

GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to University of Madras and Re-Accredited at 'A' Grade by NAAC)

Guru Nanak Salai, Velachery, Chennai – 600042.



B.Sc. Advanced Zoology and Biotechnology

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the candidates admitted in the Academic year 2020-21 and thereafter)

Vision

To instil the scientific dogmas of nature; to provoke the interest towards learning science and allied subjects; to equip the students with scientific skills to acquire competency needed for employment; to inculcate professional ethics and value-based education to improve socio-economic status; to impart interdisciplinary approach for identifying and solving real world scientific problems through research.

Mission

To facilitate an encouraging and exciting environment to develop the scientific temper in students through a curriculum based on fundamental as well as advanced scientific knowledge.

To provide technical skills in the respective disciplines through conducting practical training including internship as well as project, this will hone the skills necessary to become a successful mathematician, physicist, chemist, biotechnologist and visual communication professional.

To inculcate interdisciplinary knowledge, elective subjects in various fields are offered, thereby providing an opportunity to the students to identify their interest towards a particular field and pursue the passion.

PROGRAMME OUTCOME

- PO1.** Demonstrate an understanding of biology at the level of molecules, cells, systems, organisms and ecosystems
- PO2.** Demonstrate an understanding of key concepts in evolutionary biology, ecology, neurobiology, cell biology, molecular biology, biochemistry, genetics, developmental biology and physiology
- PO3.** Demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs, and understand and use information from scientific papers
- PO4.** Demonstrate skill in communication of scientific data in standard format
- PO5.** Demonstrate the Genetic Engineering and Recombinant DNA technology

PROGRAMME SPECIFIC OUTCOMES

- PSO1.** Knowledge about the nature and basic concepts of biological science and evolutionary relationships of major group of animals.
- PSO2.** Recognize the functions of the organism at the level of gene, genome, cell, tissue, organ, and organ-system

B. SC., ADVANCED ZOOLOGY AND BIOTECHNOLOGY

COURSE STRUCTURE (2020-2023) BATCH

Sem.	Part	Course Component	Subject Code	Subject Name	Cdt	Hrs	CIA	ESE	Total
I	I	Language	19UTAM141	Tamil I	3	6	50	50	100
	II	English	19UENG241	English I	3	4	50	50	100
	III	Core I	19UZOO301	Diversity and Functional Anatomy of Invertebrates	4	6	50	50	100
			19UZOO302P	Practical I – Invertebrata and Chordata	-	2	*	*	*
		Allied I	19UPBT331	Botany I	3	6	50	50	100
	IV	1.NME/ Basic Tamil/ Basic Hindi/ Adv. Tamil	19UNME401G	Aquaculture	2	2		100	100
			19UGSL401	Soft Skill I	2	2		100	100
Total credit =18; Total Hours = 30									
II	I	Language	19UTAM142	Tamil II	3	6	50	50	100
	II	English	19UENG242	English II	3	4	50	50	100
	III	Core II	19UZOO303	Diversity and Functional Anatomy of Chordates	4	6	50	50	100
			19UZOO302P	Practical I – Invertebrata and Chordata	4	2	50	50	100
		Allied II	19UPBT333	Botany II	3	6	50	50	100
	IV	1.NME/ Basic Tamil/ Basic Hindi/ Adv. Tamil	19UNME402G	Public Health and Hygiene	2	2		100	100
			19UGSL402	Soft Skill II	3	2		100	100
Total credit =26; Total Hours = 30									
III	I	Language	19UTAM143	Tamil III	3	6	50	50	100
	II	English	19UENG243	English III	3	4	50	50	100
	III	Core III	19UZOO304	Cell and Molecular Biology	4	6	50	50	100
			19UZOO305P	Practical II – Cell Biology & Genetics	-	2	*	*	*
		Allied III	19UCHE336	Chemistry I	3	6	50	50	100
	IV	1. Skill Based subjects	19UGSL403	Soft Skill III	3	2		100	100
			19UEVS401	Environmental Science	-	2	*	*	*

Total credit =16; Total Hours = 30									
IV	I	Language	19UTAM144	Tamil IV	3	6	50	50	100
	II	English	19UENG244	English IV	3	4	50	50	100
	III	Core IV	19UZOO306	Genetics and Evolution	3	6	50	50	100
			19UZOO305P	Practical II – Cell Biology & Genetics	4	2	50	50	100
		Allied IV	19UCHE338	Chemistry II	3	6	50	50	100
			19UCHE337P	Allied Chemistry Practical	4	2	50	50	100
	IV	1. Skill Based subjects	19UGSL404	Soft Skill IV	3	2		100	100
		2.EVS	19UEVS401	Environmental Science	2	2		100	100

Total credit =25; Total Hours = 30

V	III	Core V	19UZOO307	Developmental Biology and Immunology	4	4	50	50	100
		Core VI	19UZOO308	Biotechnology and Nanotechnology	4	4	50	50	100
		Core VII	19UZOO319	Animal Physiology, Biochemistry and Endocrinology	4	4	50	50	100
		Core VIII	19UZOO310	Biostatistics and computer Applications for Life Sciences	4	4	50	50	100
			19UZOO311P	Practical – III Animal Physiology, Biochemistry, Developmental Biology and Immunology	-	4	*	*	*
			19UZOO312P	Practical IV – Environmental Biology, Biotechnology & Microbiology	-	4	*	*	*
		Elective I (IDE)	19UIDE309	Wildlife Conservation	5	5	50	50	100
	IV	Value Education		Value Education	2	1		100	100
		Internship			2				

Total credit =25; Total Hours = 30

VI	III	Core XI	19UZOO313	Environmental Biology and Taxonomy	4	4	50	50	100
		Core XII	19UZOO314	Genetic Engineering and Recombinant DNA Technology	4	4	50	50	100
		Core XIII	19UZOO315	Microbiology and Industrial Biotechnology	4	4	50	50	100

			19UZOO311P	Practical – III Animal Physiology, Biochemistry, Developmental Biology and Immunology	4	4	50	50	100
			19UZOO312P	Practical IV – Environmental Biology, Biotechnology & Microbiology	4	4	50	50	100
		Elective - II	19UZOO316	Medical Laboratory Technique and Bioinstrumentation	5	5	50	50	100
		Elective III	19UZOO317	Economic Entomology and Pest Management	5	5	50	50	100
	V	Extension Activities			1	-			-
Total credit =31; Total Hours = 30									
					OVERALL CREDIT TOTAL = 141				

*Examination will be held in the Even Semester

SEMESTER I

GURU NANAK COLLEGE (AUTONOMOUS), CHENNAI – 600 042

(Effective for the batch of candidates admitted in 2020 - 2023)

CORE - I

DIVERSITY AND FUNCTIONAL ANATOMY OF INVERTEBRATES

SUBJECT CODE : 19UZOO301	THEORY	MARKS: 100
SEMESTER: I	CREDITS: 4	TOTAL HOURS: 90

COURSE OBJECTIVES

To enable the students to develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from cellular to multicellular animals. Studies on this group of animals bring to light knowledge of basic functions of life viz., nutrition, respiration, excretion, reproduction etc. and how the Organisms of various phyla structurally and functionally adapt themselves for surviving in different ecological conditions. Classification and general characters of the following phyla up to classes with a detailed study of the animals mentioned against each phylum.

UNIT-I (15 hrs)
Protozoa: Paramecium, Plasmodium

UNIT-II (18 hrs)
Porifera : Sycon, Canal System in Sponges
Coelenterata : Obelia, Aurelia, Polymorphism

UNIT-III (18 hrs)
Platyhelminthes : Fasciola, Taenia, Parasitic Adaptations
Nematoda : Ascaris, Nematode parasites of humans.
Annelida : Nereis, Excretory Organs in Annelida, Metamerism in Annelida

UNIT-IV (21 hrs)
Arthropoda : Penaeus, Larval Forms in Crustacea
Mollusca : Pila, Foot in Molluscs, Economic importance of Mollusca.

UNIT-V (18 hrs)
Echinodermata : Asterias, Larval Forms
Hemichordata : Balanoglossus (External Characters Only) and its Systematic Position.

Books Recommended:

1. Dhama, P.S. and Dhama, J.K., Invertebrates, 5th ed., R. Chand Publisher, 1979.
2. Kotpal, R.L., Invertebrates, Rastogi Publications, Meerut, 2005.
3. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, Vol. I edited by
4. Marshall, A.J. and Williams, W.D., CBS Publication & Dist., Delhi, 1990.
5. Barnes, A., Invertebrate Zoology, Harcourt Publishers, International Company, 2001.

6. Chaudhry, S., Fundamental Invertebrate Zoology, S.Vikas & Co. Fatehpura, Jalandhar, 2003.
7. 2003.
8. Ekambaranatha Ayyar, M and Ananthakrishnan, T.N. 1993, Outlines of Zoology, Vol.I, Part I and II, Viswanathan and Co. Madras.
9. T.C. Majpuria. 1990, Invertebrate Zoology, Pradeep Pub. Kitab Mahal.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

ALLIED ZOOLOGY –I

SUBJECT CODE - 19UZOO331	THEORY	MARKS 100
SEMESTER: I	CREDITS: 4	TOTAL HOURS: 90

COURSE OBJECTIVES

To enable the students to develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from cellular to multicellular animals.

Unit – I (20 Hrs)

Introduction: Invertebrata- General characters and Classification.

Protozoa – Type study: Plasmodium vivax

Porifera – Type study :Scypha (Sycon)

Coelenterata – Type study: Obelia geniculata

Platyhelminthes- Type study : Taenia solium

Unit – II (20 Hrs)

Annelida – Type study: Leech

Arthropoda – Type study: Prawn

Mollusca – Type study: Unio (External morphology and Respiratory system)

Echinodermata – Type study: Starfish (External morphology and Water vascular system)

Unit – III: (15Hrs)

Chordata – General characters& Classification

Prochordates – Amphioxus – Structure

Vertebrates- Pisces- Type study : Shark

Unit – IV (20 Hrs)

Amphibia- Type study: Frog (External morphology, Digestive system, Circulatory System and Reproductive system)

Reptilia: Calotes (External morphology, Digestive system, Circulatory System and Reproductive system)

Unit – V (15Hrs)

Aves- Type study: Pigeon (External morphology and Respiratory system)

Mammalia- Type study: Rabbit (External morphology and Circulatory system)

Text Book

1. Ekambaranatha Ayyar, M and Ananthkrishnan, T.N. 1993, Outlines of Zoology, Vol.I and II, Viswanathan and Co. Madras.

Reference Books:

2. P.S. Dhami and J.K. Dhami – Invertebrate Zoology – S. Chand and Co. New Delhi.
3. Jordan, E.K. and P.S. Verma, 1993. Chordate Zoology, 12th edition, S. Chand & Co. Ltd., Ram Nagar, New Delhi.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	3	30
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Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	

NON-MAJOR ELECTIVE

AQUACULTURE

SUBJECT CODE - 19UNME401G	THEORY	MARKS 100
SEMESTER: I	CREDITS: 2	TOTAL HOURS: 30

COURSE OBJECTIVES

Aquaculture is an environmentally responsible source of food and commercial products, helps to create healthier habitats, and is used to rebuild stocks of threatened or endangered species.

Unit – I **(6 hrs)**

History of aquaculture – Purpose and importance of aquaculture – Physical and chemical characteristics features of water bodies (Freshwater brackish water and marine water) – Types of culture systems (Traditional, intensive, semi-intensive and extensive).

Unit – II **(6 hrs)**

Selection criteria for cultivable species – Site selection for fish farming – Construction of fish and Prawn ponds – Types of fish ponds (breeding pond, hatchery unit, brooders pond, nursery pond, stocking pond and rearing pond) – Maintenance and management of different ponds. Feeds for cultivable species – natural, supplementary and artificial feeds.

Unit – III **(6 hrs)**

Types of culture – Monoculture, Monosex-culture & Poly culture – Integrated fish farming (paddy cum fish culture, paddy cum prawn culture and Duck cum pig cum fish culture) – Induced breeding in Indian major carps.

Unit – IV **(6 hrs)**

Culture of air-breathing fishes (Mullet and Cat fish) Sewage fed fish culture – Culture of Pearl Oyster and Edible Oyster.

Unit – V **(6 hrs)**

Culture of marine and freshwater prawns – Common fish diseases (bacterial, fungal, viral and parasitic diseases) – Prevention and treatment – Fishing technology (Crafts and gears) – Preservation and Processing of Fish and Prawn – Agencies involved in Aquaculture.

Text Books

1. R. Santhanam, N. Sukumaran and Natarajan, - A manual of fresh water aquaculture, Oxford and IBH Publishing Co Pvt. Ltd., Mumbai.
2. B.N. Yadav, - Fish and fisheries, Daya Publishing House, Delhi.

Reference Books:

1. Mathew Landan, 1991. Introduction to aquaculture, John Wilay and Sons Inc..
2. V.R.P. Sinha, 1993. Acompendium of aquaculture Technologies for developing countries, Oxford and IBH Publishing Company PVT. Ltd. 54

3. V.G. Jhingran,1991. Fish and fisheries of India, Hindustan Publishing Corporation, Delhi.
4. T.V.R. Pillay – Aquaculture principles and practices, Fishing new Books, Blackwell Science Ltd., Oxford.
5. Shanmugam, K. 1990. Fishery Biology and Aquaculture, Hindustan Pub. Corporation, New Delhi.
6. C.V. Kurian and Sebastein – Prawn and Prawn fisheries of India, Hindustan Publishing House, New Delhi.
7. Elvire Balugal, A. 1984. Aquaculture systems and practices – A selected Review, Daya Publishing House, New Delhi.
8. B.N.Yadav, 1995. Fish Endocrinology, Daya Publishing House, New Delhi.

SEMESTER II

CORE - II

DIVERSITY AND FUNCTIONAL ANATOMY OF CHORDATES

SUBJECT CODE : 19UZOO303	THEORY	MARKS 100
SEMESTER: II	CREDITS: 4	TOTAL HOURS: 90

COURSE OBJECTIVES

To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates. Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I **(20 hrs)**

Cephalochordata: Branchiostoma; Development and affinities.

Cyclostomata : Petromyzon; Migration

UNIT-II **(15 hrs)**

Hemichordata : Balanoglossus; Development and affinities

UNIT-III **(20 hrs)**

Urochordata: Herdmania; Development and Affinities: Alternation of generation in Urochordata.

Pisces : Labeo, Accessory respiratory organs in fishes, Types of fins

Amphibia : Rana, Parental care.

UNIT-IV **(20 hrs)**

Reptilia : Calotes, Arcades and fossae

Aves : Columba, Migration in birds; Palate in birds.

UNIT-V **(15 hrs)**

Mammalia : Oryctolagus, Dentition in mammals.

Books Recommended:

1. Dhama, P.S., Dhama, J.K., Chordate Zoology, Dinesh Publishers, Jalandhar, 1982.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, CBS Publishers, Delhi, 2000.
3. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vol. II- Vertebrates. Latest edition, CBS Publishers, Delhi edited by Late A.J. Marshall & Williams, W.D.
4. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.
5. Bhamrah, H.S. and Juneja, K., An introduction to fishes, Anmol Publications, New Delhi, 1990.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE III

PRACTICAL I: INVERTEBRATA AND CHORDATA

SUBJECT CODE : 19UZOO302	PRACTICAL	MARKS 100
SEMESTER: I & II	CREDITS: 4	TOTAL HOURS: 60

I. DISSECTION

A. Cockroach

1. External characters
2. Digestive system
3. Nervous system

B. Prawn

4. External characters
5. Digestive system

C. Any Bony Fish:

6. External characters
7. Digestive system

II. MOUNTING

Mouth parts of:

8. Cockroach
9. Mosquito
10. Prawn: Appendages
11. Fish Scales: Ctenoid scale, Cycloid scale and Placoid scale

III – SPOTTERS

A- Classify giving reasons up to order:

1. Paramecium
2. Scypha
3. Obelia
4. Taneaia Solium
5. Ascaris
6. Neanthes
7. Penaeus

8. Asterias
9. Balanoglossus
10. Amphioxus
11. Scoliodon sorrakowah
12. Rana hexadactyla
13. Calotes versicolor
14. Columba livia
15. Oryctolagus cuniculus

B Draw labelled sketches:

16. Obelia medusa
17. Nereis T.S.
18. Bipinnaria larva
19. Amphioxus T.S
20. Quill feather

C Comment on Biological significance:

21. Entamoeba
22. Paramecium Conjugation
23. Plasmodium
24. Ascaris
25. Heteronereis
26. Peripatus
27. Nauplius larva
28. Sacculina on crab
29. Sea anemone on Hermit crab
30. Vipera russelli (= Russel's viper)
31. Bat

D Relate structure and function:

32. Sponge – Spicules
33. Sponge – Gemmule
34. Taenia – Scolex

35. Neanthes – Parapodium

36. Penaeus – Petasma

37. Starfish - Tube foot.

38. Snake - Poison apparatus

39. Quill feather

E. Osteology / Palate in Birds / Dentition

Osteology

Frog

40. Skull and lower jaw

41. Vertebral column

42. Pectoral girdle

43. Pelvic girdle

44. Forelimb

45. Hindlimb

Palate in Birds

46. Pigeon – Palate

47. Crow – Palate

48. Duck – Palate Dentition

49. Rabbit – Dentition

50. Dog – Dentition

IV. Study Tour

Report on field visit for studying the adaptation of animals

ALLIED ZOOLOGY – II

SUBJECT CODE: 19UZOO333	THEORY	MARKS 100
SEMESTER: II	CREDITS: 4	TOTAL HOURS: 90

Unit – I **(20 Hrs)**

Cell Biology – Structure of animal cell, Mitochondria, nucleus and nucleolus and Golgi bodies.

Genetics: Molecular structure of Genes – Gene concept – Gene function – Inborn errors of metabolism – Genetic Engineering and its applications – X and Y – linked inheritance.

Unit – II **(20 Hrs)**

Developmental Biology: Gametogenesis – Fertilization - Cleavage and gastrulation of chick and pig.

Unit – III **(20 Hrs)**

Human Physiology: Digestion, Excretion, kidney failure and transplantation. Structure of heart, Cardiac cycle, composition of blood, Blood pressure. Heart diseases – Ischemia, Myocardial infarction, Rheumatic heart disease, Stroke. Endocrine glands – Hormones-feedback mechanism – Pituitary, thyroid, Islets of Langerhans, adrenal, sex organs.

Unit – IV **(15 Hrs)**

Environmental Biology: Physico-Chemical factors – Environmental Degradation treatment methods on sewage, effluents – Green house effect.

Unit – V **(15 Hrs)**

Evolution – Lamarkism and Neo-Lamarckism – Darwinism and Neo-Darwinism - Factors responsible for speciation.

Text Book:

1. Verma, P.S. and V.K. Agarwal, 2010 Reprint, Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology, S. Chand & Co., New Delhi – 110 055.

Reference Books:

1. Sambasiviah, I, Kamalakara Rao, A.P. Augustine Chellapa, S (1983). Text book of Animal Physiology, S. Chand & Co, New Delhi.
2. Verma, P.S. and Agarwal, V.K. (1983). Animal Ecology, S. Chand & Co, New Delhi.
3. Verma, P.S. and Agarwal, V.K. and Tyagi, B.S. (1991). Chordate Embryology S. Chand & Co, New Delhi.
4. Rastogi, V.B. and Jayaraj, M.S. (2000). Text book of Genetics, Kedarnath Ramnath Publishers, Meerut.
5. T.S.Gopalakrishnan, Itta Sambasivaiah and A.P.Kamalakararao, 1984 Principles of organic Evolution, Pearl publications, Chennai

Question paper pattern:

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Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

ALLIED ZOOLOGY PRACTICAL

SUBJECT CODE :19UPBT332P	PRACTICAL	MARKS 100
SEMESTER: I & II	CREDITS: 4	TOTAL HOURS: 60

I. Dissection:

Cockroach

1. Digestive System
2. Nervous System

II. Mounting:

1. Mouth parts of cockroach
2. Mouth parts of Mosquito
3. Prawn: Appendages

III. Spotters:

1. Plasmodium
2. Sycon
3. Obelia geniculata
4. Taenia solium (Entire)
5. Taenia solium (Transverse section)
6. Leech (Entire)
7. Leech (Transverse section)
8. Fresh water mussel
9. Amphioxus
10. Shark (Placoid scale)
11. Pigeon (Feathers)
12. Rabbit.

NON MAJOR ELECTIVE - II
PUBLIC HEALTH AND HYGIENE

SUBJECT CODE: 19UNME402GG	THEORY	MARKS 100
SEMESTER: II	CREDITS: 3	TOTAL HOURS: 30

Unit – I **(6 hrs)**

Scope of Public Health and Hygiene – Concepts of Health and Disease – History of Public Health in India. Nutrition and Health: Classification of foods – Nutritional deficiencies – Vitamin deficiencies – Balanced diet – Nutritional requirements of special groups.

Unit – II **(6 hrs)**

Environment and Health: water-sources, Pollution, purification – water quality standards. Air: Ventilation – Air pollution – Noise pollution – Radiation effects – Solid waste and excreta disposal – Sewage treatment.

Unit – III **(6 hrs)**

Communicable diseases: Respiratory infections: Measles, Rubella, Mumps, Diptheria. Intestinal infections: Poliomyelitis, Cholera, typhoid, Amoebiasis. Arthropod infections: Malaria, Filariasis, Dengue. Zoonosis: Rabies, Plague Japanese encephalitis. Surface infections: Tetanus, Leprosy, STD and AIDS

Unit – IV **(6 hrs)**

Non-Communicable Diseases: Coronary heart Disease – Hypertension – Diabetes – Obesity – Blindness – stroke. Occupational Health Hazards: Physical, Chemical, Mechanical, Biological and Psychological. Mental health: Causes of mental ill-health-alcoholism and Drug dependence.

Unit – V **(6 hrs)**

Health Education: Health planning in India – Health programmes in India – WHO – Nongovernmental Voluntary Health Organizations. First aid and Nursing: Methods – Dressing – care – Duties – Preparations.

Reference Books:

1. Park and Park, 1995. Text Book of Preventive and Social Medicine. M/S. Banarsidas Bhanot Publishers, Jabalpur.
2. Verma S. 1998. Medical Zoology, Rastogi Publications, New Delhi.

SEMESTER III

CORE - IV

CELL AND MOLECULAR BIOLOGY

SUBJECT CODE : 19UZOO304	THEORY	MARKS 100
SEMESTER: III	CREDITS: 4	TOTAL HOURS: 90

COURSE OBJECTIVES

To enable the students to learn various aspects of cell biology.

UNIT I (20 hrs)

Ultrastructure of animal cell, Cell theory, Cell organelles, Plasma membrane: Different mode of plasma membrane (in brief), Fluid mosaic model in detail, Differentiation at cell surface.

UNIT II (15 hrs)

Endoplasmic Reticulum: Morphology, Chemical Composition, Morphological Differentiation and Functions. Golgi complex: Morphology, Chemical Composition, Relationship with other cell components, its function with special reference to cell secretion. Microbodies: Structure, Chemical Composition, Functions and Origin of Peroxisomes and Glyoxysomes.

UNIT-III (20 hrs)

Mitochondria: Morphology including vital examination, Light and Ultramicroscopic Structures, Structural Variations with Regard to Functions, Chemical Composition, Role in Cell Physiology, Mitochondria as Semi-autonomous Organoids.

Lysosomes: Morphology, Chemistry, Polymorphism in Relation to Cytosis and Cell Autophagy.

UNIT-IV (20 hrs)

Nucleus: Nuclear Envelope, Nuclear Permeability, Structure of Interphase Nucleus, Structure and Cytochemistry of Nucleus, Structure and Biogenesis of Ribosomes.

Centrioles: Basal bodies, Cilia, Flagella, Microtubules, Amoeboid movement.

UNIT-V 15 hrs

Cell cycle and Cell division – Mitosis and Meiosis, Cell Ageing. Overview of Intercellular Signalling (Autocrine, Paracrine, Juxtacrine and Endocrine) and Intracellular signaling – GPCR pathway.

Books Recommended:

1. DeRobertis, EDP, De Robertis, E.M.F. Cell Biology and Molecular Biology. Eighth Edition. W.B. Saunders Co., Philadelphia, 1995.
2. Powar, C.B., Cell Biology, Himalaya Publishing House, Bombay.
3. Alberts, B. Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. Molecular Biology of the Cell Garland Publ. Inc., New York.
4. Darnell, J., Lodish, JH. & Baltimore, D. Molecular Cell Biology, Oxford & IBH Publishing Co., New Delhi.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

SEMESTER IV

CORE - V
GENETICS AND EVOLUTION

SUBJECT CODE : 19UZOO306	THEORY	MARKS 100
SEMESTER: IV	CREDITS: 4	TOTAL HOURS: 90

COURSE OBJECTIVES

To enable the students to learn various aspects of hereditary. To give an insight into evolution of genetic material, its functional aspects and changes in the environment that bring about evolution.

UNIT-I **(20 hrs)**

Physical basis of heredity – Mendelism, interaction of genes, multiple alleles, chromosome structure and function in Eukaryotes. Polytene chromosomes, lampbrush chromosomes.

UNIT-II **(20 hrs)**

Sex determination - Chromosomes & Sex Chromatin

Chromosomal changes- Structural aberrations and its significance. Numerical changes, Polyploidy and its types. Nature of genes-Double helix structure of DNA, Mechanisms of DNA replication. Changes in genes-Spontaneous mutations and Induced Mutations, Physical and Chemical Mutagens.

UNIT-III **(15 hrs)**

Linkage of genes, Crossing over, Sex linkage in Drosophila and Man, Criss-cross inheritance, Colour blindness and Haemophilia. Cytoplasmic inheritance. Human Genetics-Normal and abnormal karyotypes.

UNIT – IV : Evolution **(20 hrs)**

Lamarckism and Neo-Lamarckism – Darwinism and Neo-Darwinism – Mutation Theory – Geological time scale – Dating of Fossil – Living and Extinct Fossils. Mimicry & Colouration – Batesian and Mullerian – Convergent, Divergent and Parallel Evolution – Co-evolution, Adaptive radiation in mammals.

UNIT – V **(15 hrs)**

Isolating mechanisms – different types – Species Concept – definition and origin of species – Allopatric and Sympatric speciation – Genetic drift – Founder’s Principle. Evolution of Man.

Books Recommended:

1. U. Goodenough: Genetics. IIIrd Edition, Washington University, Saunders College Publishing.
2. O.P. Swanson, Timothy Herz and William, J. Young : Cytogenetics-The chromosome in division, inheritance and evolution, Prentice Hall.
3. B.S. Gardner & D.P. Smustad : Principles of Genetics, John Wiley & Sons. 6th Ed.

4. A.M. Winchester. Genetics-A survey of the Principles of Heredity, Oxford & IBH Publishing Co., New Delhi.
5. P.K. Gupta : Genetics, Rastogi Publishers, Meerut.
6. P.K. Gupta : Cytology Genetics, and Molecular Biology; Rastogi Publishers, Meerut.
7. Verma, P.S. and V.K. Agarwal, 2002, Concept of Evolution, S. Chand & Co., Ram Nagar, New Delhi – 110 055.
9. Stirton, R.A., Time, life and man, C.B.S. Publishers & Distribution, Delhi.
10. Colbert, E.H., Evolution of Vertebrates, C.B.S. Publishers & Distribution, Delhi.
11. Dobzhansky, T., Genetics and the origin of species. Columbia, Univ. Press, New York.
12. Mayr, E., Systematics and the origin of species, Columbia Univ. Press, New York.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - VI

PRACTICAL II - CELL BIOLOGY AND GENETICS

SUBJECT CODE : 19UZOO305P	PRACTICAL	MARKS 100
SEMESTER: III & IV	CREDITS: 4	TOTAL HOURS: 60

CELL BIOLOGY

1. Micrometry – Use of Microscopes- Microscopes – Light microscope, Camera Lucida, Stage and Ocular Micrometer.
2. Blood smear preparation – Differential Count of WBC.
3. Counting of RBC and WBC using Haemocytometer (Demonstration)
4. Mounting of Buccal epithelium and observing living cells using vital staining.
5. Mitosis in Onion root tip squash
6. Meiosis in grasshopper testis squash (Demonstration)
7. Study of prepared slides of histology
 - a. Columnar epithelium
 - b. Ciliated epithelium
 - c. Glandular epithelium
 - d. Connective tissue
 - e. Cartilage T.S.
 - f. Bone T.S.
 - g. Cardiac tissue
 - h. Striated muscle
 - i. Non-striated muscle
 - j. Nervous tissue
 - k. Ovary T.S.
 - l. Testis T.S.

GENETICS

1. Observation of Common Mutants of Drosophila
2. Preparation of Mount of Salivary Gland chromosomes of Chironomus larva
3. Identification of Human Blood Groups
4. Study on Normal Karyotype - Male and Female, Down Syndrome, Turner and Klinefelter Syndrome.

SEMESTER V

CORE - VII

DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

SUBJECT CODE : 19UZOO307	THEORY	MARKS 100
SEMESTER V	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

To enable the students to know about the development of all the vertebrates from an egg to the embryo. To enable the students to understand the overall organization and functions of the immune system.

UNIT I (12 hrs)

Origin of germ cells- Process of Spermatogenesis and Oogenesis; Structure of human sperm, Types of sperms, Types of eggs.

UNIT II (12 hrs)

Mechanism and Physiology of Fertilization. Early development- Cleavage, Blastulation, Gastrulation and Tubulation in Frog and Chick. Presumptive areas, Organizers and Inductors. Parthenogenesis

UNIT III (12 hrs)

Development of membranes and Formation of placenta. Types of placentae in mammals. Organogenesis – Development of brain, eye and ear in frog. Regeneration in vertebrates and invertebrates. Pregnancy and related problems. IVF-Embryo Transfer and its advantages. Test tube baby-Amniocentesis.

Unit – IV (12 hrs)

Overviews of immune system – Historical perspectives, Innate and Acquired immunity. Cells of the Immune System: Hematopoiesis and Differentiation, B-lymphocytes, Tlymphocytes, Macrophages, Dendritic cells, Natural Killer Cells and Lymphocyte Activated Killer Cells, Eosinophils, Neutrophils & Mast Cells. Organs of the Immune System: Primary and Secondary Lymphoid Organs: Thymus, Bursa of Fabricii, Spleen, Lymph Nodes, Lymphatic System, Mucosa Associated Lymphoid Tissue (MALT) - Complement system

UNIT V (12 hrs)

Antigens – types, properties- Haptens – Adjuvants – Vaccines – Types – Toxoids – Antitoxins – Immunoglobulins – structure, types, and properties – Theories of antibody production – Complement structure, properties, function and pathway – Antigen-antibody reaction – in-vitro methods – Agglutination – Precipitation – Complement fixation – Immuno-fluorescence – ELISA – RIA.

Books Recommended:

1. An Introduction to Embryology, Saunders Company.
2. Turner, C.D. and Bagnars, W.B. (1976) General Endocrinology, Saunders Company.
3. Roitt I.M. 2000. Essential Immunology. Blackwell Scientific Publishers
4. Chakravarthy, A. K.1996. Immunology, Tata Mc Graw Hill, New Delhi.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - VIII

BIOTECHNOLOGY AND NANOTECHNOLOGY

SUBJECT CODE : 19UZOO308	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

To enable students to be familiar with the basics of biotechnology together with a fundamental knowledge on the application of nanotechnology.

UNIT I

(12 hrs)

Definitions and history of Biotechnology. Structure of E.coli, Bacterial conjugation, Transduction, Transformation, Structure of Bacteriophage – Lytic and Lysogenic Cycle. Major areas of Biotechnology – Agriculture, Food and Pharmaceutical industry and Beverages. Indian scenario in Biotechnology – Centers, Activities Achievements and Bio-industries in India

UNIT II

(12 hrs)

Vectors – Types, plasmids (pBR 322, pBR 327), Phage – M13, Cosmid insertion vectors, Replacement vectors, Shuttle vectors and High expression vectors. DNA fragment, Enzymes – Nucleases, Restriction enzymes, Polymerase and Ligases.

UNIT III

(12 hrs)

Gene cloning in E.coli. Isolation of DNA – Insertion of DNA – Use of Linkers and Adapters – Transformation – Uptake of DNA by host cell – Selection of clones identification of recombinants insertional inactivation.

UNIT IV

(12 hrs)

Tissue culture: Culture media – Composition and Preparation. Principles and techniques of plant and animal cell culture. Importance of cell line culture.

UNIT V

(12 hrs)

Nanotechnology: Definition - Nanoscience and nanotechnology. Applications of nanotechnology – Nanomaterials in medicine – Medical implants – Nanomaterials for water purification – Nanomaterials in food – Nanomaterials for the environment - Elimination of pollutants – Veterinary applications.

Text Books:

1. Purohit Mathur, 1999 .Biotechnology Fundamental and applications. Botanica Publications.
2. Shah H.A and Tokeer Ahmad, 2011. Principles of nanoscience and nanotechnology. Narosa Publishing House.

Reference Books:

1. T.A. Brown .2010. Gene cloning and Introduction. Wiley Blackwell.
2. Brown J.A. 2001 – Genetics – A Molecular approach 3rd edition – Nelson Tornos.
3. Old R. W and S.B. Primrose. 1994. Principles of Gene manipulation – 5th edition – Blackwell Scientific publications.
4. John. R. W. Masters 2000. Animal cell culture – A practical approach 3rd Edition. Oxford univ press.
5. Glick B.R. and Jack J. Pasternak, 1994 . Molecular biotechnology ASM press.
6. P Ramdoss, 2009. Animal Animal Biotechnology Recent Concepts and Developments, MJP Publishers.

7. Subbiah Balaji, 2010. Nanotechnology. MJP Publishers.
8. S Shanmugam, 2011. Nanotechnology. MJP Publishers.
9. Rakesh Rathi, Nanotechnology, S. Chand & Co.
10. B K Parthasarathy, 2007. Nanotechnology in Life Science Gyan Books.
11. Kumar, 2010. Principles of Nanotechnology, Scitech. Publications (India)

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - IX

ANIMAL PHYSIOLOGY, BIOCHEMISTRY AND ENDOCRINOLOGY

SUBJECT CODE : 19UZOO309	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

To make the students understand the physiological and biochemical processes going on inside the vertebrates

UNIT-I (12 hrs)

Enzymes: Classification, Nomenclature, General Properties, Regulation of Enzyme Activity, Enzyme inhibition.

Digestion: Intracellular and extracellular digestion, digestive enzymes, Digestion by means of symbionts, Intestinal absorption.

UNIT-II (14 hrs)

Respiration: Nature of Respiratory Organs, Transport of Respiratory Gases, Control of Respiration.

Muscle: Muscle contraction – Physiology and Chemistry.

Excretion: Structure of Kidney and Nephron, Physiology of urine formation.

Circulatory System: Blood components, Functions of components, Cardiac output and Heart rate, Physiology of heart, Control of Cardiovascular function.

Nervous System: Structural elements, Nerve impulse, Resting and Action potentials, Conduction of Action Potential, Synaptic Transmission.

UNIT III (12 hrs)

Structure and Classification of Macromolecules : Protein , Lipid and Carbohydrate.

Metabolism: Carbohydrate metabolism: Glycogenesis, Glycogenolysis, Gluconeogenesis and Glycolysis; Kreb's cycle, Regulation of Carbohydrate Metabolism, Electron Transport Chain, Oxidative Phosphorylation.

Lipid Metabolism

Protein Metabolism

UNIT-IV (12 hrs)

Introduction to hormones and their mode of action. Gonadal hormones in Mammals. Hormonal control of metabolism, Development, Somatic pigmentation and Reproduction in insects. Physiology in relation to reproduction.

UNIT-V (10 hrs)

Structure of Endocrine Glands-Pituitary, Thyroid, Adrenal and Pancreas of Vertebrates.

Biological Actions of Hormones of Pituitary, Thyroid, Adrenal and Pancreas.

Books Recommended:

1. Guyton, A.X. (1986) Text Book of Medical Physiology, 7th edition, Saunders Company.
2. Best, J.P. (1985) Best and Taylor's physiological basis of medical practice (11th ed.)William and Wilkins.
3. Hoar, W.S. (1983) General and comparative physiology, Adaptation and Environment(3rd ed.) Cambridge University Press.
4. Highnam, K.C. and Hill, L.(1981) Comparative Endocrinology of invertebrates, Enwaral Arnold Ltd., London.

5. Golds Worthy, G.J. Robinson, J. and Mordue, W. 1981. Endocrinology, John Wiley and Sons, New York.
6. Tombes, A.S.(1970) An Introduction to invertebrates endocrinology, Academic Press, New York.
7. Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).
8. Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).
9. Rawn J.D. (1989). Biochemistry (Neil Patterson).
10. Voet D., Voet, J.G. (2004). Biochemistry (John Wiley & Sons).
11. Voet, D., Voet, J.G. and Pratt, C.W. (2008). Fundamentals of biochemistry: Life at the molecular level (John Wiley & Sons)

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - X

BIostatISTICS AND COMPUTER APPLICATION IN LIFE SCIENCE

SUBJECT CODE : 19UZOO310	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

All the data generated in biological sciences needs statistical verification to prove its significance so computer aided analysis of the same is need of the hour. Therefore knowledge of computer in 1st year is important.

UNIT – I (12 hrs)

An introduction, Types of data, Collection, Classification and Tabulation of the Primary data, Secondary Data, Discrete data and Continuous data, Diagrammatic and Graphical representation of grouped data, Frequency Distribution {univariate and bivariate}, Cumulative frequency distribution and their graphical representation, Histogram frequency polygon. Concept of central tendency or location and measures of dispersion

UNIT – II (12 hrs)

Normal distribution. Simple Correlation. Hypothesis testing- Student's t-test; Chi-square analysis; Regression Analysis. Theories of probability.

UNIT – III (12 hrs)

Computers: General introduction to computers, Organization to computers, Digital and Analogue computers, Computers algorithms: Milestones in hardware and software-batch oriented/online/real time applications.

UNIT – IV (12 hrs)

Data storage devices: Primary storage: Storage addressed and capacity, ROM, RAM
Input/output devices: Key-tape/diskette devices, light pen Mouse, Joystick, Source data automation. Printed outputs: Serial, line, page, Printers, Plotters, Voice Response Units.

UNIT V (12 hrs)

MS – Word: File operations – New, Open, Save & Print – Editing – Cut, Copy, Paste, Find & Replace – Insert – Page numbers & Pictures – Format – Font, Bullet and Numbering, Paragraph & Background – Tools – Spelling & Grammar – Data – Sort.

MS – Excel: Presentation of Biostatistical data using Excel – Auto-sum, Paste function, Chart wizard, Sort function & Drawing. Uses of Internet, Networking of computers.

Reference Books:

1. P.N. Arora & P.K. Malhotra (1996). Biostatistics (Himalaya Publishing House, Mumbai).
2. Sokal & Rohlf(1973). Introduction to biostatistics (Toppan Co. Japan).

3. W.J. Evens, G.R. Grant (2005). Statistical methods in bioinformatics: An introduction (Springer).
4. P.K. Sinha (2004). Computer fundamentals (BPB).
5. Suresh K. Basandra (2008). Computers today (Galgotia Publications Pvt. Ltd., New Delhi)

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	2	1
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1		1
	Unit – 2		1
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1		2
	Unit – 2		1
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

ELECTIVE - I

INTERDISCIPLINARY ELECTIVE (IDE) – WILDLIFE CONSERVATION

SUBJECT CODE : 19UIDE309	THEORY	MARKS: 100
SEMESTER: V	CREDITS 5	TOTAL HOURS: 75

COURSE OBJECTIVES

To provide education and awareness and to encourage appreciation and importance of wildlife and also to provide knowledge for competitive job oriented examinations.

Unit I (15 hrs)

Introduction to wildlife and its conservation. Economic importance and Need for conservation. Definition of wildlife – Causes of wildlife depletion – Endangered species – Threatened and Rare species. India as a mega wildlife diversity country.

Unit II (15 hrs)

Population Estimation : Basic concepts and application – Direct Count (Block Count, Transect Methods, Point Counts, Visual Encounter Survey, Waterhole Survey) – Indirect Count (Call Count, Track and Signs, Pellet Count, Pug Mark), Wildlife Photography: Types of camera, camera traps, Field equipments – Altimeter, Pedometer, Field Compass, Binoculars, Radio Collaring, GPS, GIS. Remote sensing in wildlife management

Unit III (15 hrs)

Wildlife health care and Human wildlife confliction. Infectious wildlife diseases – Viral (Rabies) – Bacterial (Anthrax) – Basic reasons for conflicts. Damage caused by wild animals and control measures.

Unit IV (15 hrs)

Wildlife Management and Legislation – Wildlife Protection Act 1972, IUCN, CITES, NBA, Project tiger, Project elephant – Wildlife Trade and Regulation. Biodiversity Act 2000. Ecotourism and Ecorestoration. Anti-poaching Operations – Village Forest Council (VFC).

Unit V (15 hrs)

Wildlife Protection – Definition – in-situ and ex-situ conservation – Zoos and Zoological Parks – National Parks and Sanctuaries (Aringar Anna Zoological Park, Guindy National Park, Srivilliputtur Wildlife Sanctuary, Vedanthangal Bird Sanctuary, Mudumalai and Periyar Tiger Reserves, Nilgiris Biosphere Reserve).

Exercises (Optional)

Visit to National Zoological Parks and Sanctuaries, Study on wetlands or about high altitude fauna.

Reference Books:

1. Saharia, V.B. (1987). Wildlife in India. Nataraj Publications, Dehradun.

2. The Eye of the Elephant: An Epic Adventure in the African Wilderness by Delia Ownes
3. The Book of Indian Birds by Salim Ali.
4. Analysis and Management of Animal Population by Byron.K. Williams.
5. A book on Wildlife Protection Act 1972, Lawmann
6. A book on the Red Data Books by IUCN.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

SEMESTER VI

CORE – XI

ENVIRONMENTAL BIOLOGY & TAXONOMY

SUBJECT CODE : 19UZOO313	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

To enable the students to identify, classify and name the organism according to International Code of Zoological Nomenclature. To acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification. To educate the students about the basic environmental phenomena and enable them to understand the adaptations of the animals to their environment.

UNIT-I

(12 hrs)

Ecology-Definition, Subdivision of Ecology and Scope of Ecology. Ecological Factors Temperature and Light as Ecological Factors. Ecosystem - Definition, Components of Ecosystem, Grazing and Detritus type of food chain, Food Web and Trophic levels. Ecological pyramids-Pyramids of number, Biomass and Energy.

UNIT-II

(12 hrs)

Energy flow-Flow of energy through a food chain in relation to laws of thermodynamics. Biogeochemical cycles – Nitrogen and Phosphorous Cycle. Laws of limiting factor-Leibigs's law of minimum, Shelford's law of tolerance and concept of limiting factors. Ecological niche – Concept of ecological niche. Ecological succession – Definition, Types of succession.

UNIT – III

(12 hrs)

Freshwater habitats – Lentic and Lotic; Marine habitat- Zonation
National and International Environmental Organizations, Red Data Book. Wildlife Management

UNIT-IV

(12 hrs)

Definitions and perspectives of systematics, Classification and Taxonomy; History, Goals and Importance of Taxonomy; Procedures of taxonomy-identification, Classification, Nomenclature, Phena, Taxa, Category; Key and its significance; Higher taxa and Linnean hierarchy; History and Theories of Classification.

UNIT –V

(12 hrs)

International Code of Zoological Nomenclature-Principles and Objectives and Rules for Nomenclature, Type system and Priority for different taxa. Population structure of species; Polytypic species, Race, Variety, Cline, Subspecies, Semi-species, Super species.

Books Recommended:

1. Mayr, E., Principles of Systematic Zoology, McGraw-Hall, New York.

2. Krebs, J.C., Ecology, Harper & Row, Publ., New York.
3. Odum, E.P., Fundamentals of Ecology, Saunders College Publishers, Philadelphia.
4. George L.C., Elements of Ecology, Johnes Wiley, New York.
5. Kendeigh, S.C., Ecology with special reference to animals, Prentice-Hall of and New Delhi.
6. Smith, Ecology, Harper & Row Publishers, New York.
7. Kormondy, Concepts of Ecology, Prentice Hall of India, New Delhi.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - XII

GENETIC ENGINEERING AND RECOMBINANT DNA TECHNOLOGY

SUBJECT CODE : 19UZOO314	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

To facilitate students to understanding the basic concepts involved in genetic manipulation and the application of rDNA technology

Unit – I (12 hrs)

Introduction to Gene Cloning, DNA Manipulative Enzymes-Nucleases, Ligases, Polymerases, Modifying Enzymes, Restriction Enzymes and its Nomenclature, reverse transcriptase, topoisomerases, plasmids- Basic features of plasmids, Plasmid Classification, Blunt And Sticky Ends.

Unit – II (12 hrs)

Vectors: Cloning vectors for E. coli- Nomenclature, pBR 322, pBR 327, pUC 8, pGEM3Z. Methods of identification of recombinants: Insertional inactivation, Blue/white selection. Bacteriophages: Basic features, Phage and its vector, Lytic & Lysogeny, Linear and Circular forms of Lambda Vector, Insertion and Replacement Vectors; Identification of Recombinant Phages.

Unit – III (12 hrs)

Cloning vectors for yeast and fungi, YEp, YIp, YRp, artificial chromosomes, YAC, application of YAC, Identification of a recombinants from a gene library, Methods of clone identification, Radioactive and non- radioactive DNA and RNA labeling techniques.

Unit - IV (12 hrs)

Southern, Northern and western blotting, colony hybridization, In situ hybridization, Genomic Cloning, Transformation of E. coli, Yeast and Plant cells. PCR: Types, Applications and Limitations. Applications of rDNA Technology to Medicine, Agriculture & Environment.

Unit - V (12 hrs)

DNA sequencing- Restriction fragment probe, Sanger Coulson Method. Maxman Gilbert Method- RFLP- Techniques and Application. Genetic Finger Printing- Polymerase Chain Reaction- Taq Polymerase Primers, Human Genome Project. Applications of Genetic Engineering- Alcohol Production, Medicine- Insulin and Hepatitis Vaccine Production

Text book:

1. Dubey, R.C. 1995, A Text Book of Biotechnology, S.Chand & Co. Ltd., Ram Nagar, New Delhi – 110 055.

Reference Books:

1. J. Sambrook, D.W.Russell (2001). Molecular cloning: A laboratory manual (Cold spring Harbour Laboratory Press).
2. R.M. Old, S.B. Primrose (2001). Principles of gene manipulation (Wiley- Blackwell).

3. D. Hames, S. J. Higgins (1995). Gene probes: A. practical approach (Oxford University Press).
4. Tuan Rocky S. (1997). Recombinant gene expression protocols (Edition Illustrated, Publisher Springer).
5. White Bruce A. (1997). PCR cloning protocols: from molecular cloning to genetic engineering (Humana Press).
6. Sandy B. Primrose, Richard Twyman (2006). Principles of gene manipulation and genomics (Wiley Blackwell).
7. Terence A. Brown (2006). Gene cloning and DNA analysis: An introduction (WileyBlackwell)

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition. Answer any 10 out of 12 questions	1 – 12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13–19	6	30
Section C	Essay Answer any 4 out of 6 questions	20– 25	10	40
TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - XIII

MICROBIOLOGY AND INDUSTRIAL BIOTECHNOLOGY

SUBJECT CODE : 19UZOO315	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE OBJECTIVES

Microbes are playing significant role in understanding medical science and industries so study of microbes from basic to advance level, with understanding of biochemistry, cell structure and application makes this paper significant.

UNIT – I (12 hrs)

History of Microbiology: A. Leewenhook, L. Pasteur, R. Koch, J. Lister, J. Tyndall. Biogenesis Vs Abiogenesis, Koch Postulates, Discovery of Antibiotics. Principle of Microscopy: Bright field, Dark field, Phase Contrast, Fluorescent, Electron Microscopy.

UNIT – II (12 hrs)

Microbial Classification: Bacteria, Fungi and Algae. Morphology of Bacteria, Viruses and Fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, Sporulation/ germination process.

UNIT – III (12 hrs)

Microbial growth, Nutritional biodiversity, Phases of growth, Generation time, Growth rate. Chemostat and Turbidostat, Microbes in extreme environment like high temperature and high/low pH values, Sterilization.

UNIT – IV (12 hrs)

Dairy Microbiology – Pasteurization – Milk products – Curd, Butter and Cheese; Food Microbiology – Fermented food - Food spoilage - Food poisoning – Physiochemical methods in food preservation. Soil Microbiology – Common soil microbes – Symbiotic and asymbiotic organisms. Water Microbiology - Microbiology of drinking water – Waterborne diseases.

UNIT V (12 hrs)

Production of Industrial Enzymes such as Proteases, Amylases, Lipases, Cellulases. Biopreservatives (Nisin) Cheese, Biopolymers (Xanthan Gum, PHB), Antibiotics, (penicillin). Production of Recombinant Proteins having Therapeutic and Diagnostic Applications, Products of Plant and Animal Cell Culture.

Text Books:

1. Dubey, R.C. 1995, A Text Book of Biotechnology, S.Chand & Co. Ltd., Ram Nagar, New Delhi – 110 055.
2. Sundara Rajan, S, 2002, College Microbiology – Vol. I to IV, Vardhana Publications, Bangalore – 560 095.

Reference Books:

1. Pelczar Jr. M.J. Chan E.C.S. and Kreig N.R. 2001 Microbiology – McGraw Hill Inc. New York.
2. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R. 1999 General Microbiology –Macmillan Education Ltd. London.
3. Purohit Mathur. 1999. Biotechnology Fundamentals and applications. Botanica Publications.

4. Higgins I.J., Best G.J., and Jones J. 1996, Biotechnology – Principles and applications, Blackwell Scientific Publications, Oxford London.
5. Gupta P.K. Elements of Biotechnology 2001, Rastogi Publications, Meerut.
6. Rittmann, B.E. and P.L. McCarty, 2001. Environmental biotechnology: principles and applications. Mcgraw- Hill, New York.
7. Ahmed, N., F.M.Qureshi and O.Y. Khan, 2001. Industrial environmental Biotechnology, Horizon Press.

Question paper pattern:

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TOTAL MARKS				100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
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	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

ELECTIVE - II

MEDICAL LABORATORY TECHNIQUES AND BIOINSTRUMENTATION

SUBJECT CODE : 19UZOO316	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 5	TOTAL HOURS: 75

COURSE OBJECTIVES

To familiarize students with various laboratory techniques undertaken before medical intervention and the instruments utilized in common laboratories.

Unit I (15 hrs)

Introduction – Scope of the subject. Collection of specimens, Records and Preparation of reports.

Cleaning, Maintenance and Care of Glasswares.

Unit II (15 hrs)

Sterilization – Physical and Chemical Methods. Disposal of Specimens and Infected Materials, Safety Precautions and First Aid Treatment for Superficial wounds, Burns, Chemical Poisoning, Contamination of infected microbiological specimens and Electric shock.

Unit III (15 hrs)

Urine: Analysis of urine samples, Chemical parameters routinely required to be analysed. Pregnancy test. Analysis of stools, semen, Cerebrospinal fluid for chemical investigation.

Unit IV (15 hrs)

Pathology: Organisms causing infectious diseases. Viruses – Measles, Poliomyelitis, Hepatitis, HIV. Bacteria – Tuberculosis, Whooping cough – Tetanus – Diphtheria, Cholera. Protozoans – Amoebic dysentery, Malaria, Leishmaniasis. Helminths – filariasis, Cysticercosis.

Unit V (15 hrs)

Principles use and maintenance of laboratory instruments like Autoclave, Hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Colorimeter, pH meter, Haemoglobinometer, Haemocytometer, Microtomes, Balances.

Text Book:

1. Sood Ramnik, 1985. Medical Laboratory Technology. Jaypee brothers, New Delhi, 384 pp.

Reference Book:

1. Baker F.J. and Silvertson R.E. Introduction to Medical Laboratory Technology.

Question paper pattern:

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Distribution of Questions:

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	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

ELECTIVE - III

ECONOMIC ENTOMOLOGY AND PEST MANAGEMENT

SUBJECT CODE : 19UZOO317	THEORY	MARKS 100
SEMESTER: VI	CREDITS: 5	TOTAL HOURS: 75

COURSE OBJECTIVES

India being an agricultural oriented country, economic losses through agriculture is a major concern. This study facilitates an understanding of insect's pests and diseases of major crops cultivated in India and their management strategies.

Unit I **(15 hrs)**

Brief account of morphology, Classification (Major orders) and Development (Metamorphosis) of insects.

Unit II **(15 hrs)**

Beneficial and Harmful Insects. Economic importance of Honeybees, Silkworm and Lac insect – Parasitic and Predatory Insects. Damages to plants, animals and man by insects. Brief account of any three pests of 1. Rice, Cholan and Pulses 2. Sugarcane 3. Cotton 4. Groundnut, Gingely and Coconut 5. Brinjal, Tomato and Lady's finger 6. Cardomam, Chilies, Tea and Coffee 7. Mango and Citrus.

Unit III **(15 hrs)**

Insect pests of stored grains – Insect vectors of plants, animals and man – Other insects affecting the health of man domestic animals.

Unit IV **(15 hrs)**

Insect pest control methods (Physical, mechanical, biological and chemical) – Classification of pesticides and their modes of action.

Unit V **(15 hrs)**

Plant protection appliances used – Basic principles of insecticide formulations and their application in pest control. Pesticides and environmental pollution – Precautions in handling pesticides.

Text Book:

1. David, B.V. and T. Kumarasamy, 1984. Elements of Economic Entomology, Popular Book Depot, Madras, 536 pp.

Reference Books:

1. Nayar, K.K., T.N. Ananthkrishnan and B.V. David. 1992. General and Applied Entomology. Tata McGraw Hill Publishing Co., Ltd., New Delhi – 110 051.

2. David, B.V., 1992. Pest Management and Pesticides Indian Scenario, Namratha Publications, Madras.
3. Metcalf, C.L. and W.P. Flint, 1973. Destructive and Useful Insects. 4th Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi – 110 051, 1087 pp.
4. Roy D.N. and A.W.A. Brown (Eds), 1981. Entomology Medical and Veterinary (3rd Ed.) The Bangalore Printing and Publishing Company, Bangalore –18.
5. Ramakrishna Iyer, T.V., Economic Entomology, Government Publications. Madras.

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	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	1	
Section C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

CORE - XIV

PRACTICAL III - ANIMAL PHYSIOLOGY, BIOCHEMISTRY, DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

SUBJECT CODE : 19UZOO311P	PRACTICAL	MARKS: 100
SEMESTER: V & VI	CREDITS: 4	TOTAL HOURS: 60

ANIMAL PHYSIOLOGY

1. Use of Kymograph unit, B.P. apparatus, Respirometer.
2. Survey of Digestive enzymes in cockroach.
3. Estimation of Oxygen consumption in a fish with reference to body weight.
4. Detection of nitrogenous waste products in fish tank water, frog tank water, bird excreta and mammalian urine.

BIOCHEMISTRY

1. Qualitative analysis of sugar (Glucose, Fructose, Lactose, Starch, Dextrin)
2. Estimation of Glycogen (Anthrone method) (Demonstration)
3. Estimation of Protein (Biuret method) (Demonstration)

DEVELOPMENTAL BIOLOGY

Study of the following prepared slides, museum specimens and materials.

1. Sections of testis and ovary showing the maturation stages of gametes.
2. Slides of mammalian Sperm and Ovum.
3. Study of Egg types – Frog's egg, Hen's egg.
4. Slides of cleavage stages, blastula, gastrula and neurula of frog.
5. Slides of different stages of chick embryo. 18 Hours (primitive streak stage), 24 Hours, 48 Hours, 72 hours and 96 Hours.
6. Placenta of sheep, Pig and Man.

IMMUNOLOGY

1. Immuno electrophoresis-antigen, antibody reactions – agglutination - precipitation ring test. (Demonstration)
2. ABO, Rh typing

CORE - XV

PRACTICAL IV- ENVIRONMENTAL BIOLOGY, BIOTECHNOLOGY AND MICROBIOLOGY

SUBJECT CODE : 19UZOO312P	PRACTICAL	MARKS: 100
SEMESTER: V & VI	CREDITS: 4	TOTAL HOURS: 60

ENVIRONMENTAL BIOLOGY

1. Estimation of O₂, salinity, pH, free CO₂, Carbonates and bicarbonates, Calcium in water samples.
2. Use of Rain gauge, Maximum & minimum thermometer, Hygrometer, Anemometer and Barometer.
3. Plankton study – Fresh water and marine plankton.
4. Adaptations of aquatic and terrestrial animals based on a study of museum specimens - rocky, sandy, muddy shore animals, flying and burrowing animals.
5. Study of natural ecosystem and field report of the visit.

BIOTECHNOLOGY

1. Demonstration of PCR technique.
2. Blotting techniques
 - a) Southern blot
 - b) Northern blot
 - c) Western blot
3. Paper chromatography (Demonstration)
4. Instrumentation – Components and application of instruments – Centrifuge
Electrophoresis – Colorimeter-Spectrophotometer.
5. Visit to Industries, Laboratory – Report to be submitted.

MICROBIOLOGY

1. Media preparation- Broth, agar, slants, plating
2. Spotters: *Staphylococcus aureus*, *E.coli*, *Rhizopus*, *Aspergillus flavus*, *A.niger*, *Pencillium*, *Candida albicans*.
3. Instruments- Autoclave, culture plate, Inoculation chamber
4. Staining: Simple and differential staining