfer of Copyright, Infringement and penalties. Objectives, Rights of holder.	
Unit IV	Protection of Traditional knowledge	6 Hours
	Objective, Concept of Traditional Knowledge, Holders, Traditional knowledge on the International Arena, at WTO at National level, International enforcement of intellectual property rights. Bioprospecting and Bio – piracy	
Unit V	Biotechnology and Intellectual Property Rights	6 Hours
	Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Moral Issues in Patenting Biotechnological inventions.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Case study, Field visit, Activity based teaching.

Text Books

1. N.Gurumani (2017) Research Methodology for Biological Sciences, WWW. Mjppublishers.com,Chennai.
2. R.C.Dubey (2006), A Text Book of Biotechnology, S. Chand & Company Ltd, New Delhi.

Reference Books

1. N.S. Gopalakrishnan & T.G. Agitha, (2009) Principles of Intellectual Property Eastern Book Company, Lucknow.
2. Kerly's Law of Trade Marks and Trade Names (14th Edition) Thomson, Sweet & Maxwell.
3. Ajit Parulekar and Sarita D Souza, (2006) Indian Patents Law - Legal & Business Implications: Macmillan India Ltd.
4. B.L.Wadehra (2000) Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal Law Publishing Pvt. Ltd., India.
5. P. Narayanan (2010) Law of Copyright and Industrial Designs; Eastern law House, Delhi.

E-Resources

https://www.itu.int/en/ITU-T/ipr/Pages/default.aspx
https://copyright.gov.in/Documents/CopyrightRules1957.pdf
https://www.thestreet.com/how-to/how-to-patent-an-idea-14564100
https://blog.ipleaders.in/protection-traditional-knowledge-ipr-india-need-sui-generis-legislation/
https://www.obhanandassociates.com/blog/patenting-in-biotechnology-the-indian-scenario/

Course Outcomes

After completion of this course, the students will be able to:

CO1	Understand the concept of IPR
CO2	Explain the importance of patents and their filling procedures
CO3	Compare the characteristic features of Copyrights and Trademarks
CO4	Describe various protection acts for several geographical indications and its uses
CO5	Explain IPR application for various biotechnology inventions

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	1	-	-	3	2	1	-	2	2	3	2	1
CO2	1	-	-	3	2	1	-	2	2	3	2	1
CO3	1	-	-	3	2	1	-	2	2	3	2	1
CO4	1	-	-	3	2	1	-	2	2	3	2	1
C05	1	-	-	3	2	1	-	2	2	3	2	1

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**	**Section B**
			Either/ or Choice	**Open Choice**
			No. Of Question	
1	CO1	Up to K2	2(K1&K1)	K2
2	CO2	Up to K3	2(K1&K1)	K3
3	CO3	Up to K2	2(K2&K2)	K2
4	CO4	Up to K2	2(K2&K2)	K2
5	CO5	Up to K3	2(K3&K3)	K3
No of Questions to be asked			10	05
No of Questions to be answered			05	03
Marks for each Question			03	05
Total marks for each Section			15	15

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (Either/or)	Section B (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	12	-	12	21.8 %	22 %
K2	12	15	27	49 %	49 %
K3	06	10	16	29 %	29 %
Total Marks	30	25	55	100 %	100%

Lesson Plan

Unit I	**Introduction to Intellectual Property Right (IPR)**	**12 Hours**	**Mode**
	1.IPR and Copyright Act and its importance	**1**	Lecture, PPT and Videos
	2.IPR in India and world	**1**	
	3.IPR – objectives and Rights	**1**	
	4**.** Genesis and scope, some important examples, IPR and WTO (TRIPS, WIPO)	**3**	
Unit II	**Patents**	**12 Hours**	**Mode**
	1.Protocol of obtaining patents	**1**	Lecture, PPT and Videos
	2.Industrial Application – Non – Patentable Subject Matter	**1**	
	3.Registration Procedure	**1**	
	4.Rights and Duties of patentee	**1**	
	5**.** Licence: infringement of patents	**2**	
Unit III	**Copyrights and Trademarks**	**12 Hours**	**Mode**
	1.Type of work protected under copyright laws, Rights.	**2**	Lecture, PPT and Videos
	2.Transfer of Copyright, Infringement and penalties.	**3**	
	3.Objectives, Rights of holder	**1**	
Unit IV	**Protection of Traditional knowledge**	**12 Hours**	**Mode**
	1.Objective, Concept of Traditional Knowledge, Holders	**2**	Lecture, PPT, and Videos
	2.Traditional knowledge on the International Arena at WTO at National level, International enforcement of intellectual property rights.	**2**	
	3.Bioprospecting and Bio – piracy	**2**	
Unit V	**Biotechnology and Intellectual Property Rights**	**12 Hours**	**Mode**
	1.Patenting Biotech Inventions: Objective, Applications	**2**	Lecture, PPT, and Videos
	2.Concept of Novelty, Concept of inventive step	**2**	
	3.Moral Issues in Patenting Biotechnological inventions	**2**	

Course designed by: Dr. K. Krishnaveni

Programme	**B.Sc., Zoology**	**Programme Code**		**UZO**	
Course Code	**20UZOS62**	Number of Hours/Cycle		**2**	
Semester	**VI**	Max. Marks		**50**	
Part	**IV**	**Credit**		**2**	
Skill Based Course IV					
Course Title	**Basic Bioinformatics**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**30**		

Preamble:

Enable about the bioinformatics databases, databanks, data format and data retrieval from the online sources and to understand the essential features of the interdisciplinary field of science for better understanding biological data.

UNIT I	**Introduction**	**6 Hours**
	Bioinformatics – Definition, aim, scope, branches and applications. Biological databases – features and layout – sequence databases, structure databases, specialized databases, genome databases, literature database, mapping database, model organism databases – database search and retrieval tools – Entrez, SRS and other tools	
UNIT II	**Sequence Alignment**	**6 Hours**
	Need and importance – pairwise alignment – dot plot, dynamic programming – global (NeedlemanWunsch) and local (Smith - Waterman) alignment algorithms – scoring matrices – gap penalties – substitution matrices – need, types – PAM and BLOSUM – pairwise alignment tools – BLAST. Multiple alignment – Clustal – NJ plot – phylogenetic trees – types and methods of construction, Phylogenetic softwares	
UNIT III	**Sequence Aanlysis**	**6 Hours**
	Bioinformatic tools to analyze nucleotide sequences – Detecting ORFs, finding genes, constructing restriction maps, designing primers and probes, calculating TM, prediction of secondary structure of RNA. Bioinformatic tools to analyze protein sequences – finding protein parameters – tools for peptide cleavage and mapping – prediction of secondary structure of proteins.	
UNIT IV	**Genomics and Proteomics**	**6 Hours**
	Genomics – structural, functional and comparative genomics – DNA microarrays – Present status and future prospects. Proteomics – traditional proteomics vs modern proteomics – 2-D gel electrophoresis, mass spectroscopy, MALDI-TOF and other methods of analysis Protein microarrays – present status and future prospects	
UNIT V	**Phylogenetic Methods and Applications**	**6 Hours**
	Concept of evolutionary trees – Dendrograms – Methods for construction, Maximum Parsimony – Distance methods – NJ, UPGMA, –Character based method – Maximum Parsimony – Maximum likelihood method (qualitative concepts only) – Phylogenetic Tools – ClustalW, PHYLIP, PAUP, MEGA4 (Introduction only). Bioinformatics Applications – Agricultural – Pharmaceutical – Drug design and Medical – SNP.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Activity based teaching, Field Study

Text Books

1. Srinivasa Rao D, Bioinformatics, Sci Tech Publishers, No. 7/3c, Madley Road, T. Nagar, Chennai 600 017.www.scitechpublications.com.

2. Ignacimuthu S (2005). Bioinformatics, Alpha Science International.

Reference Books

1. David W Mount (2004) Bioinformatics: Sequence and Genome analysis, 2nd Edition, CBS Publishers, New Delhi.

2. Attwood T.K., D J Parry Smith, Samiron Phukan (2007) Introduction to Bioinformatics, Pearson Education, UK.

3. Michael Gromiha M (2010) Protein Bioinformatics - From Sequence to Function, Elsevier India Pvt. Ltd, New Delhi.

e-Resources

- www.Bioinformatics.org/
- www.bioinfo.mbb.yale.edu/mbb452a/intro/
- www.biology.ucsd.edu/others/dsmith/Bioinformatics.html

Course Outcomes

At the end of the course, students would be able to:

CO1	Explain the genome sequencing projects, protein folding analysis, NCBI and about Indian Bioinformatics projects
CO2	Describe the aminoacid bonding, protein sequencing and data base searching techniques
CO3	Illustrate various forms of DNA, types of RNA structure, gene hunting and cDNA libraries
CO4	Explain the programs needed for pairwise, multiple sequence aligments and data base searching
CO5	Describe about various phylogenetic methods and their bioinformatics applications

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	2	3	1	0	2	1	2	1	1	0	1	1
CO2	2	3	1	1	2	1	2	0	0	1	0	1
CO3	3	2	1	1	2	1	2	1	0	1	1	1
CO4	3	2	1	0	2	1	2	0	1	0	1	1
CO5	2	3	1	1	2	1	2	0	0	0	0	1

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A	Section B
			Either/or Choice	Open Choice
			No. Of Questions	No. Of Questions
1	CO1	Up to K2	K1,K1	K2
2	CO2	Up to K2	K1,K1	K2
3	CO3	Up to K2	K2,K2	K2
4	CO4	Up to K3	K2,K2	K3
5	CO5	Up to K3	K2,K2	K3
No of Questions to be asked			10	05

No of Questions to be answered	05	03
Marks for each Question	03	05
Total Marks for each Section	15	15

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (Either/or)**	**Section B (Either/or)**	**Total Marks**	**% of Marks without choice**
K1	12	-	12	20%
K2	18	10	28	46.6%
K3	-	20	20	33.4%
Total Marks	30	30	60	100%

Lesson Plan

Basic Bioinformatics				
Unit	**S. No.**	**Topics**	**Hours**	**Teaching mode**
I		**Introduction**		Chalk & Talk, PPT & Animation Videos
	I	Bioinformatics – Definition, aim, scope, branches and applications.	1	
	Ii	Biological databases – features and layout – sequence databases,	1	
	Iii	structure databases, specialized databases, genome databases	2	
	Iv	literature database, mapping database, model organism databases –	1	
	V	database search and retrieval tools – Entrez, SRS and other tools	1	
		Total Hours	**6**	
II		**Sequence Alignment**		Class Lecture, PPT Presentation, Animation Videos
	I	Need and importance – pairwise alignment – dot plot, dynamic programming	1	
	Ii	Global (NeedlemanWunsch) and local (Smith - Waterman) alignment algorithms – scoring matrices	1	
	Iii	Gap penalties – substitution matrices – need, types – PAM and BLOSUM – pairwise alignment tools – BLAST.	2	
	Iv	Multiple alignment – Clustal – NJ plot – phylogenetic trees – types and methods of construction	1	
	V	Phylogenetic softwares	1	
		Total Hours	**6**	
III		**Sequence Analysis**		Class Lecture, PPT Presentation, Animation Videos
	I	Bioinformatic tools to analyze nucleotide sequences – Detecting ORFs, finding genes,	2	
	ii	Constructing restriction maps, designing primers and probes, calculating TM, prediction of secondary structure of RNA.	2	
	iii	Bioinformatic tools to analyze protein sequences – finding protein parameters	1	
		Tools for peptide cleavage and mapping – prediction of secondary structure of proteins.	1	

		Total Hours	**6**	
IV		**Genomics and Proteomics**		Chalk & Talk, PPT & Animation Videos
	i	Genomics – structural, functional and comparative genomics	1	
	ii	DNA microarrays – Present status and future prospects.	1	
	iii	Proteomics – traditional proteomics vs modern proteomics	1	
	iv	2-D gel electrophoresis, mass spectroscopy, MALDI-TOF and other methods of analysis	2	
	v	Protein microarrays – present status and future prospects	1	
		Total Hours	**6**	
V		**Phylogenetic Methods and Applications**		Class Lecture, PPT Presentation, Animation Videos
	i	Concept of evolutionary trees – Dendrograms – Methods for construction, Maximum Parsimony	1	
	ii	Distance methods – NJ, UPGMA, – Character based method – Maximum Parsimony – Maximum likelihood method (qualitative concepts only) –	1	
	iii	Phylogenetic Tools – ClustalW, PHYLIP, PAUP, MEGA4	1	
	iv	Bioinformatics Applications – Agricultural – Pharmaceutical –	2	
	v	Drug design and Medical – SNP.	1	
		Total Hours	**6**	

Course designed by: Dr. S. Dharaneedharan

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20CZOO51	Number of Hours/Cycle		2	
Semester	V	Max. Marks		50	
Part	IV	Credit		2	
Value Added Course III					
Course Title	Vermitechnology		L	T	P
Cognitive Level		Up to K3	30		

Preamble

This course is meant for the students work in preparing biocompost, vermicomposting and vermi-culturing to develop acquire skill for Entrepreneurship opportunity.

Unit I	Morphology and Anatomy of Earth worm	6 Hours
	Earthworm taxonomy & classification – Endemic and Exotic Species of earth worms – Morphological and Anatomical – Food habits – Digestive system – Excretion – Reproduction and Life cycle.	
Unit II	**Physical and chemical composition of Vermicompost**	**6 Hours**
	Physical property of soil – Major types of soil (red soil, black soil, alluvial soil) – Soil Profile - Soil temperature – Soil moisture – Chemical properties of soil pH – Nitrogen – Phosphate and potash – Microorganisms and their relationship with earthworm.	
Unit III	**Material and Methods**	**6 Hours**
	Vermicomposting materials – Requirements –Different methods of Vermicomposting (small scale & large scale factories) -Pot method and Tray method - Vermi wash production techniques.	
Unit IV	**Applied Vermiculture**	**6 Hours**
	Role of earthworms in soil fertility – Socio-economic constraints in organic farming – recycling of food wastes in vermitechnology – Earthworm in Bio-reclamation of soil – Uses of medical values in food – ayurvedic & unani.	
Unit V	**Management of Vermicompost**	**6 Hours**
	Harvesting and vermicomposting – Earthworm as animal feed – Earthworm as bioreactors or Bioreclamation of soil – Vermicomposting as a tool for soil waste management – Marketing of Vermicomposting products and financial support by governments and NGOs for vermiculture.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Activity based teaching

Text Book

3. M. Seetha Lekshmy, R.Santhi (20) Vermitechnology, Saras Publiation, Kottar, Nagesrcoil.

Reference Books

1. Edwards, C.A & P.J Bohlen, 1996. Biology and ecology of earthworms III Edn. Chapman & Hall N.Y.U.S.A.
2. Edwards, C.A & J.R Lofty Vermicoloogy – The Biology of earthworm, 1997 Chapman & Hall Publications N.Y.U.S.A.
3. Lee, K.E. 1985. Earthworms their ecology and relationships 4.Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.

E-Resources

- **https://www.krishisewa.com/articles/soil-fertility/305-vermicompost-production-**
- **https://www.intechopen.com/chapters/18484**
- **https://www.brinkart.com/article/Vermitechnology_39993**

Course Outcomes

At the end of the course, students would be able to:

CO1	Explain in detail about Earthworms classification, anatomical and morphological structure
CO2	Classify the different form of soil, microorganisms and their relationship with Earthworm
CO3	Develop the knowledge of vermicomposting materials
CO4	Identify the role of vermiculture in maintaining the health of soil
CO5	Illustrate the vermiculture is protecting the environment and managing the wastes

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO 10**	**PSO 11**	**PSO 12**
CO 1	1	3	3	3	2	1	0	3	1	0	1	2
CO 2	1	1	2	2	2	1	0	3	1	2	1	2
CO 3	0	0	0	3	2	1	0	3	1	3	1	3
CO 4	0	0	1	3	2	1	3	3	1	3	2	3
CO 5	0	0	1	3	2	1	0	3	1	2	1	3

1 – Low 2 – Moderate 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**	**Section B**
			Either/or Choice	**Open Choice**
			No. Of Questions	**No. Of Questions**
1	CO1	Up to K2	2(K1&K1)	K2
2	CO2	Up to K2	2(K1&K1)	K2
3	CO3	Up to K3	2(K2&K2)	K3
4	CO4	Up to K3	2(K2&K2)	K3
5	CO5	Up to K2	2(K2&K2)	K2
No of Questions to be asked			10	05
No of Questions to be answered			05	03
Marks for each Question			03	05
Total marks for each section			15	15

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	**Section A**	**Section B**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	12	-	12	12%	22%
K2	18	15	33	33%	51%
K3	-	10	10	10%	27%
Total Marks	30	25	55	55	100%

Lesson Plan

Unit I	**Morphology and Anatomy of Earth worm**	**6 Hours**	**Mode**
	a. Earthworm taxonomy & classification – Endemic and Exotic Species of earth worms	**1**	Class room lecture, PPT, Videos and Group Discussion
	b. Morphological and Anatomical	**1**	
	c. Food habits – Digestive system	**1**	
	d. Excretion	**1**	
	e. Reproduction and Life cycle.	**2**	
Unit II	**Physical and chemical composition of Vermicompost**	**6 Hours**	**Mode**
	a. Physical property of soil – Major types of soil (red soil, black soil, alluvial soil)	**2**	Class room lecture, PPT, Videos and Group Discussion
	b. Soil Profile - Soil temperature – Soil moisture – Chemical properties of soil pH	**2**	
	c. Nitrogen–Phosphate and potash – Microorganisms and their relationship with earthworm.	**2**	
Unit III	**Material and Methods**	**6 Hours**	**Mode**
	a.Vermicomposting materials – Requirements	**2**	Class room lecture, PPT, Videos and Group Discussion
	b. Different methods of Vermicomposting (small scale & large scale factories)	**2**	
	d. Pot method and Tray method - Vermi wash production techniques.	**2**	
Unit IV	**Applied Vermiculture**	**6 Hours**	**Mode**
	a. Role of earthworms in soil fertility	**2**	Class room lecture, PPT, Videos and Group Discussion
	b. Socio-economic constraints in organic farming – recycling of food wastes in vermitechnology	**2**	
	c. Earthworm in Bio-reclamation of soil	**1**	
	d. Uses of medical values in food – ayurvedic & unani	**1**	
Unit V	**Management of Vermicompost**	**6 Hours**	**Mode**
	Harvesting and vermicomposting – Earthworm as animal feed	**1**	Class room lecture, PPT, Videos and Group Discussion
	Earthworm as bioreactors or Bioreclamation of soil	**1**	
	.Vermicomposting as a tool for soil waste management	**2**	
	Marketing of Vermicomposting products and financial support by governments and NGOs for vermiculture.	**2**	

Course designed by: B. Subasri

Programme	B.Sc., Zoology	Programme Code		UZO	
Course Code	20CZOO61	Number of Hours/Cycle		2	
Semester	VI	Max. Marks		50	
Part	IV	Credit		2	
Value Added Course IV					
Course Title	Bee Keeping		L	T	P
Cognitive Level		Up to K3	30		

Preamble

To enable the students to be familiarized with morphology, life cycle and colony organization of honey bees, bee keeping techniques, bee enemies and diseases, apiary management and to motivate them to become entrepreneur

Unit I	**Introduction to Apiculture**	**6 Hours**
	History of Bees and Beekeeping, Scope of Apiculture, Honey bee species, Bee morphology, anatomical features, Life cycle, Colony life and social organization – Queen, drone, worker	
Unit II	**Beekeeping techniques**	**6 Hours**
	Purchase of a colony, how to manage a colony, Establishment of a colony, Queen rearing, Bee flora and planned pollination services. Bee keeping Equipments : Primitive beekeeping, Modern hives - Langstroth hive and Newton's hive, Manipulations of honey production	
Unit III	**Bee Products and Marketing**	**6 Hours**
	Products of Apiculture: Bee products: Honey, Bees wax, Pollens, Royal Jelly, Propolis and Bee venom, Nutritional and medicinal values of honey - Extraction of honey, Preservation and storage of honey, Harvesting and marketing of bee products	
Unit IV	**Bee Enemies and Bee diseases**	**6 Hours**
	Bee Enemies: Predatory wasps, Wax moths, Ecoparasitic mites, Wax beetles and black ants **Bee diseases:** Brood diseases, Fungal brood disease, Relationship between plants and Bees.	
Unit V	**Apiary management**	**6 Hours**
	Principles of bee management, Spring management, Summer management, Monsoon management, Winter management, migratory bee keeping Important Institutions pertinent to Apiculture: National Bee Board, Role of Central Honey Bee Research & Training Institute, Apiaries. Economics and extension of Bee keeping.	

Pedagogy

Chalk and Talk, Class Room Lectures, Seminar, Power point presentation, Quiz, Assignments, Group Discussion, Field visit, and Activity based teaching.

Text Books

1. Jayashree, K.V. Tharadevi, C.S & Arumugam, N. (2014). Apiculture, Saras Publication, Nagercoil,
2. Nagaraja N & Rajagopal D. (2009). Honey Bees- Diseases, Parasites, Pests, Predators & their management, MJP Publishers, Chennai.

Reference Books

1. Abrol, D. P. (2010) AComprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.
2. Withhead, S. B.(2010) Honeybees and their management Axis books Publisher, Jodhpur.
3. Nagaraja, N. and Rajagopal , D.(2013)Honeybees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.
4. Dharamsingand Singh,D. P. A Handbook ofBeekeeping, AgrobiosIndia(Publisher), Jodhpur.

E-Resources

- **http://ecoursesonline.iasri.res.in/course/view.php?id=613**
- **https://www.britannica.com/animal/honeybee**
- **https://www.bbau.ac.in/dept/dz/TM/lecture%20summary%20ZL-OE-02%20APICULTURE-classification%20&%20biology%20of%20honey%20bees.pdf**
- **https://agritech.tnau.ac.in/farm_enterprises/fe_api_careandmanagement.html**
- **https://vikaspedia.in/agriculture/farm-based-enterprises/bee-keeping-1/diseases-of-honeybee**
- **https://wandofknowledge.com/methods-of-bee-keeping/**

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain about history, morphology, life cycle and colony organization of honey bees
CO2	Elaborate bee keeping as an occupation
CO3	Illustrate bee keeping techniques
CO4	Examine bee products and bee enemies
CO5	Apply the knowledge in Apiary management

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A	Section B
			Either/or Choice	Open Choice
1	CO1	Up to K2	2(K1&K1)	K2
2	CO2	Up to K2	2(K1&K1)	K2
3	CO3	Up to K3	2(K2&K2)	K3
4	CO4	Up to K3	2(K2&K2)	K3
5	CO5	Up to K3	2(K2&K2)	K3
No of Questions to be asked			10	05
No of Questions to be answered			05	03
Marks for each Question			03	05
Total Marks for each Section			15	15

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (Either/or)	Section B (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	12	-	12	21.8%	22%
K2	18	10	28	50.9%	51%
K3	-	15	15	27.2%	27%
Total Marks	30	25	55	100%	100%

Course designed by: Dr. N. Renuga Devi

Programme	B.Sc Zoology	Programme Code	UZO		
Course Code	20UZOP51	Number of Hours/Cycle	-		
Semester	V	Max. Marks	100		
Part	III	Credit	2		
Project					
Course Title	Project		L	T	P
Cognitive Level	Up to K5		-	-	-

L-Lecture Hours, T-Tutorial Hours, P-Practical Hours

Preamble

The research project aims to help students to develop research aptitude and skills for solving research problems. This will help them to learn appropriate research methodologies, develop new ideas, interpret and understand research concepts. The course is intended to instill scientific temper and to take up careers in research.

Course Outcomes

Upon successful completion of this project work, students will be able to:

CO1	Identify problem and frame appropriate research methodology
CO2	Formulate hypothesis, design and conduct experiments
CO3	Analyze data using statistical tools and interpret the results findings
CO4	Demonstrate capacity to carry out independent research
CO5	Create new applications using research findings and prepare proposals

Project work:

- Each faculty will be alloted a group of **(3-5)** students for their research project in any one of the areas of Zoology in consultation with their guide and the Head of the Department.
- The topic/area of work will be finalized at the end of IV semester, allowing scope for the students to gather relevant literature during the vacation.
- The project report should be submitted to the Head of the Department of Zoology through the Guide one week prior to the commencement of the summative examination.
- They should submit **three** copies of their project report for valuation.
- The choice of the topic for the project can be from a wide range of subjects, but a text or topic prescribed for study should be strictly avoided.

Area of work:

Biodiversity, Aquaculture, Ethnomedicobiology, Environmental Biotechnology, Medical Microbiology, Molecular Genetics.

Each project should contain the following details:

- Brief introduction on the topic
- Materials and Methods
- Results and Discussions
- Conclusion / Summary
- Bibliography
- The project should be at least 25 pages excluding bibliography and appendices.
- There shall be single **internal valuation only**.
- The maximum marks for the project work shall be 100

InternalAssessment:100 Marks

Mode of Evaluation	**Marks**
Project Report	**60**
Presentation and Viva Voce	**40**

- Further for a pass in this course as a whole, a group should secure at least 40 marks in project report and viva-voce put together.