KALAIGNAR KARUNANIDHI

GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS)

(Reaccredited with B^{++} by NAAC)

PUDUKKOTTAI -622 001

DEPARTMENT OF ZOOLOGY

SYLLABUS – PG

(2021 – 2022 Onwards)

KALAIGNAR KARUNANIDHI

GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS),

PUDUKKOTTAI -622 001

DEPARTMENT OF ZOOLOGY –BOARD OF STUDIES

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DEPARTMENT OF ZOOLOGY - BOARD OF STUDIES

Meeting on 27.05.2022

Members of the Board

CHAIR PERSON

Dr.A.NAGASATHYA,M.Sc.,M.Phil.,Ph.D.,
Assistant Professor& HOD of Zoology

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Assistant Professor of Zoology.

2.Dr. SP. Jeyapriya, M.Sc.,M.Phil.,M.Ed,Ph.D
Assistant Professor of Zoology.

3.Dr. G.Sankar M.Sc.,Ph.D.,
Associate Professor of Zoology.

EXPERT NOMINATED BY VICE CHANCELLOR

Dr.R.Thirumurugan,
Associate Professor
Department of Animal Science
Bharathidasan University
Thiruchirapalli– 24

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KALAIGNAR KARUNANIDHI

GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS), PUDUKKOTTAI

M.Sc. Zoology- Course Structure under CBCS - Distribution of Hours, Marks and Credits for M.Sc Zoology

Semester	Course	Subject code	Course Title	Ins. Hrs / Week	Credit
I	Core Course – I (CC)	21PZO01	Animal Physiology	6	5
	Core Course – II (CC)	21PZO02	Biochemistry and Biophysics	6	5
	Core Course – III (CC)	21PZO03	Developmental biology &Evolution	6	5
	Core Course – IV (CC IV P)	21PZO04P	Practical I – (CC I, II, III)	6	4
	Elective – I	21PZOE1	General Entomology	6	4
			Tot	**30**	**23**
II	Core Course – V (CC)	21PZO05	Biology of the Cell	6	5
	Core Course – VI (CC)	21PZO06	Genetics and Molecular Biology	6	5
	Core Course – VII (CC)	21PZO07	Tools and techniques for Biology	6	5
	Core Course – VIII (CC V P)	21PZO08P	Practical II – (CC V, VI,VII)	6	4
	Elective – II	21PZOE2	Biotechnology	6	4
			Total	**30**	**23**
	Self study course -I				
III	Core Course – IX (CC)	21PZO09	Microbiology	6	5
	Core Course – X (CC)	21PZO10	Biostatistics and Bioinformatics	6	5
	Core Course – XI (CC XI)	21PZO11	Environmental Biology and Toxicology	6	5
	Core Course – XII (CC XIIP)	21PZO12P	Practical III – (CC IX, X)	6	4
	Elective – III	21PZOE3	Immunology	6	4
				30	**23**
	Self study course –II				
	Core Course – XIII (CC)	21PZO13	Aquaculture	5	5
	Core Course – XIV	21PZO14P	Practical IV- (CC XI, XIII)	5	4
	Elective – IV	21PZOE4	Health and Hygiene	6	4
	Elective – V	21PZOE5	Poultry Science	4	4
	Project Work	21PZO15PR	Project	10	4
			Total	**30**	**21**
			Total	**120**	**90**

Courses offered by the Department

S.N0	Subject code	Course Title	Ins. Hrs / Week	Credit
		CORE COURSES		
1	21PZO01	Animal Physiology	6	5
2	21PZO02	Biochemistry and Biophysics	6	5
3	21PZO03	Developmental biology &Evolution	6	5
4	21PZO04P	Practical I – (CC I, II, III)	6	4
5	21PZO05	Biology of the Cell	6	5
6	21PZO06	Genetics and Molecular Biology	6	5
7	21PZO07	Tools and techniques for Biology	6	5
8	21PZO08P	Practical II – (CC V, VI,VII)	6	4
9	21PZO09	Microbiology	6	5
10	21PZO10	Biostatistics and Bioinformatics	6	5
11	21PZO11	Environmental Biology and Toxicology	6	5
12	21PZO12P	Practical III – (CC IX, X)	6	4
13	21PZO13	Aquaculture	5	5
14	21PZO14P	Practical IV- (CC XII, XIII)	5	4
15	21PZO15PR	Project	10	4
16	21PZO16	Nutrition and Dietetics	6	5
17	21PZO17	Animal Behaviour and Neurophysiology	6	5
		ELECTIVE COURSES		
18	21PZOE1	General Entomology	6	4
19	21PZOE2	Biotechnology	6	4
20	21PZOE3	Immunology	6	4
21	21PZOE4	Health and Hygiene	6	4
22	21PZOE5	Poultry Science	4	4
23	21PZOE6	Nanotechnology	6	4
24	21PZOE7	Genomics and Proteomics	6	4
		SELF STUDY PAPERS		
25	21PZOSS1	Vermitechnology		
25	21PZOSS2	Endocrinology		

M.Sc., ZOOLOGY - Question Paper Pattern

PART	TYPE	Qn.NO	UNIT	Marks for each Qn	Total Marks
A	Answer all the Questions	1 &2	I	2	20
		3&4	II		
		5 &6	III		
		7 &8	IV		
		9&10	V		
B	Internal choice – Answer all the Questions	11a/11b	I	5	25
		12a/12b	II		
		13a/13b	III		
		14a/14b	IV		
		15a/15b	V		
C	Answer any three Questions	16	I	10	30
		17	II		
		18	III		
		19	IV		
		20	V		
	External Marks CIA				75 25
	Max. Marks				**100**

Continuous Internal Assessment Pattern – PG

THEORY

Exam	Max.Marks	Converted to
MidSem	40	5
End Sem	40	5
Model	75	10
Seminar	5	5
	Total	**25**

PRACTICAL

External

Practical : 60

Record : 10

Viva -voce : 05

Total : 75

Internal:

Model Exam : 15

Performance in the class : 05

Viva -voce : 05

Total : 25

Programme Outcomes (PG Science)

Upon completion of M.Sc degree programme, postgraduates will be able to

PO1 : Relate advanced and contemporary concepts, principles, theories and advancements in relevant fields.

PO2 : Execute critical investigation through various approaches, methods and evaluation strategies.

PO3 : Utilize software tools and techniques to cope up with latest trends in technological development.

PO4 : Evaluate the results of scientific work effectively, comprehend reports, design documentation and make effectual presentations.

PO5 : Formulate professional, ethical and social values to excel as team leaders, entrepreneurs, administrators, educators and researchers.

Programme Outcomes (PSO)

Upon completion of the M.Sc. Degree programme, the graduate will be able to

PSO1:Interpret the knowledge of structural organisation and their Biochemistry in metabolic functions

PSO2: Analyze the interaction of animals with the environment and their function at the level of the gene, cell, tissue, organ, organ-system and physiology.

PSO3: Apply the skills of handling scientific instruments, planning and performing laboratory experiments and also drawing logical and statistical inferences from the scientific experiments.

PSO4: Appraise the Scientific facts behind the Natural Phenomena, Proficient at critical thinking and communication of scientific information which enables them to succeed in competitive examinations and creative research.

PSO5: Design methodology using the Knowledge procured in Applied Sciences to upgrade their economic status and up liftment of the society.

New Syllabi for M.Sc Zoology

Course code	21PZO01	ANIMAL PHYSIOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: I	06		05

Course Objectives:

The main objectives of this course are

1. To understand, analyze, and evaluate the physiology of Digestion and respiration.
2. To understand the various pathways that regulate metabolism.
3. To understand the structure and functions of circulatory and excretory system
4. To understand and analyze the physiology of effectors, receptors, muscular contraction and neuronal conduction.
5. To understand the Physiology and structure of Endocrine glands and Reproductive Physiology

UNIT:1	Gastro Intestinal Physiology & Respiratory Physiology	18—HOURS

1.1 Digestive tract – structure and functions.

1.2 Secretory function of the alimentary tract and the glands.

1.3 Gastro intestinal hormones – Digestion, absorption of Carbohydrates, Proteins and Lipids.

1.4 Structure of lungs –Respiration - External Respiration, Respiratory movements - Breathing & Ventilation, Haemoglobin as oxygen carrier.

1.5 Respiratory quotient, Respiratory exchange in tissues – Regulation of respiration.

Unit:2	Metabolism	18—HOURS

2.1Carbohydrate metabolism – Glycogenesis, Glycogenolysis and Gluconeogenesis. Glycolysis - Kreb's cycle & ETS- HMP pathway.

2.2 Protein metabolism – Deamination, Transamination and Transmethylation of amino acids.

2.3 Lipid metabolism – Oxidation and Biosynthesis of fatty acids

2.4 Intermediary metabolism – role of hormones in metabolism.

Unit:3	Cardio Vascular Physiology & Renal Physiology	18 – HOURS

3.1Heart – Structure and Function, Cardiac rate – Cardiac rhythm – ECG – Induction and Regulation of heart beat

3.2 Heart block – Haemodynamics – Cardiac output, Venous return – Blood pressure – normal, hypo and hypertension,

3.3 Compositions of blood and blood pigments – properties and functions.**:**

3.4 Structure of kidney, Nephron – Mechanism of formation of urine – Glomerular filtration and clearance.

3.5 Role of Hormones in excretion.

Unit:4	Nerve and Muscle physiology & Sense organs	18—HOURS

4.1 Structure and function of Brain and Spinal cord.

4.2 Propagation and transmission of nerve impulse – Synaptic transmission.

4.3Mechanism of muscle contraction – Regulation and energetics of contraction.

4.5 Structure and function –Eyes and Ears.

Unit:5	Endocrine & Reproductive physiology	18—HOURS

5.1 Hypothalamus, Pineal, Thyroid, Parathyroid, Pancreas, Adrenal, Testis and Ovary – Location and Structure – Hormones and functions. 5.2Sperm and Ovary – Structure, its hormonal control 5.3 Ovulation – corpus Luteum – Phases of menstrual cycle, Menopause 5.4 Pregnancy – Parturition – Lactation.		
	Total Lecture hours	**90 – HOURS**
Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Organize the role of digestive and respiratory systems in the human body.	**K3**
2	Analyze the knowledge of metabolism	**K4**
3	Compare the structure and functions of Heart and Kidney	**K4**
4	Explain the conduction of neurons, muscle contraction and importance of various sense organs.	**K5**
5	Compile the Role of various hormones secreted by the endocrine glands and Structure and hormonal regulation of male and female reproductive organs	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	S.C.Rastogi, (2003). Essentials of Animal Physiology. S. Chand and Co.	
Reference Books		
1	A.K.Berry. (2014) Text Book of Animal Physiology, Emkay Publications.	
2	K.A.Goyal, K.V.Sasthri (2017)Text Book of Animal Physiology. Rastogi Publications.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102104042	
2	https://bio.libretexts.org/	
Course Designed By: Dr. S.P.Jeyapriya	**Checked by : Dr. A. Nagasathya**	

Semester	**Code**		**Title of the Course**			**Hours**			**Credits**	
I	**21PZO01**		**ANIMAL PHYSIOLOGY**			**6**			**5**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓			✓	✓	✓		
CO2	✓	✓	✓			✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO5	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓)=39 Relationship : High										

Mapping	1-20	21 – 40	41 – 60	61 - 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO02	BIOCHEMISTRY AND BIOPHYSICS	L	P	C
Core/Elective/Supportive		CORE COURSE: II	06		05

Course Objectives:

The main objectives of this course are

1. To describe the structure, classification and properties of Carbohydrates and Lipids.
2. To understand he Classification and Structural organization of amino acids and Proteins.
3. To understand the Classification, Properties of Enzymes and Vitamins.
4. To understand and analyse the concepts and laws of energy, redox potential and NMR Spectroscopy.
5. To acquire knowledge of Radioactivity and their measures and effects and Bioluminescence.

UNIT:1	Carbohydrates and Lipids	18—HOURS

1.1 Structure, classification and properties of mono, di and polysaccharides.
1.2 Lipid – structure and chemistry of simple and compound lipids.
1.3 Prostaglandins – their classes and functions.

Unit:2	Proteins	18—HOURS

2.1Structure and classification of amino acids
2.2 Biosynthesis of Tyrosine and Tryptophan**.**
2.3 Proteins – Classification,
2.4 Chemical structure and Structural organization (primary, secondary tertiary and quaternary) and their biological role.

Unit:3	Enzymes & Vitamins	18 – HOURS

3.1 Classification – Properties and Kinetics of enzymes
3.2 Mechanism of enzyme action – Active sites –Prosthetic groups- Coenzymes – Activators and inhibitors
3.3 Isoenzymes – Allosteric enzymes – Regulation of enzyme activity-Factors influencing enzyme activity.
3.4 Fat soluble vitamins (A, D, E and K) their occurrence and biochemical role.
3.5 Water soluble vitamins (B & C) their occurrence and biochemical role.

Unit:4	Biophysics - Atoms and molecules	18—HOURS

4.1Structure – properties.
4.2 Laws of Thermodynamics
4.3 Concepts of free energy and entropy –Exergonic and endergonic reactions
4.4 Redox potential in biological systems – High energy phosphate groups
4.5 NMR Spectroscopy

Unit:5	Radioactivity	18—HOURS

5.1 Ionizing radiations
5.2 Measurement of radioactivity – Geiger Muller Counter – Liquid Scintillation Counter – Autoradiography.
5.3 Effects of radiation in biological systems –DNA, proteins and enzymes
5.4 Bioluminescence

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Organize the Carbohydrates and lipids with their structure	**K3**
2	Categorize amino acids and proteins based on the structural organization.	**K4**
3	Appraise the biochemical role of the enzymes and Vitamins.	**K5**

4	Explain the laws of thermodynamics and NMR Spectroscopy	**K5**
5	Elaborate various methods to assay Radioactivity and Bioluminescence.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	S. C. Rastogi, Biochemistry. 2nd edition. (2003). Tata McGraw Hill Publishing Company Ltd., New Delhi.	
2	Narayanan, P Essentials of Biophysics (2000), New Age Int. Pub. New Delhi	
Reference Books		
1	Subramanian M.A. (2019) Essentials of Biophysics. MJP Publications.	
2	Sathyanarayana U and Chakarapani U (2020) Biochemistry 5th edition Elsevier Health sciences publications.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.biophysics.org/	
2	https://www.easybiologyclass.com/topic-biochemistry/	
Course Designed By: Dr. A. Mary Helitha	**Checked by : Dr. A. Nagasathya**	

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
I	**21PZO02**	**BIOCHEMISTRY AND BIOPHYSICS**	**6**	**5**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	□		✓	□	✓		✓□	□✓	✓
CO4	✓		□	✓		✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓
Number of Matches(✓)=41 Relationship : Very High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21 -30	31-40	**41-50**
Relationship	Very Poor	Poor	Moderate	High	Very High

Course code	21PZO03	DEVELOPMENTAL BIOLOGY AND EVOLUTION	L	P	C
Core/Elective/Supportive		CORE COURSE: III	06		05

Course Objectives:

The main objectives of this course are

1. To understand the structure of gametes and the events of Gametogenesis, Fertilization involved in the developing embryo
2. To understand the Cleavage, Gastrulation, Morphogenetic movements and Organogenesis and Differentiation.
3. To understand the embryonic organizer, inductions and Human Development.
4. To learn how Natural selection controls all the biological processes.
5. To understand the types of Speciation, Isolating Mechanism and Human Evolution.

UNIT:1	Gametogenesis	18—HOURS

1.1Spermatogenesis – Biochemistry of semen, sperm physiology
1.2 Oogenesis – Vitellogenesis
1.3 Fertilization
1.4 Morphogenetic gradients in egg – Double gradient theory- Embryonic field and their properties.

Unit:2	Development	18—HOURS

2.1Cleavage – Patterns of cleavage
2.2 Blastula – Blastulation – Significance of Blastopore
2.3 Gastrulation
2.4 Morphogenetic movements – Germ layer
2.5 Differentiation – Organogenesis – Growth and Differentiation.

Unit:3	Embryonic induction&Human development	18 – HOURS

3.1 Concepts – organizers – Experiment on organizers — Chemical nature of inducing substances
3.2 Mechanism of induction – Influence of hormones on growth
3.3 metamorphosis of Frog and Insects.
3.4 Fertilization – Blastocyst formation – Implantation – Extra Embryonic membranes
3.5 Pregnancy – Abnormal pregnancy – Twins – Congential deformities - IVF – IVI- Test tube baby.

Unit:4	Natural selection	18—HOURS

4.1 Definition, Evidences of natural selection - Genetical theory of Natural selection
4.2 Hardy Weinberg law and Natural selection
4.3 Polymorphism- Transient and Balanced.

Unit:5	Polyploidy and evolution	18—HOURS

5.1Genetic speciation – types – Genetic assimilation
5.2 Isolating mechanisms. Quantum evolution – Simpson's adaptive grid.
5.3 Human evolution – Uniqueness of man – Fossil history and phylogeny of man – Cultural evolution and future evolution of mankind.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Develop the gametogenesis and Fertilization process.	**K3**
2	Distinguish the Cleavage, Gastrulation, fertilization and morphogenetic movements in the developing embryo.	**K4**
3	Appraise the modern technologies in the Human development.	**K5**
4	Assess the role of Natural Selection in Biological processes.	**K5**
5	Elaborate the Importance of Speciation and Human Evolution.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	A.K. Berry (2016), An Introduction to Embryology Emkay publications, New Delhi	
2	V. B. Rastogi(2021), Organic Evolution (Evolutionary Biology), Med tech publisher	
Reference Books		
1	Balinsky, B.I.(1981) An Introduction to Embryology. W.B Saunders Co., Philadelphia.	
2	Strickberger,M.W.(1996).Evolution.JonesandBarlettpublishersInc.,London.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	http://www.ndvsu.org/images/StudyMaterials/Anatomy/Embryology-Part-1.pdf	
2	https://www.biologycorner.com/	
Course Designed By: Dr. A.Maryhelitha	**Checked by : Dr. A. Nagasathya**	

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
II	**21PZO03**	**DEVELOPMENTAL BIOLOGY AND EVOLUTION**	**6**	**5**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓			✓	✓		□	✓
CO4	✓	✓		✓	✓	✓	✓	✓		✓
CO5	✓		✓		✓	✓	✓	✓	✓	
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO04P	PRACTICAL I – COMPARATIVE ANATOMY AND PHYLOGENY OF INVERTEBRATES AND CHORDATES, ANIMAL PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS	L	P	C
Core/Elective/Supportive		**CORE COURSE: IV**		**06**	**04**

Course Objectives:

The main objectives of this course are

1. To identify various specimens belonging to Invertebrata and Chordata.
2. To analyze the O_2 consumption, salt loss and salt gain of fish.
3. To analyse and evaluate the chemical composition of tissues through Quantitative and Qualitative estimations.
4. To Learn clinical procedures for Blood and Urine analysis.
5. To Understand the working principle and application of Sphygmomanometer, Kymograph, Haemoglobinometer, ESR, Colorimeter and Electrophoresis.

Paper:1	**Comparative anatomy and phylogeny of invertebrates and chordates**	**18—HOURS**

1. Taxonomy - A list of at least two representative animals belonging to major classes of each invertebrate phyla.

2. A list of at least two representative animals belonging to major orders of 5 classes of Chordata.

3. Minor Phyla - Rotifera, Phoronida, Chaetognatha

Paper:2	**Animal physiology**	**18—HOURS**

1. Estimation of O_2 consumption in fish.
2. Determination of salt loss and salt gain in fish.
3. Quantitative estimation of proteins, carbohydrates and lipids in the animal tissues.
4. Quantitative estimation of ammonia and urea.
5. Principles and applications of the following instruments – Kymograph, Colorimeter, Sphygmomanometer, Electrophoresis unit, Chromatographic assembly.

Paper:3	**Biochemistry & Biophysics**	**18 – HOURS**

1. Qualitative estimation of amino acids in tissue samples (Paper chromatography).
2. Separation of Plant pigments using Column chromatography
3. Qualitative analysis of urine (protein, glucose and ketone).
4. Blood – clotting time & bleeding time.
5. Preparation of Haemin crystals.
6. Estimation of Haemoglobin
7. Colorimeter-Determination of optical density of samples using standards.
8. Electrophoresis -Separation of human serum proteins (Demonstration only)

	Total Lecture hours	**90 – HOURS**

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the organisms belonging to the phylum Invertebrata and Chordata.	**K3**
2	Estimate various parameters using the fishes.	**K5**
3	Evaluate the chemical composition of tissues through Quantitative and Qualitative estimations.	**K5**
4	Determine clinical analysis of Blood and Urine analysis.	**K5**
5	Adapt themselves in utilizing various analytical instruments.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Reference Books

1	Shivaraja Shankara Ym (2013)Laboratory Manual for Practical Biochemistry, Jaypee Brothers Medical Publishers.
2	E.L.Jordan and P.S.Verma, (2009) Invertebrate Zoology, S.Chand publications
3	E.L.Jordan and P.S.Verma, (2013) Chordate Zoology, S.Chand publications

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://opentextbc.ca/biology2eopenstax/chapter/chordates/
2	https://bio.libretexts.org/

Course Designed By: Dr.A.Nagasathya **Checked by: Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
I	**21PZO4P**	**PRACTICAL I – COMPARATIVE ANATOMY AND PHYLOGENY OF INVERTEBRATES AND CHORDATES, ANIMAL PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS**	**6**	**4**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓			✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓		✓			□✓	✓
CO4	✓	✓	□	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	

Number of Matches(✓)=39 Relationship : High

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO05	BIOLOGY OF THE CELL	L	P	C
Core/Elective/Supportive		CORE COURSE: V	06		05

Course Objectives:

The main objectives of this course are

1. To understand and analyze the Principles and applications of Microscopy, Micrometry, Micro techniques and Immuno cytochemistry.
2. To understand the structural and functional aspects of Cell, Plasma membrane and its modification, Principles of Cell communication and Cell adhesion.
3. To study the Cytoskeleton and Cell organelles of the Cell like Mitochondria, Endoplasmic reticulum, Golgi complex and Lysosomes.
4. To learn the importance of Nucleus and Chromosomes.
5. To understand the Process of Cell Cycle and Characteristics, types and process of Cancer caused by Oncogenes.

UNIT:1	Microscope	18—HOURS

1.1 Light Microscope
1.2 Phase Contrast microscope
1.3 Electron Microscope
1.4 Micrometry – Cytological techniques – Fixation, Dehydration, Embedding, Sectioning and Staining.
1.5 Fixation and Staining – Types and mechanism-Immuno cytochemistry.

Unit:2	Cell Structure	18—HOURS

2.1 Prokaryotic and Eukaryotic cells
2.2 Plasma membrane –structure, Composition and functions—Modifications-microvilli,Desmosomes , Terminal bars , Interdigitation and Gap junctions —Membrane potential.
2.3 Cell adhesion.
2.4 Cell Signalling- Ligands and receptors –Forms of intercellular signalling-G-protein coupled receptors-structure and mechanism of action.

Unit:3	Cytoskeleton& Cell organelles	18 – HOURS

3.1 Microtubules –structure, Assembly of tubulin and functions– Ciliary movement.
3.2 Microfilaments-Actin and Myosin
3.3Mitochondria- Ultra structure of mitochondria, Respiratory chain and ATP synthesis.
3.4 Endoplasmic Reticulum – Structure and function.
3.5 Golgi Complex-– Structure and function.
3.6 Lysosomes-Origin, Lysosomal enzymes and functions.

Unit:4	Chromosomes &Nucleus	18—HOURS

4.1 Chromosomes: Historical background and chromosomal number
4.2 Chromosomes –structure, composition and function.
4.3 Nucleus – Occurrence, Ultra structure and function.
4.4 Nuclear membrane –Nuclear pore complex, Nucleolus, nucleoplasm, chromatin fibres

Unit:5	Cell Cycle and Cancer	18—HOURS

5.1 Mitotic and Meiotic cell division – phases of cell cycle —Mitotic apparatus –Synaptonemal complex.
5.2 Cancer-Characteristics of cancer cells, Types and causes of cancer
5.3 Tumour progression-Oncogenes.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Compare and Contrast various types of Microscopy and Microtechniques	**K4**
2	Explain the structure, functions of Cell, Plasma membrane and Cell signalling.	**K5**
3	Elaborate the various aspects of Cytoskeleton and Cell organelles.	**K6**
4	Evaluate the role of Chromosomes and Nucleus in the cells.	**K5**
5	Discuss the Process of cell cycle and cancer causing Oncogenes.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Verma, P. S. and V. K. Agarwal, (2016). Cytology. S. Chand and Co.	
Reference Books		
1	E.D.P. De Robertis, (1987). Cell Biology and Molecular Biology Lea&Febiger Publisher.	
2	Ajoy Paul.(2015) Text book of Cell and Molecular biology. Books and Allied Ltd.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https// www.ndvsu.org	
2	https://books.google.co.in/books	
3	https// www.bjcancerorg	
Course Designed By: Dr. S.P.Jeyapriya		**Checked by : Dr. A. Nagasathya**

Semester	**Code**		**Title of the Course**			**Hours**			**Credits**	
II	**21PZO05**		**BIOLOGY OF CELL**			**6**			**5**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓			✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches(✓)=43 Relationship :Very High										

Mapping	1-20	21 - 40	41 – 60	61 - 80	81 – 100
Matches	1-10	11-20	21-30	31-40	**41-50**
Relationship	Very Poor	Poor	Moderate	High	**Very High**

Course code	21PZO06	GENETICS AND MOLECULAR BIOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: VI	06		05

Course Objectives:

The main objectives of this course are to:

1. To get an overview of Mendalian traits, Gene interactions, Linkage, Crossing over, Sex determination and Sex linkage.
2. To provide knowledge on the genetic makeup of Microorganisms,Human Genetics involving chromosomal disorders and role of Human Genome Project.
3. To understand the Hardy Weinberg law, various aspects of Population Genetics and Genetic basis of Cancer
4. To learn the structure of DNA &RNA, DNA replication, types and DNA repair mechanisms
5. To understand the Process of Gene expression by Transcription, Post transcriptional changes, Translation, gene Regulation andoperon concept.

UNIT:1	Mendelian Genetics & Classical Genetics	18—HOURS

1.1Mendelian laws – Gene interaction.
1.2 Linkage – Crossing over – Chromosome mapping
1.3 Sex determination in Man
1.4Sex linkage — X linked genes - Y linked genes
1.5 Sex limited traits and Sex influenced traits.

Unit:2	Microbial Genetics & Human Genetics	18—HOURS

2.1 Genetics of Bacteria and Viruses – Plasmids
2.2 Mechanisms of genetic recombination in bacteria
2.3 Conjugation, transformation and transduction.
2.4 Recombination in viruses.
2.5 Multiple allelism and blood group genetics
2.6 Mutation – Chromosomal and Gene – Molecular basis of induced and spontaneous mutation.
2.7 Applications of genetics – inbreeding and eugenics.
2.8 Human Genome Project – Salient features, methods adopted, future prospects.

Unit:3	Population Genetics & Cancer Genetics	18 – HOURS

3.1Genes in population – Allelic and gene frequencies
3.2 Implications of Hardy – Weinberg principle
3.3 Factors affecting Hardy Weinburg Equilibrium.
3.4 Genetic load and genetic counselling.
3.5Carcinogenes – Genetic basis of cancer – Chromosomal translocations
3.6 Role of oncogenes and tumour suppressor genes – RB genes and P53.

Unit:4	Nuclei acids - Structure, DNA Replication, Damage and Repair	18—HOURS

4.1 Structure of DNA & RNA, Types of DNA, Denaturation, and Renaturation.
4.2 Replication – Conservation,semi conservative replication
4.3 Linear DNA replication – Replication fork and Okazaki fragments, Mechanism of replicative DNA synthesis – DNA polymerase.
4.4 Circular DNA replication – Rolling circle replication
4.5 DNA repair mechanism – Photo reactivation – Excision and SOS repairing.

Unit:5	Gene Expression and Regulation	18—HOURS
	Total Lecture hours	**90 – HOURS**

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Elaborate the knowledge on Gene interactions, Chromosomal Mapping, Sex determination, Sex linked, Sex limited and Sex Influenced traits.	**K6**
2	Interpret the process of Transformation, Conjugation, Transduction and Recombination, types of Mutation and Mutagens, importance of Human Genome Project.	**K5**
3	Elaborate the role oncogenes and tumour viruses in cancer progression and various aspects of Population Genetics.	**K6**
4	Compare the process of DNA replication with the structure of DNA and know the molecular basis of replication, various damages and error mechanism.	**K4**
5	Compile the mechanism of transcription, translation and gene regulation with operon models.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Textbook(s)

1	Ajoy Paul. (2018). Text book of Genetics. Books and Allied Ltd.
2	David Freifelder(1998), The Essentials of Molecular Biology, II Ed., Narosa Publishing House, New Delhi.

Reference Books

1	Watson, J. D., T. A. Baker, S. P. Bell, M. Gann A. Levine and R. Losick. (2014) Molecular Biology of the Gene. Pearson Edn., Delhi.
2	Stickberger, M.W. (1985). Genetics. Printice - Hall of India, Pvt. Ltd., New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/102104052
2	https://nptel.ac.in/courses/102103013

Course Designed By: Dr. A.Nagasathya **Checked by : Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
II	**21PZO06**	**GENETICS AND MOLECULAR BIOLOGY**	**6**	**5**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO3	✓	□✓	✓	✓	✓□	✓	✓	□✓	□✓	✓
CO4	✓		□✓	✓			✓	✓	✓	
CO5	✓			✓			✓	✓	✓	

Number of Matches(✓)=40 Relationship : High

Mapping	1 -20	21 – 40	41 – 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO07	TOOLS AND TECHNIQUES FOR BIOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE : VII	06		04

Course Objectives:

The main objectives of this course are to:

1. To understand the principles and applications of Microscopy and Micrometry.
2. To understand the principles of Microtome, Histochemistry and Cryopreservation techniques.
3. To understand the principles and applications of analytical techniques using Centrifuge, pH meter and Spectrophotometer.
4. To understand the principle and types of Chromatography and Electrophoresis
5. To understand the Basic concepts of Research Methodology and role of Intellectual property rights.

UNIT:1	Microscopy	18—HOURS

1.1 Principle of transmission

1.2 Types of light microscopes – Bright field, Dark field, Phase contrast, fluorescence, Polarization, Confocal,

1.3 Transmission and Scanning Electron microscopes and types – Scanning tunnelling.

1.4 Micrometry

Unit:2	Microtomy and Histochemistry	18—HOURS

2.1 Microtome and its types

2.2 Histochemistry: Principle involved in identification of carbohydrates, proteins and lipids.

2.3 Cryotechniques – Cryopreservation.

Unit:3	Analytical techniques	18 – HOURS

3.1 Centrifuge – Principles and types – Differential Centrifugation – Density gradient and Ultra Centrifugation.

3.2 pH meter – Principles and applications.

3.3 Spectrophotometer - Principles and types and applications

Unit:4	Chromatography &Electrophoresis	18—HOURS

4.1 Principles and Applications – Paper, Thin layer, Column

4.2 Gas – Liquid Chromatography and HPLC.

4.3 Principles and kinds - PAGE, Agarose Gel Electrophoresis.

4.4 Immuno electrophoresis

4.5 Pulse field electrophoresis.

Unit:5	Preparation of Manuscripts	18—HOURS

5.1 What is research? Literature collection – literature citation

5.2 Research report – manuscript preparation – formatting and typing

5.3 Laboratory safety – Intellectual property rights.

5.4 Review paper – Thesis writing – Bibliography

5.5 Web Browsing and Searching – Electronic biological database – Some important database such as Biological Abstracts.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Compare the principle and applications of various types of Microscopy and estimate the size of various samples using Micrometry.	K4

2	Analyse various tissue samples using Histochemistry	**K4**
3	Interpret various aspects of analytical techniques using Centrifuge, pH meter and Spectrophotometer.	**K5**
4	Categorize the chromatography and Electrophoresis techniques for separation of Different samples.	**K4**
5	Adapt the Basic concepts of Research Methodology and role of Intellectual property rights.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Textbook(s)

1	Gurumani.N. (2019). Research Methodology for Biological Sciences. MJP Publications.

Reference Books

1	Veerakumari M. (2011). Bioinstrumentation. MJP Publications.
2	Bisen, P. S. and Shruti Mattur. (2004). Life Science in Tools and Techniques. CBS Publisher.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.researchgate.net/publication/316976812_
2	https://nptel.ac.in/courses/102103083
3	https://nptel.ac.in/courses/102107028

Course Designed By: Dr.G.Sankar **Checked by : Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**			**Hours**	**Credits**			
III	**21PZO07**	**TOOLS AND TECHNIQUES FOR BIOLOGY**			**6**	**5**			
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓			✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	□✓		✓	✓□	✓□	✓
CO4	✓	✓	□	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓			✓	✓	✓		
Number of Matches(✓)=39 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO08P	PRACTICAL II - DEVELOPMENTAL BIOLOGY AND EVOLUTION, BIOLOGY OF CELL, GENETICS AND MOLECULAR BIOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: VIII		06	04

Course Objectives:

The main objectives of this course are:

1. To demonstrate developmental stages of chick embryo by Blastoderm mounting.
2. To understand the Natural Selection and Genetic drift using colour beads.
3. To understand the Micrometry and Histochemistry of tissues using Micro techniques.
4. To understand the Preparation of Buccal and Blood smear, Enumerate RBC and Differential count of WBC.
5. To Understand the identification of Drosophila and Pedigree analysis of Mendelian traits in man, calculation of probability using Chi square analysis.
6. To analyze Hardy Weinberg law calculation of gene frequencies for dominant recessive and co-dominant traits and multiple alleles.
7. To estimate of nucleic acids from animal tissue

Paper: 1	Developmental Biology & Evolution	30 Hours

1. Preparation of sperm suspension in bull and observation of motility of Sperm
2. Early embryogenesis of chick – 24, 48, 72 and 96 hours – Blastoderm mounting of chick
3. Action of Natural Selection in population using colour beads.
4. Genetic drift in a small population using colour beads.

Paper:2	Biology of cell	30 Hours

1. Cytological techniques – Micrometry – measurements of cells using ocular and stage micrometers.
2. Histochemical work on Micro techniques.
3. Human Buccal smear and blood smear.
4. Enumeration of RBC.
5. Differential counting of WBC
6. Spotter: karyotypes of man.

Paper:3	Genetics and Molecular biology	30 Hours

1. Drosophila culture – Identification of male, female and mutants.
2. Hardy Weinberg law and calculation of gene frequencies for dominant recessive and co-dominant traits and multiple alleles.
3. Probability of Chi-square analysis of results.
4. Analysis of mendelian traits of Drosophila.
5. Mendelian traits in man – pedigree analysis.
6. Extraction and estimation of nucleic acids from animal tissue
   a. DNA estimation
   b. RNA Estimation
7. Spotters: DNA, RNA, tRNA, ATP and DNA replication.

	Total Practical hours	90 – Hours

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the morphology of sperm through smear preparation and developmental stages of chick embryo and Emphasize the Importance of Natural	K3

	Selection and Genetic drift.	
2	Evaluate the tissues using Micrometry and Microtechniques.	**K5**
3	Interpret the results of Buccal and Blood smear	**K5**
4	Discuss the results of Pedigree analysis in man, calculate the results using Chi square analysis and Identify male, female and mutants of Drosophila.	**K6**
5	Compile gene frequencies for dominant recessive and co-dominant traits and multiple alleles using Hardy Weinberg law and estimate of nucleic acids from animal tissue.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Reference Books

1	Julio E. Celis (1998) Cell Biology: A Laboratory Handbook, Academic Press

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.researchgate.net/publication/330654692_Cell_Biology_Practical_Manual
2	https://www.researchgate.net/publication/320508474_Molecular_Biology_Laboratory_manual
3	https://www.researchgate.net/publication/226006732_Developmental_Biology_Protocols

Course Designed By: Dr. S.P.Jeyapriya **Checked by: Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
II	**21PZO8P**	**PRACTICAL II- DEVELOPMENTAL BIOLOGY AND EVOLUTION, BIOLOGY OF CELL, GENETICS AND MOLECULAR BIOLOGY**	**6**	**4**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓			✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓			✓	✓	✓		
CO5	✓	✓	✓			✓	✓	✓	✓	✓

Number of Matches(✓)=40 Relationship : High

Mapping	1-20	21 - 40	41 - 60	61 - 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO09	MICROBIOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: IX	06		05

Course Objectives:

The main objectives of this course are to:

1. To know the History of Microbiology and understand the structure and characteristic features of Bacteria.
2. To understand and analyze the growth, factors affecting growth, growth characteristics and requirements of bacteria and Identification of microbes.
3. To understand and apply the physical and chemical control measures and Quorum Sensing using Bioluminescence.
4. To understand and apply role of microbes in Causing various diseases and Fermented dairy products and its processing, spoilage and preservation, Microbe as food SCP.
5. To Understand the concepts of Environmental Microbiology – role of Biogeochemical cycles, waste treatment and discuss its association in Biofertilizer production, nature of Bio pesticides and Bioremediation process.

UNIT:1	History of Microbiology - Bacteria	18—HOURS

1.1 Discovery of microorganisms (Robert Hooke & Leeuwenhoek), Contributions of Francesco Redi, Louis Pasteur, Robert Koch and Edward Jenner, Classification based on H. Whittaker (Five Kingdom system).
1.2 Morphological types - Structure and functions of flagella, cilia and pili.
1.3 Cell wall – Cell walls of Gram negative, Gram positive and Plasma Membrane
1.4 Nuclear material – bacterial chromosomes and bacterial plasmids.
1.5 Endospore types, structure and functions.

Unit:2	Culture technique	18—HOURS

2.1 Isolation of different types of Bacteria – Fungi – Actinomycetes – Cyanobacteria – Protozoa.
2.2 Identification of Bacteria - biochemical identification of bacteria -IMVIC test.
2.3 Preservation of microbes for storage and microscopic studies and Culture Collections.
2.4 Microbial growth - nutritional requirements and nutritional types
2.5 Growth, types of culture media, growth curve, measurement of growth
2.6 Factors affecting growth – pH – temperature – Substrate and osmotic condition.

Unit:3	Control of microorganisms	18 – HOURS

3.1 Physical agents- temperature, desiccation, osmotic pressure, radiation, filtration.
3.2 Chemical agents-characteristics of an ideal antimicrobial agents, phenolic compound, alcohol, halogens, heavy metals, dyes, synthetic detergents, quaternary ammonium compounds, aldehydes, gaseous agents.
3.3 Microbial Bioluminescence – Mechanism – Quorum sensing - Advantages.

Unit:4	Medical Microbiology & Food Microbiology	18—HOURS

4.1 Causative means, mode of transmission and control of Air borne diseases – Tuberculosis, Whooping cough and Meningitis.
4.2 Food borne and water borne disease – Cholera, Shigellosis and Typhoid.
4.3 Soil borne diseases - Tetanus.
4.4 Sexually transmitted and contact diseases - Gonorrhea, Syphilis.
4.5 Microbiology of fermented milk – Starter cultures, butter milk, yoghurt and cheese –Food spoilage – spoilage of Milk.
4.6 Microbes as source of food – *Spirulina* - SCP and Methods of food preservation.

Unit:5	Environmental Microbiology & Applied Microbiology	18—HOURS

5.1 Role of microorganisms in nutrient cycling -Nitrogen, Carbon, Iron, Sulphur and Phosphorous.
5.2 Waste treatment- types of wastes - characteristics of solid and liquid wastes.
5.3 Treatment of solid wastes - composting and vermiform composting.
5.4 Treatment of liquid wastes - primary, secondary (trickling filter, activated sludge, oxidation pond,

oxidation ditch) and tertiary treatment. 5.5 Biofertilizers (Rhizobium, Azolla) – mass production, advantages and disadvantages. 5.6 Bioremediation of metals and oil, Bio pesticides and Bioleaching – significance.		
	Total Lecture hours	**90 – HOURS**
Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Identify the structural organization and morphology of Bacteria and contributions in the Microbiology.	**K3**
2	Assess, Enumerate, characterize and identify the microbes and its Preservation.	**K5**
3	Interpret the use of chemical and physical control of microbes and Quorum Sensing.	**K5**
4	Appraise the diagnosis, prevention, treatment and epidemiology of infectious diseases and importance of Food Microbiology.	**K5**
5	Elaborate the role of microbes in biogeochemical cycles, Waste water treatment techniques, Biofertilizers and Bioremediation process.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Dubey R.C and Maheswari D.K. (2010). Text book of Microbiology, S. Chand and Company Ltd, New Delhi.	
Reference Books		
1	Rajan .S. (2014) Text book of Microbiology, Books and Allied Pvt ltd.	
2	Ananthanarayanan, T. and C. K. Jayaram Paniker, (2006). Text Book of Microbiology. VI Ed. Orient Langman Ltd., Madras.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102103015	
2	https://microbiologyinfo.com/	
Course Designed By: Dr. A. Nagasathya	**Checked by: Dr. A. Nagasathya**	

Semester	**Code**		**Title of the Course**			**Hours**			**Credits**	
III	**21PZO09**		**MICROBIOLOGY**			**6**			**5**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓			✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓		✓	✓			✓
CO4	✓	✓	□	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO10	IMMUNOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: X	06		05

Course Objectives:

The main objectives of this course are to:

1. To understand the concept of Immunity and Lymphoid organs.
2. To learn about Antigen and Antibodies
3. To understand the process and mechanism of Humoral and Cell mediated immune response, Complements pathways and hypersensitivity Reactions
4. To understand the organization of MHC, Organ transplantation, Tumour and Autoimmunity.
5. To understand various techniques of Immunology.

UNIT:1	Immunity – cells and organ systems	18—HOURS

1. Introduction: Innate immunity – physical and mechanical factors, biochemical factors, cellular factors, genetic factors and other factors.

1.1 Acquired immunity – natural and artificial active immunity, natural and artificial passive immunity and Adoptive immunity.

1.2 Cells of immune system _ Lymphoid lineage –T cells and its types, B cells and its types, Null cells and its types

1.3 Myeloid lineage – Eosinophil, Basophil, Neutrophil, Mast cell, Antigen presenting cells, platelet, monocytes and macrophages.

1.4 Organs of Immune System _ Primary Lymphoid organs – Thymus, Bone marrow, Bursa of Fabricius.

1.5 Secondary lymphoid organs – Lymph node, spleen, Payer's patches (GALT), Tonsils (MALT).

Unit:2	Antigens and antibodies	18—HOURS

2.1 Antigens -Types of antigens – cross reacting antigen, heterophile antigens, Forssman antigens, haptens - epitope and paratope- chemical nature of antigens- essential factors for antigenicity.

2.2 Antibodies – Antibodies and immunoglobulin - Structure of immunoglobulin, Types of Immunoglobulin, Structure and biological properties of immunoglobulin G, M, A, D and E - Monoclonal and polyclonal antibodies.

2.3 Antigen and Antibody reactions - Salient features of Ag-Ab reaction – Immune complex, specificity of Ag-Ab reaction, binding sites of antigen and antibody, binding force of antigen and antibody, avidity, bonus effect, cross reaction.

Unit:3	Immune response and Hypersensitivity reactions	18 – HOURS

3.1 Humoral immune response - Primary and secondary humoral immune response, importance of B-cells in humoral immune response (antibody formation), factors influencing antibody formation.

3.2 Cell mediated immune response – cells involved in the cell mediated immune response, cytokines and their actions.

3.3 Factors causing hypersensitivity, types of hyper sensitivity – Type I, II, III, IV and V hyper sensitivity reactions

3.4 Complement system – Biological functions of complement system, complement fixation test.

Unit:4	Clinical immunology	18—HOURS

4.1 Major histocompatibility complex – Structure of MHC molecule, Genetic polymorphism of class. I, II and III MHC molecules.

4.2 Transplantation – Classification of grafts, mechanism of grafts, mechanism of graft rejection, graft versus host reaction, immuno suppressive therapy during transplantation.

4.3 Tumour immunology – properties of tumour, immune surveillance, immunodiagnosis of tumour, immunotherapy of tumour.

4.4 Auto immune diseases – Rheumatoid arthritis , Psoriasis, Multiple sclerosis and Myasthenia Gravis characteristics and treatment of auto immune diseases.

Unit:5	Immuno Technology	18—HOURS
5.1 Agglutination, precipitation, complement fixation, immuno fluorescence – ELISA, 5.2 Radio immunoassay – Immuno diffusion, Immuno electrophoresis – Isoelectric focussing 5.3 Cytotoxicity assay – labelled antibody techniques in light and electron microscopy and Immuno histochemistry. 5.4 Techniques of immunization – use of adjuvants.		
	Total Lecture hours	**90 – HOURS**

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Develop the knowledge on the cells of immune system, types of Immunity and the structure and functions of lymphoid organs.	**K3**
2	Compare the structure, types and properties of antigens and immunoglobulin, Monoclonal antibodies and polyclonal antibodies.	**K4**
3	Explain the process of Humoral and Cell mediated immune response, Complements pathways and the types of hypersensitivity.	**K5**
4	Interpret the organization of MHC and its application in Organ Transplantation and characteristics, treatment of Tumour cells and Autoimmune diseases.	**K5**
5	Adapt various Immunotechniques.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Ajoy Paul.(2018) Text book of Immunology . Books and Allied Ltd.	
Reference Books		
1	Roitt, I. M. (2017) Essential Immunology. ELBS.	
2	Janis Kuby. (2007). Immunology. W. H. Freeman and Company, New York.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102105083	
2	http://www.helmberg.at/immunology.pdf	
Course Designed By: Dr. G. Sankar	**Checked by: Dr. A. Nagasathya**	

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
III	21PZO10	IMMUNOLOGY	6	5

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓		✓		✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓		✓	✓			✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓			✓		✓	
Number of Matches(✓)=38 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 - 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO11	ENVIRONMENTAL BIOLOGY & TOXICOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: XI	05		05

Course Objectives:

The main objectives of this course are to:

1. To understand the concept of Interaction between environment and biota, concepts of Ecosystem, energy transformation between trophic levels and Productivity.
2. To understand different habitat ecology like Fresh water, Marine. Estuarine and Terrestrial Habitat.
3. To understand the prospects of the various natural resources and biodiversity , analyse the need for conservation of resources, applications of renewable resources
4. To know the different types of pollution and their management to protect the health and welfare of human population in the world.
5. To understand the fundamentals in the basic areas of toxicology.

UNIT:1	Principles and concepts of ecosystem	18—HOURS

1.1 Interaction between environment and biota
1.2 Concept of productivity – Food Chains – Food Webs – Trophic levels
1.3 Energetics in an ecosystem – Energy flow
1.4 productivity and measurement of Primary productivity
1.5 Principles and concepts of biogeochemical cycles – Laws of limiting factors.

Unit:2	Habitat Ecology	18—HOURS

2.1Fresh water – Types, limiting factors – Ecological classification of fresh water organisms – Zonation.
2.2Marine Habitat – Marine environment – Biota – Zonation.
2.3Estuarine Habitat – Types, biota – food production potential.
2.4Terrestrial habitat – Biota, Biogeographic regions.

Unit:3	Conservation of natural resources	18 – HOURS

3.1 Renewable (food, water, forest)
3.2 Non-renewable energy resource (land, energy and mineral)
3.3 Conventional – non conventional energy sources –Causes of depletion of wild life
3.4 Conservation of wild life – Methods of Conservation – *Insitu ,Exsitu* - Wild life Sanctuaries of India.
3.5Biodiversity-Basic concepts, types, values, Hot spot and Threats to Biodiversity and Biodiversity indices.

Unit:4	Pollution	18—HOURS

4.1 Sources, effects and control of Air, Water, Land, Noise,
4.2 Pesticides, Heavy metals, Thermal and Radiation – Indicator organisms.
4.3 Biomagnification – BOD – COD
4.4 Sewage Treatment.

Unit:5	Exposures to toxicants	18—HOURS

5.1 Toxicants and their types
5.2 Routes of entry, dose, time and response, relationship,
5.3 Toxicity tests- acute, chronic, LC50, LD50.
5.4Mode of action of toxicants- metals, pesticides, carcinogens.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Compare the biotic and abiotic interactions and principles of ecosystem ecology and Interaction between environment.	**K4**
2	Interpret the habitat ecology of Fresh water, Marine. Estuarine and Terrestrial including its types, biota and food production potential.	**K5**
3	Compile various types of natural resources and their management practice and conservation of species and habitats.	**K6**
4	Discuss the types, effects and control of pollution	**K6**
5	Predict the fundamentals in the field of toxicology	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Textbook(s)

1	Sharma, P. D., (2014). Ecology and Environment. Rastogi Publications, Meerut.
2	Pandey. K andJ.P.Shukla (1992), Elements of Toxicology South Asia Books

Reference Books

1	Subramanian M.A. (2010), Toxicology. MJP Publications.
2	Arvind Kumar. (2004), Biodiversity and Environment. APH Publishing Corporation, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/127106004
2	https://bio.libretexts.org/

Course Designed By: Dr.A.Maryhelitha **Checked by: Dr. A. Nagasathya**

Semester	**Code**		**Title of the Course**			**Hours**		**Credits**	
IV	**21PZO11**		**ENVIRONMENTAL BIOLOGY & TOXICOLOGY**			**5**		**5**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓		✓			✓		✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓		□✓	✓	✓	□✓	□✓	✓
CO4	✓	✓		✓	✓		✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓		✓	
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO12P	PRACTICAL III: MICROBIOLOGY, IMMUNOLOGYAND BIOSTATISTICS & BIOINFORMATICS	L	P	C
Core/Elective/Supportive		CORE COURSE: XII		06	04

Course Objectives:

The main objectives of this course are to:

1. Demonstrate an overview of the instruments, glass wares, chemicals and media for culturing different types of microbes and explaining various physical and chemical means of sterilization.
2. Know the methodology for isolation of pure cultures of bacteria, fungi and algae and Construct an experiment to isolate microorganisms.
3. Identify the cells of the blood samples.
4. Evaluate the Descriptive statistics and Diagrammatic representation of data and calculate the correlation and regression analyses among various data.
5. Understand and interpret results based on Test of Significance for small samples using student's t – test and chi- square.

Paper: 1	MICROBIOLOGY	30—HOURS

1.1 Principles and methods of sterilization – Wet, dry and cold sterilization.
1.2 Isolation methods – Serial dilutions, spread plate method, streak plate method and Pour plate method.
1.3 Preparation of Media: Nutrient broth, Nutrient agar plates, Slants.
1.4 Staining methods – Simple and Gram staining.
1.5 Enumeration of bacterial microbes – viable count (plate count).

Paper :2	IMMUNOLOGY	30—HOURS

2.1 Identification of various immune cells by morphology – Leishman staining.
2.2 Differential counts of Blood
2.3 Total counts of Blood

Unit:3	BIOSTATISTICS AND BIOINFORMATICS	30 – HOURS

3.1 Collection, classification and presentation of data relating to continuous and discrete variables
3.2 Graphical representation of data
3.3 Problems relating to mean, median. Mode, standard deviation, standard error,
3.2 Problems relating to test of significance (Chi square test and t-test).
3.3 Problems relating to correlation and regression.
3.4 Biological databases for protein and DNA

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Categorize the instruments, glass wares, chemicals and media for culturing different types of microbes and distinguish various physical and chemical means of sterilization.	K4
2	Assess various Culture media for the culture of unknown microorganisms.	K5
3	Determine the cells of the blood samples	K5
4	Evaluate the correlation and regression analyses among various data and Diagrammatic representation of data.	K5
5	Adapt Test of Significance for small samples using student's t – test and chi- square.	K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Reference Books	
1	D.K.Maheshwari, (2002), Practical Microbiology, S. Chand Publishing.
2	A.K.Sharma, (2005),Text Book of Biostatistics, Discovery Publishing House.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.easybiologyclass.com/biostatistics
2	http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
Course Designed By: Dr. A.Nagasathya	**Checked by: Dr. A. Nagasathya**

Semester	Code	Title of the Course	Hours	Credits
III	21PZO12P	PRACTICAL III: MICROBIOLOGY, IMMUNOLOGYAND BIOSTATISTICS & BIOINFORMATICS	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓		✓	✓			✓
CO4	✓			✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO13	AQUACULTURE	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: XIII	05		04

Course Objectives:

The main objectives of this course are to:

1. Understand the importance of aquaculture and construction of pond and control of Predatory insects.
2. Understand different types of aquaculture systems.
3. Understand the Finfish and shell fish culture techniques, Fish preservation, fishery by-products and Fish pathology.
4. Know the nutritional requirements, the feed formulation techniques and to Learn the new techniques in live feed aquaculture.
5. Understand the Breeding and fish genetical approach.

UNIT:1	Introduction	18—HOURS

1.1 Purpose and importance of aquaculture.
1.2 Construction of ponds: site selection – water quality manangement – Liming, Fertilization of ponds, types of ponds.
1.3 Aquatic plants and their control; Control of predatory insects; fish enemies and their control.

Unit:2	Kinds of Aquaculture	18—HOURS

2.1Fresh water culture, Brackish water culture,
2.2 Mariculture - Extensive, semi-intensive, intensive, super intensive, monoculture, mono sex culture, poly culture.
2.3 Integrated fish farming: Animal husbandry cum aquaculture, Agriculture cum Aquaculture, Pen and cage culture.

Unit:3	Finfish and shell fish culture	18 – HOURS

3.1 Fin fish culture: Culture of Indian major carps, tilapia, Trout, Seaweed culture.
3.2 Shellfish culture: culture of freshwater and marine prawns, edible and pearl oysters.
3.3 Fish pathology: Ectoparasites, Endoparasites, Bacterial, Viral and Fungal diseases, nutritional deficiency diseases.

Unit:4	Feed	18—HOURS

4.1Nutritional requirements;
4.2 Live fish feed Culture- Artemia and Tubifex.
4.3 Artificial feed:Feed formulation; Feed requirements.
4.4 Seed production, sex identification, brooders care and management, bundh breeding, induced spawning of carps. Hypophysation – application of synthetic hormones
4.5 Transport of fish seed and brooders – crafts and gears.

Unit:5	Genetics in Aquaculture	18—HOURS

5.1 Role of genetics in Aquaculture - fish breeding and hybridization.
5.2 Sex manipulation: Chromosomal manipulation, polyploidy, production of monosex and sterile fishes and super males.
5.3 Transgenic fishes.
5.4 Cryopreservation of gametes, Role of Biotechnology in conservation in fishes.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:		
1	Elaborate the importance of aquaculture and construction of pond and control of Predatory insects.	K6
2	Distinguish the different types of aquaculture systems.	K4
3	Interpret the basic culture methodologies, common problems and solutions and prescribe economically important species for culture.	K5
4	Formulate and enhance the nutrition through feed formulation techniques and acquire the knowledge about crafts and gears.	K6
5	Perceive the knowledgein the Breeding and fish genetics.	K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Santhanam, R. (2013) Fisheries Science, Daya Publishing House, New Delhi.	
Reference Books		
1	Jhingran, V. G., 1997. Fish and fisheries of India. Hindustan Publishing Co., New Delhi.	
2	Biswas, K. P., 2007. Prevention and control of fish and prawn diseases. II edn. Narendra Publishing House, New Delhi.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/120108002	
2	https://www.fao.org	
Course Designed By: Dr. G.Sankar	Checked by: Dr. A. Nagasathya	

Semester	Code		Title of the Course			Hours			Credits	
IV	21PZO13		AQUACULTURE			5			4	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	□✓	✓	✓	✓□		✓
CO4	✓	✓	□		✓	✓	✓			✓
CO5	✓	✓		✓	✓		✓	✓		✓
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO14P	PRACTICAL IV -ENVIRONMENTAL BIOLOGY AND TOXICOLOGY AND AQUACULTURE	L	P	C
Core/Elective/Supportive		CORE COURSE: XIV		06	04

Course Objectives:

The main objectives of this course are to:

1. Understand, apply and analyze the water quality index through various parameters.
2. Study the collection, isolation and identification of planktons.
3. Understand sandy, muddy, rocky shore fauna with special reference to the adaptation to the environment.
4. Understand the importance of Aquaculture

Paper :1	Environmental Biology and Toxicology	60 —HOURS

1. Estimation of primary productivity – Dark Light Bottle Method.
2. Estimation of DO in water samples.
3. Estimation of Hardness and Alkalinity.
4. Estimation of Calcium in water samples.
5. Estimation of Silicatesand PO4 in water samples.
6. Ecological spotters

Study of sandy, muddy, rocky shore fauna with special reference to the adaptation to the environment.

Paper :2	AQUACULTURE	20—HOURS

1. Gut content analysis of fish.
2. Mounting of plankton
3. Aquaculture spotters

Indian Major Carps, Shell Fish –Fresh or Marine Prawn, Pearl Oyster.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyze various components of Water samples.	K4
2	Assess the collection, isolation and identification of planktons.	K5
3	Appraise the organisms on the sandy, muddy, rocky shore fauna with special reference to the adaptation to the environment.	K5
4	Perceive job in companies or organisation involved in environmental monitoring.	K5
5	Adapt the skills acquired to carry out research projects.	K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Reference Books

1	P. Prabhu Prasadini, G Lakshmi Swarajya(2018), Environmental Science: A Practical Manual,BS publications
2	Judith Betsy .C and Felix S (2019)Principles of Aquaculture: Practical Manual, NPH publications, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.nios.ac.in/
2	https://www.sciencedirect.com
Course Designed By: Dr. A. Mary Helitha	**Checked by: Dr. A. Nagasathya**

Semester	Code	Title of the Course	Hours	Credits
IV	21PZO14P	PRACTICAL IV -ENVIRONMENTAL BIOLOGY AND TOXICOLOGY AND AQUACULTURE	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓		✓	✓			✓
CO4	✓	✓		✓			✓	✓	✓	✓
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 – 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO16	NUTRITION AND DIETETICS	L	P	C
Core/Elective/Supportive		CORE COURSE: XVI	06		05

Course Objectives:

The main objectives of this course are to:

1. Understand the Food its types and functions andBiological significance of Micro and Macro nutrients.
2. Understand the nutritive value of different food products and food processing.
3. Understand the mixed diet and balanced diet, planning and evaluation, malnutrition, obesity and role of digestive hormones.
4. Know the nutritional requirements of different age groups, food related problems during pregnancy, adolescence and aged persons.
5. Understand the various Government organized programmes, food standards and adulteration and food spoilage.

UNIT:1	Food types and functions	18—HOURS

1.1 Socio cultural aspects of food nutrients and its types
1.2 Macronutrients – carbohydrates, proteins, fats and water and their biological significance
1.3 Micronutrients
1.4 Vitamins and minerals and their biological significance
1.5 Food preference – preservation
1.6 Food and personal hygiene – hypo and hyperglycemia – proteinuria – hypercholesterolemia
1.7 Nutritional deficiency disorders.

Unit:2	Nutritive values of cereals and millets	18—HOURS

2.1 Pulses – nuts and oil seeds
2.2 Dairy products
2.3 Poultry products
2.4 Aqua products
2.5 Nutritive value of vegetables and fruits – importance of fibre diet
2.6 Food processing – some important spices and condiments.

Unit:3	Balanced diet and mixed diet	18 – HOURS

3.1 Nutrients and its calorie values
3.2 significance of the food guide in meal planning and evaluation
3.3 Dietary intake with age and activity
3.4 Growth pattern and nutritional requirements – growth measurement
3.5 Malnutrition and health and over nutrition and obesity
3.6 Energy needs for the maintenance of body weight

Unit:4	Nutritional requirements	18—HOURS

4.1Pregnancy and foetal growth, infants, preschool age, school age to old age.
4.2 Food and pregnancy related problems
4.3The importance of breast feeding
4.4Adolescence and nutritional status
4.5Diet and social considerations – measurement of body size

Unit:5	Green, white blue revolutions and Government's programmes	18—HOURS

5.1Operation flood programme – supplementary feeding programmes

	5.2 Sources of food spoilage – DDT, pests, rodents, fungi etc. 5.3 Food standards – Agmark, ISI, FPO (Fruit Products Order) 5.4 Food laws and consumer education – food adulteration – precautions.	
	Total Lecture hours	**90 – HOURS**
Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Categorize theFood, its types and functions andBiological significance of Micro and Macro nutrients.	**K4**
2	Evaluate the nutritive value of different food products and food processing.	**K5**
3	Assess the mixed diet and balanced diet, planning and evaluation, malnutrition and obesity.	**K5**
4	Compare the nutritional requirements of different age groups, food related problems during pregnancy, adolescence and aged persons.	**K5**
5	Adapt the knowledge on the various Government organized programmes, food standards and adulteration and food spoilage.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Shubhangini A. Joshi (2017),Nutrition and Dietetics, McGraw Hill Education publications	
Reference Books		
1	Frazier, W. C. and D. C. Westhoff, (2003). Food Microbiology. Tata Mc Graw Hill Publishing Co. Ltd.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102104042	
2	https://bio.libretexts.org/	
Course Designed By: Dr.A.Nagasathya		**Checked by: Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**			**Hours**			**Credits**	
VI	**21PZO16**	**NUTRITION AND DIETETICS**			**6**			**5**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓		✓	✓	✓	✓		✓	✓
CO2	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO3	✓	✓□		✓		✓		✓□		✓
CO4	✓	✓		✓		✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓	✓
Number of Matches(✓)=39 Relationship : High										

Mapping	1 -20	21 – 40	41 – 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZO17	ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY	L	P	C
Core/Elective/Supportive		CORE COURSE: XVII	06		05

Course Objectives:

The main objectives of this course are to:

1. Understand the Ethology, classification of Behavioral pattern, analysis, reflections and perception to the Environment.
2. Understand Neural and hormonal control of behaviour, Genetic and environmental components in the development of behaviour and Motivation.
3. Understand the Ecological aspects of behaviour, Biological rhythms, Learning and memory.
4. Know the different types of Reproductive behaviour and Social Behaviour.
5. Understand the Thermoregulation anda comparative study on Receptor physiology.

UNIT:1	Introduction	18—HOURS

1.1 Ethology as a branch of biology
1.2 Animal psychology, classification of behavioural patterns
1.3 Analysis of behaviour (ethogram), Reflexes and complex behaviour,
1.4 Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual
1.5 Evolution and ultimate causation: Inheritance behaviour and relationships.

Unit:2	Neural and hormonal control of behaviour	18—HOURS

2.1 Genetic and environmental components in the development of behaviour.
2.2 Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation.
2.3 Communication: Chemical, visual, light and audio
2.4 Evolution of language (primates).

Unit:3	Ecological aspects of behaviour	18 – HOURS

3.1 Habitat selection, food selection,optimal foraging theory, anti-predator defences, aggression, homing territoriality, dispersal, host parasite relations.
3.2 Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.
3.3 Learning and memory: Conditioning, habituation, insight learning,association learning and reasoning.

Unit:4	Reproductive behaviour.	18—HOURS

4.1 Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care.
4.2 Social behaviour. aggregations, schooling in fishes, flocking in birds, herding in mammals.
4.3 Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.

Unit:5	Regulation	18—HOURS

5.1 Thermoregulation: Homoeothermic animals, poikilotherms &Hibernation.
5.2 Receptor physiology a comparative study – Mechanoreceptor,Photoreceptor,Phono receptor, Chemo receptor, Equilibrium receptor.
5.3 Bioluminescence

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Categorize the classification of Behavioral pattern, analysis, reflections and perception to the Environment.	**K4**
2	Analyze the Neural and hormonal control of behaviour, Genetic and environmental components in the development of behaviour and Motivation.	**K4**
3	Appraise various types of the Ecological aspects of behaviour, Biological rhythms, Learning and memory.	**K5**
4	Explain the different types of Reproductive behaviour likemating systems, courtship, sexual selection, parental care and Social Behaviour.	**K5**
5	Compile the knowledge concerning the Thermoregulation and a comparative study onReceptor physiology.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Agarwal V.K. (2010)Animal Behaviour (Ethology),Kindle edition.	
Reference Books		
1	Gould, J.L. (1982), The mechanism and Evolution of Behaviour. W. W. Norton & Company	
2	Fatik Baran Mandal, (2015) Textbook of Animal Behaviour, Kindle Edition.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://archive.nptel.ac.in/	
2	https://www.bbau.ac.in/	
Course Designed By: Dr.S.P.Jeyapriya		**Checked by: Dr. A. Nagasathya**

Semester	Code	Title of the Course	Hours	Credits
VI	21PZO17	ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	□✓		✓	✓□		✓
CO4			□	✓	✓	✓	✓		✓	✓
CO5	✓			✓	✓	✓	✓		✓	
Number of Matches(✓)=39 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE1	GENERAL ENTOMOLOGY	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: I	06		04

Course Objectives:

The main objectives of this course are to:

1. To learn the taxonomical importance and classification of insects and General organization of head, Thorax and abdomen.
2. To understand the structure and physiology of digestion, respiration and Feeding habits.
3. To understand the structure and physiology of Circulation and excretion.
4. To know the structure and physiology ofHormonal systems and sense organs.
5. To understand the structure and physiology ofReproduction

UNIT:1	Insect diversity & Organization	18—HOURS

1.1 Insect taxonomy dealing with outline classification of class insect upto orders.
1.2 Apterygote insects, Exopterygote insects and Endopterygote insects
1.3 General organization of head, Thorax and abdomen
1.4 Head capsule – Structure – Antennae – mouth parts
1.5 Wing structure – Abdominal segmentation and appendages.

Unit:2	Feeding and digestion & Respiration	18—HOURS

3.1 Feeding – Ingestion
3.2 Alimentary canal – General Structure – peritrophic membrane – Filter chamber
3.3 Digestion – Salivary glands – Digestive enzymes- Absorption.
3.4 Respiration – Tracheal system – Physiology of respiration
3.5 Respiration of aquatic and endoparasitic insects.

Unit:3	Circulation and excretion	18 – HOURS

3.1 Tubular heart – Composition of haemolymph
3.2 Functions of haemocytes – Flow of circulatory fluid
3.3 Nitrogeneous excretion – Excretory organs – Histophysiology of Malpighian tubules
3.4 Excretory functions of labial glands, nephrocytes and gut cells, uric acid formation and water absorption.

Unit:4	Hormonal systems and sense organs	18—HOURS

4.1 Structure of the brain
4.2 Functions and distribution of Neurosecretory cells of the brain
4.3 Endocrine organs – Corpora cardiaca – Corpora allata – Hormonal action and processing of moulting – Role of ectohormones.
4.4 Sense organs – Eyes and vision mechanoreceptors
4.5 Chemoreceptors – Receptors of temperature and humidity – Sound production.

Unit:5	Reproductive physiology	18—HOURS

5.1 Reproductive system – Mating – Sperm transfer – Egg – Chorionic architecture
5.2 Oviposition
5.3 Pheromones
5.4 Fertilization – Types of development
5.5 Metamorphosis.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:		
1	Build the concrete knowledge about taxonomy and classification and General organization of head, Thorax and abdomen	K3
2	Compare the structure and physiology of digestion, respiration and Feeding habits.	K4
3	Explain the structure and physiology of Circulation and excretion.	K5
4	Interpret the structure and physiology of Hormonal systems and sense organs.	K5
5	Elaborate the structure and physiology of Reproduction	K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Rajendra Singh (2018), Elements Of Entomology, Rastogi Publications	
Reference Books		
1	Mani, M. S., 1973. General Entomology. Oxford and IBH Publications	
2	Chapman, R. F. (1998) , The Insects : Structures and functions. Hodder and Bhoughter Ltd., Kent, USA.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/126104003	
2	https://www.ck12.org/biology/insect-structure-and-function/	
Course Designed By: Dr.A.Maryhelitha	**Checked by: Dr. A. Nagasathya**	

Semester	Code	Title of the Course	Hours	Credits
I	21PZOE1	GENERAL ENTOMOLOGY	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓	✓	✓	✓		✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3		□✓		✓	□✓	✓	✓		□✓	✓
CO4		✓		✓	✓	✓	✓	✓		✓
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE2	BIOTECHNOLOGY	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: II	06		04

Course Objectives:

The main objectives of this course are to:

1. To understand the various techniques used in genetic engineering including enzymes and cloning vehicles.
2. To Screen and select the recombinants and construction of genomic libraries andunderstand the principle and applications of gene sequencing methods
3. To understand the applications of Biotechnology, scientific methodologies used to developvaccines, human peptide hormones and Gene therapy
4. To learn the objectives of gene transfer techniques and techniques in animal Cell cultures
5. To learn the Production and application of Transgenic plants and animals and the ethics related to animal and plant biotechnology

UNIT:1	Introduction to Genetic Engineering	18—HOURS

1.1 Enzymes - Restriction endonuclease- types and properties, ligases, SI nucleases, DNA polymerase-I, Klenow fragment, ribonucleases, terminal dioxynucleotidyl transferase, polynucleotidyl phosphatase, polynucleotidylkinase and reverse transcriptase.

1.2 DNA cloning vectors and their applications : plasmid based cloning vectors – phage vectors -Lambda and M13 virus based vectors, phagemids and cosmids – yeast vectors

1.3 Artificial chromosomes : BAC, YAC and PAC.

Unit:2	Gene cloning strategies	18—HOURS

2.1 Isolation of plasmid and DNA- Cutting and joining of DNA- Method of joining DNA molecules – sticky end ligation – blunt end ligation, Linkers, Adaptors and Homopolymer Tailing.

2.2 Selection and Screening of Recombinants: Methods of transforming *E. coli* and other cells with rDNA methods of selection and screening of transformed cells

2.3 Construction of Genomic and cDNA libraries

2.4 Strategies of expressing cloned genes.

2.5 DNA Sequencing: Maxam and Gilbert method, Sanger method and Automated DNA sequencing – applications.

Unit:3	Biotechnology and Health care	18 – HOURS

3.1 PCR technology: concept – types – primer design – analysis of products and applications.

3.2 Forensic medicine- DNA finger printing - methods and applications, DNA Microarray- applications – site directed mutagenesis.

3.3 Diseases prevention (Vaccines) – Disease diagnosis – probes – monoclonal antibodies – Human peptide hormones (insulin, somatotrophin) – interferons.

3.4 Gene therapy – fertility control – genetically engineered microbes (GEMs) and genetically modified microbes (GMOs).

Unit:4	Animal tissue culture and hybridoma technology	18—HOURS

4.1 Objectives of gene transfer – vectors – gene constructs

4.2 Transfection methods.

4.3 Organ culture technique –large scale culture of cell lines – somatic cell fusion – hybridoma technology - embryonic stem cell culture- cell culture products.

4.4 Applications

Unit:5	Transgenic plants and animals	18—HOURS
1.1 Transgenic plants - *Agrobacterium tumefaciens* - principle – gene transfer. 1.2 Transgenic animals - mice and fish- production and applications **1.3** Ethical issues.		
	Total Lecture hours	**90 – HOURS**

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Categorize the basic tools and techniques of gene cloning in new innovative strategies.	**K4**
2	Compare the principle and applications of gene sequencing methods	**K4**
3	Explain the applications of Biotechnology in various fields and scientific methodologies.	**K5**
4	Assess the objectives of gene transfer techniques and Organ culture techniques in animal cell culture.	**K6**
5	Adapt the knowledge in Production and application of Transgenic plants and animals and its ethics.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Textbook(s)

1	Dubey R. C.(2014)A text Book of Biotechnology. S. Chand and Company, New Delhi.

Reference Books

1	Sathyanarayana. U.(2020) Biotechnology. Books and Allied Pvt Ltd. Kolkata.
2	Primrose S.B. (2000), Modern Biotechnology, Blackwell Scientific Publications, Oxford, London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/102103013
2	https://biotechinfo.com

Course Designed By: Dr.G.Sankar **Checked by: Dr. A. Nagasathya**

Semester	Code	Title of the Course	Hours	Credits
II	21PZOE2	BIOTECHNOLOGY	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓			✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓		✓			✓	✓		

Number of Matches(✓)=40 Relationship : High

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE3	BIOSTATISTICS AND BIOINFORMATICS	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: III	06		04

Course Objectives:

The main objectives of this course are to:

1. To evaluate the Descriptive statistics and Diagrammatic representation of data and Measures of Central tendency.
2. To analyze the statistical inference by, dispersion, Variance and Co efficient of variation.
3. To understand and interpret results based on normal scores by probability and Test of Significance
4. To understand the classification of biological databases.
5. To Understand the protein structural and Molecular modelling and Phylogenetic study using Bioinformatics tools.

UNIT:1	Biostatistics- Introduction	18—HOURS

1.1 Definition, scope of Biostatistics
1.2 Data collection, Classification, Tabulation,
1.3 Graphical and Diagrammatic Presentation – Line graphs, three dimensional graphs, logarithmic curves, scatter diagram, histogram, frequency polygon, frequency curve, Pie charts.
1.4 Measures of Central Tendency - Arithmetic mean, median and mode.

Unit:2	Measures of dispersion	18—HOURS

2.1 Standard deviation, Standard error, Variance, Co efficient of variation.
2.2 Statistical Analysis - Simple correlation – correlation co-efficient
2.3 Regression – Simple and Linear regression
2.4 Analysis of variance – One Way.

Unit:3	Elements of probability	18 – HOURS

3.1 Distribution – Binomial, Poisson and Normal.
3.2 Test of Significance- Sampling – Sampling estimates.
3.3 Test of significance for small samples: Student's t- test, Chi-square test and F test.

Unit:4	Bioinformatics:Introduction	18—HOURS

4.1 Importance and scope
4.2 Classification of Biological Databases
4.3 DNA databases- types, primary and secondary databases – formats and analysis.

Unit:5	Protein databases &Phylogenetic tree	18—HOURS

5.1 Primary and Secondary - structural and molecular modeling database,
5.2 Comparative homology modelling, Protein structure –RasMol.
5.3 Phylip – Sequenc submission through web resources – NCBI, EMBL & PDBI
5.4 Procedure- Tools for submission – BLAST types, FASTA, CLUSTAL.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Discuss the basic statistical concepts and construct their skills in diagrammatic representations.	K6
2	Compare the correlation and regression analyses and measures of Dispersion.	K4
3	Evaluate and find solution to statistical problem in the Research work using Probability, student's t – test, chi- square and F – test.	K5

4	Interpret the classification of biological databases.	**K5**
5	Assess and apply Bioinformatics tools in biomedical research and protein structural and Molecular modelling.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Textbook(s)

1	Ignacimuthu .S (2004) Basic Bioinformatics. Narosa Publications
2	Ramakrishnan, P., 1996. Biostatitics. Saras Publications, Nagercoil.

Reference Books

1	Gurumani. (2011) Biostatistics, MJP Publishers.
2	Rastogi .S.C. (2013) Bioinformatics. PHI Learning PVT limited

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://microbenotes.com/category/bioinformatics/
2	https://nptel.ac.in/courses/102101056

Course Designed By: Dr. S.P.Jeyapriya **Checked by: Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
III	**21PZOE3**	**BIOSTATISTICS AND BIOINFORMATICS**	**6**	**4**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓		✓		✓		✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓		✓	✓	□✓		✓
CO4	✓	✓		✓	✓	✓	✓		✓	✓
CO5	✓		✓				✓	✓	✓	✓

Number of Matches(✓)=38 Relationship : High

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE4	HEALTH AND HYGIENE	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: IV	06		04

Course Objectives:

The main objectives of this course are to:

1. Understand the Health and Personal hygiene, Food hygiene and sanitation.
2. Understand the Causes symptoms and treatment of selected Communicable Diseases and Non Communicable Diseases.
3. Understand the balanced diet, malnutrition, obesity and Nutritional requirement.
4. Understand and analyse the Causes, symptoms of Infective Parasitic Diseases.
5. Understand the Occupational health and Health Programmes in India.

UNIT:1	Health	18—HOURS

1.1 Definition - Physical, Mental, Social and Positive health
1.2 Personal hygiene - Food hygiene
1.3 Food toxicants-Food allergies-Sanitation.

Unit:2	Communicable Diseases &Non- Communicable Diseases	18—HOURS

2.1 Causes, symptoms and treatment of Hepatitis, , Influenza, and AIDS.
2.2 Causes, symptoms and treatment of Tuberculosis, Typhoid and Gonorrhea
2.3 Causes, symptoms and treatment of Chronic Heart disease[CHD],Stroke ,
2.4 Causes, symptoms and treatment of Diabetes, Hypertension, Asthma
2.5 Causes, symptoms and treatment of Chronickidney disease.

Unit:3	Nutrition And Health	18 – HOURS

3.1 Balanced diet-Calorie requirements- Protein, Fat and Carbohydrate
3.2 Malnutrition
3.3 Obesity
3.4 Nutritional requirements-For School children, Adolescents, Pregnant and Lactating Women.

Unit:4	Infective Parasitic Diseases	18—HOURS

4.1 Causes, symptoms and life cycle -Protozoans –*Entamoeba histolytica, Trypanosoma, Leishmania* and *Plasmodium.*
4.2 Helminthes-*Taenia solium, Fasciola hepatica* and *Ascaris.*
4.2 Causes and symptoms -Arthropods - Mosquito, House fly and Head Louse.

Unit:5	Occupational health	18—HOURS

5.1 Physical, Mechanical, Biological and Psychological Hazards.
5.2 Health Programmes-Primary Health Centre [PHC], WHO,National Malarial Eradication Programme
5.3 Vaccination Campaign and National AIDS control Programme.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Apply the knowledge on the he Health and Personal hygiene, Food hygiene and sanitation.	**K3**
2	Analyze the Causes, symptoms and treatment of selected Communicable	**K4**

	Diseases and Non Communicable Diseases.	
3	Categorise the composition of balanced diet causes of malnutrition and obesity and Nutritional requirement.	**K4**
4	Evaluate the Causes, symptoms of Infective Parasitic Diseases.	**K5**
5	Adapt the knowledge in Occupational health and Health Programmes.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Sorna Raj. R and Kumaresan V. (2015) Public health and Hygiene. Saras Publication	
2	Kochhar. S.K (2009) A Text Book of Parasitology, Wisdom Press.	
Reference Books		
1	Dr K Dass (2021) Public Health and Hygiene, Notion Press.	
2	Swaminathan. M (2015) Advanced Text Book on Food and Nutrition Bangalore Printing and publishing Co Ltd.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102104042	
2	https://bio.libretexts.org/	
Course Designed By: Dr.S.P.Jeyapriya	**Checked by: Dr. A. Nagasathya**	

Semester	**Code**		**Title of the Course**			**Hours**			**Credits**
IV	**21PZOE4**		**HEALTH AND HYGIENE**			**6**			**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1				✓	✓		✓	✓		✓
CO2	✓	✓		✓	✓		✓	✓	✓	✓
CO3	✓	□✓		✓	□✓	✓	✓	✓□	□✓	✓
CO4	✓	✓	□✓	✓		✓	✓	✓	✓	✓
CO5	✓		✓	✓	✓	✓	✓	✓		✓
Number of Matches(✓)=39 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE5	POULTRY SCIENCE	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: V	05		04

Course Objectives:

The main objectives of this course are to:

1. Understand the Different breeds of poultry and Choosing commercial laying stock and Poultry Housing
2. Understand the Rearing of Chick, Culling and Management of chicks, layers, broilers and Debeaking.
3. Understand the Poultry Nutrition, Feed formulations and Deficiency diseases
4. Understand the symptoms and preventive measures of Poultry diseases and Vaccination programme
5. Understand the Quality Management of freshly laid eggs and Preservation.

UNIT:1	Introduction	18—HOURS

1.1 Different breeds of poultry – Indigenous – Aseel, Chittagong ,Ghagus, Basra.

1.2 Exotic- Asiatic, English, American, Mediterranean, Oriental, their advantageous features – Choosing commercial laying stock.

1.3 Poultry Housing – Semi intensive method, intensive method, Deep litter system, cage system – Poultry manure.

Unit:2	Rearing of Chick	18—HOURS

2.1 Culling – Management of chicks

2.2 Management of layers

2.3 Management of broilers – Lighting and Temperature

2.4 Summer management – Winter management

2.5 Debeaking.

Unit:3	Poultry Nutrition	18 – HOURS

3.1 Sources – Carbohydrate, fat, proteins, amino acids, minerals, vitamins

3.2 Deficiency diseases

3.3 Feed additives

3.4 Feed stuffs and Feed formulations.

Unit:4	Poultry diseases	18—HOURS

4.1 Viral – symptoms and preventive measures

4.2 Bacterial – symptoms and preventive measures

4.3 fungal – symptoms and preventive measures

4.4 parasitic – symptoms and preventive measures

4.5 Vaccination programme

Unit:5	Quality Management of freshly laid eggs	18—HOURS

5.1 Size and shape – Deterioration in quality and its causes

5.2 Preserving the quality of market eggs – Preserving eggs for home use – Dealer control of egg quality

5.3 Preserving quality in storage – Shell sealing to preserve egg quality – Thermostabilizing to preserve egg quality – Freezing yolks and whites – Drying yolks and whites – Grading eggs in the shell – packing eggs for market

5.4 Marketing problems in relation to production – shell egg marketing methods.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Choose commercial laying stock and Poultry Housing for Different breeds of poultry	**K6**
2	Compare the procedures for Rearing of Chick, Culling and Management of chicks, layers, broilers and Debeaking.	**K5**
3	Deduct the Poultry Nutrition, Feed formulations and Deficiency diseases.	**K5**
4	Explain the symptoms and preventive measures of Poultry diseases and Vaccination programme	**K5**
5	Improve the Quality Management of freshly laid eggs and Preservation.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Textbook(s)

1	Gnamani. (1993) Modern aspects of poultry keeping. Hytone Publishers, Madurai.

Reference Books

1	Chauhan, (2018) Poultry Diseases, Diagnosis and Treatment. Wiley Eastern Ltd., New Delhi.
2	Singh, J. and E. N. More, (1982) Livestock and Poultry Production. Prentice Hall of India.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://agritech.tnau.ac.in/
2	https://dahd.nic.in/

Course Designed By: Dr. A. Mary Helitha **Checked by: Dr. A. Nagasathya**

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
IV	**21PZOE5**	**POULTRY SCIENCE**	**5**	**4**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓	✓	✓		✓
CO3	✓		✓	✓		✓	✓	✓□	□✓	✓
CO4	✓				✓	✓	✓			✓
CO5		✓	✓	✓	✓	✓	✓	✓	✓	

Number of Matches(✓)=39 Relationship : High

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE6	NANOTECHNOLOGY	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: VI	05		04

Course Objectives:

1. To understand the Basic concepts of Nano science and technology.
2. To understand structure, types and properties of Nano scale materials, processing methods and Use of microorganisms for nanostructure formation
3. To understand the process and mechanism of Gold and Silver Nanoparticles in cancer targeting and treatment, Biomedical Nanoparticles, Different types of drug loading and Drug delivery
4. To understand and analyse the Interaction between biomolecules and nanoparticle surface, Nanosensors, Biochips and Nanotechnology in agriculture typing
5. To understand the impact of Nano toxicology and Microorganisms for toxicity detection

UNIT:1	Introduction	18—HOURS

1.1 Nano Materials and Nanotechnology
1.2 Basic concepts of Nano science and technology
1.3 Quantum wire – Quantum well – Quantum dot - Carbon Nanotubes -Fullerenes- Nano Shells Nano pores and Metal Nanoparticles –Structure and their properties

Unit:2	2. Nano Material synthesis and processing methods	18—HOURS

2.1Nano scale materials - mechanical grinding, wet chemical synthesis – sol-gel processing, gas phase synthesis, gas condensation processing, chemical vapour condensation and Physical vapour condensation– Nano composite synthesis – processing.
2.2 Microwave Synthesis of materials – Principles of SEM, TEM and AFM.
2.3 Microorganisms for synthesis of nanomaterials, Natural and artificial synthesis of nanoparticles in microorganisms
2.4 Use of microorganisms for nanostructure formation

Unit:3	**3.** Nanostructured materials in Medicine	19 – HOURS

3.1 Gold and Silver nanoparticles in cancer targeting and treatment – Nanoparticles in treatment of breast cancer – Chemotherapy – Active and Passive cancer tissue targeting – Micro fluidics – Chemotherapeutic agents, Nano particulate targeting.
3.2 Nano-materials in bone substitutes & Dentistry
3.3 Antibody conjugated nanoparticles – Conjugated nanoparticles interaction with biological surfaces – Biomedical nanoparticles – Different types of drug loading and Drug delivery.

Unit:4	Nano-biotechnology	18—HOURS

4. Nano-biotechnology
4.1 Interaction between bimolecules and nanoparticle surface
4.2 Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, nanoprobes for Analytical Applications,Nanosensors.
4.3 Biochips- analytical devices, Natural nanocomposite systems as spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly.
4.4 Polymeric nanofibres – Implications in Neuro science, tissue engineering and cancer therapy. Micro emulsions in nanotechnology.
4.6 Nanoparticles as carrier for genetic material – Nanotechnology in agriculture –Fertilizer and pesticides

Unit:5	5.Quality Management of freshly laid eggs	18—HOURS

5. Nano toxicology

5.1 Microorganisms for toxicity detection.

5.2 Testing of environmental toxic effect of nanoparticles using microorganisms; Mechanism of nanosize particle toxicity - Reactive oxygen species mechanisms of NSP toxicity

5.3 Biological Activities of Respiratory Tract – Efficient deposition of inhaled NSPs. - Disposition of NSPs in the respiratory - Epithelial translocation - Translocation to the circulatory system - Neuronal uptake and translocation - Exposure via GI Tract and Skin

	Total Lecture hours	**90 – HOURS**

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Apply the Basic concepts of Nano science and technology.	**K3**
2	Categorize the structure, types and properties of Nano scale materials, processing methods and Use of microorganisms for nanostructure formation.	**K4**
3	Distinguish the process and mechanism of Gold and Silver Nanoparticles in cancer targeting and treatment, Biomedical Nanoparticles, Different types of drug loading and Drug delivery.	**K5**
4	Explain the Interaction between biomolecules and nanoparticle surface, Nanosensors, Biochips and Nanotechnology in agriculture typing.	**K5**
5	Compile the knowledge on the impact of Nano toxicology and Microorganisms for toxicity detection.	**K6**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Reference Books

1	Text Book of Nanoscience and Nanotechnology, (2013) B.S.Murthy & P.Shankar

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	www.kth.se
2	www.wikipedia.org

Course Designed By: Dr. A. Nagasathya **Checked by: Dr. A. Nagasathya**

Semester	Code	Title of the Course	Hours	Credits
IV	21PZOE6	NANOTECHNOLOGY	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓	✓	✓		✓
CO3	✓		✓	✓		✓	✓	✓□	□✓	✓
CO4	✓				✓	✓	✓			✓
CO5		✓	✓	✓	✓	✓	✓	✓	✓	

Number of Matches(✓)=39 Relationship : High

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	11-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOE7	GENOMICS AND PROTEOMICS	L	P	C
Core/Elective/Supportive		ELECTIVE COURSE: VII	06		04

Course Objectives:

The main objectives of this course are to:

1. Understand the Organization and structure of genomes and genome mapping.
2. Understand the Sequencing methods and Strategies and Mapping by genetic markers.
3. Understand the comparative genomics of bacteria, organelles, and eukaryotes.
4. Understand and analyse the construction, design and applications of Microarray and Gene silencing.
5. Understand Proteomics expression, structure and interaction.

UNIT:1	GenomeMapping	18—HOURS

1.1 Organization and structure of genomes - size, complexity, Prokaryotic and Eukaryotic genomes.

1.2 Organelle genome - Mitochondrial genome, and Chloroplast genome.

1.3 Transposable elements, retro-transposons, SINE, LINE, Alu and other repeat elements and pseudogenes,

Unit:2	Sequencing methods and Strategies	18—HOURS

2.1 Mapping genomes - physical maps- EST, SNPs as physical markers.

2.2 Genetic maps – linkage mapping, cross breeding and pedigree analysis.

2.3 Restriction mapping- FISH – STS mapping.

2.4 Mapping by genetic markers- DNA markers, RAPD, RFLP, SSLPs.

2.5 Sequencing genomes- Basic DNA sequencing, high-throughput sequencing, Shotgun sequencing- strategies of sequencing, recognition of coding and non-coding regions and annotation of genes.

Unit:3	Comparative genomics	18 – HOURS

3.1 Orthologs and Paralogs, protein evolution by exon shuffling

3.2 human genome project

3.3 Comparative genomics of bacteria, organelles, and eukaryotes.

3.4 Bioinformatics - datasets, sequence analysis based on alignment, de novo identification of genes, *in silico* methods.

Unit:4	Functional genomics	18—HOURS

4.1 DNA micro-array profiling –Construction and Design

4.2 Applications in cancer and Healthcare.

4.3 Gene silencing, RNAi, Si RNA , SH RNA

4.4 Transcriptome analysis.

Unit:5	Proteomics	18—HOURS

5.1 Expression analysis,

5.2 protein structure analysis,

5.3 protein-protein interaction and drug discovery.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:		
1	Explain the Organization and structure of genomes and genome mapping.	**K4**
2	Compare Sequencing methods, Strategies and Mapping by genetic markers.	**K4**
3	Justify the comparative genomics of bacteria, organelles, and eukaryotes.	**K5**
4	Elaborate the construction, design and applications of Microarray and Gene silencing.	**K6**
5	Adapt the knowledge of Proteomics expression, structure and interaction.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Primrose, S. B. and Twyman R. M., (7th Ed., 2013),Principle of Genome Analysis and Genomics, Blackwell Publishing Company, Malden, USA	
Reference Books		
1	Brown, T. A., (2006) , Genomes 3, Garland Science Publishing, London, UK	
2	Lesk (2015)Introduction to Genomics, Oxford University press,India	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/102103017	
2	https://nptel.ac.in/courses/102101076	
Course Designed By: Dr.A.Nagasathya	**Checked by: Dr. A. Nagasathya**	

Semester	**Code**	**Title of the Course**	**Hours**	**Credits**
IV	**21PZOE7**	**PROTEOMICS AND GENOMICS**	**6**	**4**

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓		✓		✓		✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO3	✓	□✓	✓	✓	□✓	✓	✓	✓□	□✓	
CO4	✓	✓	□✓	✓		✓	✓	✓		✓
CO5	✓		✓		✓		✓	✓	✓	✓
Number of Matches(✓)=40 Relationship : High										

Mapping	1 -20	21 – 40	41 - 60	61 – 80	81 – 100
Matches	1-10	10-20	21-30	**31-40**	41-50
Relationship	Very Poor	Poor	Moderate	**High**	Very High

Course code	21PZOSS1	VERMITECHNOLOGY	L	P	C
Core/Elective/Supportive		SELF STUDY PAPER – I			

Course Objectives:

The main objectives of this course are to:

1. Understand the Earthworms and their environment, diversity, distribution and biology.
2. Understand the Role of earthworms in soil structure, fertility and productivity.
3. Understand the process and mechanism of Earthworms in organic waste management.
4. Understand and analyse the Effects of agricultural practices and chemicals on Earthworms.
5. Understand the effects of earthworms on the number, biomass and activity of microorganisms and field sampling methods.

UNIT:1	Introduction	18—HOURS

1.1 Earthworms and their environment, diversity, distribution and biology.
1.2 The nature of earthworms- soil environment – basic environmental requirements.
1.3 Food and digestive capabilities, respiratory requirements and adaptation.
1.4 Systematic affinities and evolutionary descent. Families, genera and species.Geographical distribution. Life style, behavior patterns, water relationships, regeneration and transpiration.

Unit:2	Role of earthworms in soil structure, fertility and productivity	18—HOURS

2.1 Earthworms burrows and casts.
2.2 Effect earthworms in soil structure – carbon, nitrogen and phosphorous.
2.3 Transformations. Earthworms as bio-indicators of soil types.
2.4 Effect of earthworms on plant productivity.
2.5 Earthworms in land amelioration and reclamation.
2.6 Earthworms as indicators of environmental contamination.

Unit:3	Earthworms in organic waste management	18 – HOURS

3.1 Management of sewage sludge by earthworms.
3.2 Management of animal, vegetable and industrial organic waste by earthworms.
3.3 Earthworm composts as plant growth media and its marketing.
3.4 The use of earthworm as food protein source for animals Engineering of waste management.
3.5 Role of earthworms in processing organic wastes applied to agricultural and Other land

Unit:4	Effects of agricultural practices and chemicals on Earthworms.	18—HOURS

4.1 The effects of cultivation, Cropping,
4.2 Fertilizers, Chemicals,
4.3 Radioisotopes,
4.4 Heavy metals and acid deposition and earthworms.

Unit:5	Earthworms and microorganisms and field sampling methods.	18—HOURS

5.1 The effects of earthworms on the number, biomass and activity of microorganisms.

5.2 Importance of microorganisms as food for earthworms.

5.3 Dispersal of microorganisms earthworms.

5.4 Role of intestinal microbes of earthworms on the decomposition of organic wastes. 5.5 Field sampling – Passive methods, behavioural methods and Mark recapture methods. 5.6 Counting of mass and biomass estimation.		
	Total Lecture hours	**90 – HOURS**
Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Apply the indepth knowledge on theEarthworms and their environment, diversity, distribution and biology.	**K3**
2	Assess the Role of earthworms in soil structure, fertility and productivity.	**K4**
3	Analyze the process and mechanism of Earthworms in organic waste management.	**K4**
4	Explain the Effects of agricultural practices and chemicals on Earthworms.	**K5**
5	Elaborate the knowledge on the effects of earthworms on the number, biomass and activity of microorganisms and field sampling methods.	**K5**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Seetha lekshmy.M and Shanthi.R 2017 Vermitechnology Saras Publications	
Reference Books		
1	Edwards, C. A. and P. J. Bohlen, 1996. Ecology of Earthworms, 3rdEdn. Chapneau and Hall.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.swayam2.ac.in/cec21_ag03/	
Course Designed By: Dr. A.Maryhelitha		**Checked by: Dr. A. Nagasathya**

Course code	21PZOSS2	ENDOCRINOLOGY	L	P	C
Core/Elective/Supportive		SELF STUDY PAPER – II			

Course Objectives:

The main objectives of this course are to:

1. Understand the scope of endocrinology and the endocrine glands in crustaceans, insects and vertebrates its Localisation and organization.
2. Study the Nature, function and classification of hormones and regulation of Hormones.
3. Understand the action of hormones and hormonal control involved in the reproduction of crustaceans, insects and vertebrates.
4. Know the different types of Endocrine abnormalities and its symptoms, diagnosis.
5. Understand the Induced breeding in fish and prawn

UNIT:1	Introduction	18—HOURS

1.1 Scope and Historical perspective
1.2 Endocrine glands in vertebrates
1.3 Localisation and organization: Rat: Hypothalamus, pineal, pituitary, thymus, thyroid, pancreas, adrenal, ovary and testis.

Unit:2	Mechanism of hormonal regulation	18—HOURS

2.1 Peptide hormones - positive and negative feed back mechanism.
2.2 Steroid hormones- positive and negative feed back mechanism.

Unit:3	Hormonal control of reproduction	18 – HOURS

3.1 Crustacea and Insecta: pheromone, allomone,
3.2 Hormone- behaviour- pest control.

Unit:4	Endocrine abnormalities	18—HOURS

4.1 Acromegaly- Etiology,symptoms,diagnosis
4.2 cretinism, dwarfism- Etiology,symptoms,diagnosis
4.3 gigantism, goiter- Etiology,symptoms,diagnosis
4.4 mellitus and infertility- Etiology,symptoms,diagnosis

Unit:5	Induced breeding in fish and prawn	18—HOURS

5.1 Uses of hormones in assisted reproduction[farm animals and human]
5.2 Hormonal contraceptives.

	Total Lecture hours	90 – HOURS

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Assess the endocrine glands in crustaceans, insects and vertebrates its Localisation and organization.	K3
2	Analyze the structural organization and mechanism of peptide hormones and	K4

	steroid hormones.	
3	Explain the feedback control of gonadial hormones and their role in the development of male and female gametes.	**K5**
4	Elaborate the different types of Endocrine abnormalities and its symptoms, diagnosis.	**K5**
5	Adapt strong knowledge concerning the Induced breeding in fish and prawn.	**K6**
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create		
Textbook(s)		
1	Mala Dharmalingam (2010)Textbook of Endocrinology,Athithi publisher	
Reference Books		
1	Wilson J.D. and D.W.Foster. 1992. William's Textbook of endocrinology. 8dth edn. W.B. sauunders company, Philadelphia.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.swayam2.ac.in/cec20_bt21/	
Course Designed By: Dr. S.P.Jeyapriya	**Checked by: Dr. A. Nagasathya**	