

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS) KUMBAKONAM
(Curriculum – M.Sc., Zoology– 2023 - 2024)

Department :Zoology

Programme Code: PSZO

SEMESTER – I

Part	Course type	Course Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
							CIA	ES E	Total
Part-I	CC- I	P23ZC101	Structure and Function of Invertebrates	6	5	3	25	75	100
	CC – II	P23ZC102	Comparative Anatomy of Vertebrates	6	5	3	25	75	100
	CC – III	P23ZC103P	Lab Course in Invertebrates & Vertebrates	6	4	3	40	60	100
	EC - I	P23ZDE1	Economic Entomology	5	3	3	25	75	100
	EC - II	P23ZDE4	Aquaculture	5	3	3	25	75	100
Part II	SEC- I	P23Z1SE1	Technical English for Zoologist	2	2	3	25	75	100
Total				30	22				600

SEMESTER – II

Part	Course type	Course Code	Title of the Course	Hrs/ Week	Credit s	Exam Hrs	Marks		
							CIA	ES E	Total
Part-I	CC- IV	P23ZC204	Cellular and Molecular Biology	6	5	3	25	75	100
	CC – V	P23ZC205	Developmental Biology	6	5	3	25	75	100
	CC – VI	P23ZC206P	Lab Course in Cell Biology and Developmental Biology	6	4	3	40	60	100
	EC - III	P23ZDE7	Microbiology and Immunology	5	3	3	25	75	100
	EC - IV	P23ZDE10	Biotechnology and Bioinformatics	5	3	3	25	75	100
Part II	SEC- II	P23Z2SE2	Apiculture	2	2	3	25	75	100
			Internship / Industrial Activities	--	--	--	--	--	--
Total				30	22				600

STRUCTURE AND FUNCTION OF INVERTEBRATES

Course Objectives:

The main objectives of this course are:

1. To understand the concept of classification and their characteristic features of major group of invertebrates.
2. To realize the range of diversification of invertebrate animals.
3. To enable to find out the ancestors or derivatives of any taxon.
4. To know the functional morphology of system biology of invertebrates.

Credits: 4Pre-requisite:

Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.

Expected Course Outcome:

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

1. Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.
2. Understand the evolutionary process. All are linked in a sequence of life patterns.
3. Apply this for pre-professional work in agriculture and conservation of life forms.
4. Analyze what lies beyond our present knowledge of life process.
5. Evaluate and to create the perfect phylogenetic relationship in classification.

Units I

Structure and function in invertebrates: Principles of Animal taxonomy;

SUB CODE: P23ZC101

Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy.

Units II

Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata

Units III

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration.

Units IV

Excretion:

Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda); Trends in neural evolution.

Units V

Invertebrate larvae: Larval forms of free living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Chaetognatha, Rotifera and Phoronida. Concept and significance; Organization and general characters

Reading list

Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.

Recommended texts

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.
2. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.

Mapping with Programme Outcomes*										
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	S	M	S	S	S	M	S	S	S
CO 2	S	S	M	M	S	S	M	M	S	S
CO 3	S	M	S	M	S	S	M	M	S	S
CO 4	S	M	S	M	S	S	M	M	S	M
CO 5	S	M	S	M	S	S	M	M	S	M

*S - Strong; M - Medium; L – Low

COMPARATIVE ANATOMY OF VERTEBRATES

Course Objectives:

The main objectives of this course are:

1. Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.
2. Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.
3. Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals.
4. Imparting conceptual knowledge about the animal life in the air and their behaviors.
5. Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates..

Pre-requisite:

Students with knowledge and comprehension on zoology.

Expected Course Outcome:

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

1. Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.
2. Understand the evolutionary process. All are linked in a sequence of life patterns.
3. Apply this for pre-professional work in agriculture and conservation of life forms.
4. Analyze what lies beyond our present knowledge of life process.
5. Evaluate and to create the perfect phylogenetic relationship in classification.

Units I

SUB CODE: P23ZC102

Origin and classification of vertebrates; The unique features of vertebrate morphology; Definition of vertebrates, Importance of the study of vertebrate morphology. Protochordata – Characteristics and classification.

Units II

Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

Units III

General plan of circulation in various groups; Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs.

Units IV

Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jaw suspension, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.

Units V

Sense organs: Simple receptors; Organs of Olfaction and taste; Lateral line system; Electroreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.

Reading list

1. SwayamPrabha <https://www.swayamprabha.gov.in/index.php/program/archive/9>

2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.

Recommended texts

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
3. EkambaranathaAyyar and T. N. Ananthkrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
4. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

Mapping with Programme Outcomes*										
Co s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	L	S	M	S	M	S	M	S
CO 2	S	L	L	S	M	S	M	M	M	M
CO 3	S	M	L	S	M	S	M	L	M	M
CO 4	S	L	L	S	L	S	M	L	M	L
CO 5	S	M	L	S	S	S	M	S	M	M

*S - Strong; M - Medium; L - Low

LAB COURSE IN INVERTEBRATES & VERTEBRATES

Course Objectives:

The main objectives of this course are:

1. Understanding the different systems in invertebrates & vertebrates.
2. Learning about various animal species, their phylogenetic affinities and their adaptive features.
3. Imparting conceptual knowledge about the salient features and functional anatomy.
4. Developing the skill in mounting techniques of the biological samples.
5. Gaining fundamental knowledge on the skeletal system

Pre-requisite:

Basic knowledge on the animals living in different habitats

Expected Course Outcome:

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

1. Understand the structure and functions of various systems in animals.
2. Learn the adaptive features of different groups of animals.
3. Learn the mounting techniques.
4. Acquire strong knowledge on the animal skeletal system

INVERTEBRATES

Dissection

Earthworm	: Nervous system
<i>Pila</i>	: Digestive and nervous systems
<i>Sepia</i>	: Nervous system
Cockroach	: Nervous system
Grasshopper	: Digestive system and mouth parts
Prawn	: Appendages, nervous and digestive systems

SUB CODE: P23ZC103P

Crab : Nervous system

Study of the following slides with special reference to their salient features and their modes of life

1. *Amoeba*
2. *Entamoebahistololytica*
3. *Paramecium*
4. *Hydra* with bud
5. Sporocyst – Liver fluke
6. *Cercarialarva*
7. *Tape worm (Scolex)*
8. *Ascaris* T. S.
9. Mysis of prawn

Spotters

1. Scorpion
2. *Penaeusindicus*
3. *Emerita (Hippra)*
4. *Pernaviridis*

Mounting

Earthworm	: Body setae
<i>Pila</i>	: Radula
Cockroach	: Mouth parts
Grasshopper	: Mouth parts

CHORDATES

Study the nervous system of Indian dog shark - Dissection

1. Nervous system of *Scoliodonlaticaudatus* – 5th or Trigeminal nerve
2. Nervous system of *Scoliodonlaticaudatus* – 7th or Facial nerve
3. Nervous system of *Scoliodonlaticaudatus* – 9th and 10th

or Glossopharyngeal & Vagus nerve

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodonlaticaudatus*(Indian dog shark)
4. *Trygon*sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus*(Cat fish)
7. *Belonecancila*(Flute fish)
8. *Exocoetuspoecilopterus*(Flying fish)
9. *Mugilcephalus*(Mullet)
10. *Tilapia mossambicus*(Tilapia)
11. *Rachycentroncanadum*(Cobia)
12. *Tetrodonpunctatus*(Puffer fish)
13. *Dendrophis*sp. (Tree snake)

Study of the different types of scales in fishes

1. Cycloid scale
2. Ctenoid scale
3. Placoid scale

Study of the frog skeleton system (Representative samples)

1. Entire skeleton
2. Skull
3. Hyoid apparatus
4. Pectoral girdle and sternum
5. Pelvic girdle
6. Fore limb
7. Hind limb

Mounting

1. Weberianossicles of fish

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjee, P. Chattopadhyaya. 2011. Advanced Practical Zoology, ArunabhaSen Publishers, pp-1070.

Mapping with Programme Outcomes*										
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	S	S	S	M	S	S	M	S	M	S
CO 2	S	M	L	S	M	S	M	M	M	M
CO 3	M	M	L	S	L	S	M	L	M	M
CO 4	S	S	L	S	L	S	M	L	M	L
CO 5	S	S	M	L	M	S	M	S	M	M

*S - Strong; M - Medium; L - Low

ECONOMIC ENTOMOLOGY - P23ZDE1

Course Objectives:

The main objectives of this course are:

1. Students should acquire a fairly good understanding about the life of insects and their classification.

Pre-requisite:

The students with a basic background in biological sciences with a special emphasis on the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.

Expected Course Outcome:

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

1. Understand taxonomy, classification and life of insects in the animal kingdom.
2. Know the life cycle, rearing and management of diseases of beneficial insects.
3. Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control
4. Recognize insects which act as vectors causing diseases in animals and human.
5. Overall understanding on the importance of insects in human life.

UnitsI

Overview of insects and insect taxonomy: Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.

UnitsII

Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.

UnitsIII

Destructive insects: Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.

UnitsIV

Pest management/Control strategies:Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.

Units V

Vector biology:Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures

Reading list

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.
3. Ross. H.H. 1965. A Text Book of Entomology, John Wiley & Sons Inc., New York, pp-746.

Recommended texts

1. Chapman, R.F., S.J. SimpsonandA.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards and R.G. Davies (Eds.) IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. McGraw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
6. Mani, M.S. 1982. General Entomology. Oxoford& IBH Publishing Co., pp-912.
- Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

AQUACULTURE

SUB CODE: P23ZE4

Course Objectives:

The main objectives of this course are:

1. Students should know basic concepts in Aquaculture.

Pre-requisite:

Students should know the fin fishes and shell fishes of commercially important candidate species.

Expected Course Outcome:

Upon completion of this course, Students would have

1. To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques.
2. To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture.
3. Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations.

UnitsI

Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture - Types of fish ponds for culture practice. Topography, site selection - water quality - soil condition and quality – structure and construction design and layout - inlet and outlet. Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays – Fishing gears used in aqua farming.

UnitsII

Procurement of seed from natural resources- collection methods and segregation. Hatchery technology for major carps and freshwater prawn. Artificial seed production –Breeding under control conditions, induced breeding technique, larval rearing, packing and transportation Commercial substitute for pituitary extracts. Classification of fish feed- Artificial feedsTypes, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.

UnitsIII

Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, algal culture, packing and transportation. Shrimp culture technology - extensive culture methods semi- intensive - intensive culture methods - Biofloc technology - Culture operations (water quality, feed and health management) - harvesting, preservation and marketing. Brackish water fish culture. Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products. Types of Seaweeds - species and methods of culture – by-products

UnitsIV

Fish and Shrimp diseases and health management – infectious diseases - Bacterial, Fungal, Viral, Protozoan; Non-infectious - environmental and nutritional diseases. Diseases diagnosis, prevention and control measures.

Units V

Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Setting and maintenance of freshwater Aquarium tanks. Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA and its activities.

Reading list

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. (1997). Fish and fisheries. Daya Publishing house, New Delhi.

Recommended texts

1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N.

2. Day, F (1958). Fishes of India ,VoL I and Vol. II. William Sawson and Sons Ltd., London.
3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India
4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S 0	M	S 0	M	S	M	L	S	S

*S-Strong; M-Medium; L-Low

TECHNICAL ENGLISH FOR ZOOLOGISTS SUB CODE: P23Z1SE1

Objectives: To understand and acquire knowledge of subject, verb and object, parts of speech, tense and its applications, voices and writing skill of letter, report and research paper.

UNIT-I

Sentence: Types (Assertive, Interrogative, Imperative and Exclamatory), Subject, verb and object & predicate.

UNIT-II

Parts of speech: Noun, pronoun, verb, adverb, adjectives, preposition, conjunction, and interjunction

UNIT-III

Tense – Present, past and future application of present and past participle

UNIT-IV

Active voice and passive voice, degrees of comparison.

Synthesis of sentences – simple, compound and complex.
Punctuation.

UNIT-V

Letter writing, Scientific report writing, Research article writing.

REFERENCES

1. Ref: Wren & Martin, 2017, High school, English Grammar & Composition, (Revised by N.D.V. Prasad rao) S. Chand Publication
2. Madras Rajan, 2014. Basic English Grammar, Leo Book publisher

COURSE OUTCOMES

- CO1: Acquire knowledge of Types of sentence making
- CO2: Understand the parts of speech
- CO3: Gain the knowledge of Tenses
- CO4: Learn the Active and passive voices, degrees of comparison
- CO5: Learn the ability of writing skill of letter, Scientific report and article etc.,

CELLULAR AND MOLECULAR BIOLOGYSUB CODE : P23ZC204

Course Objectives:

The main objectives of this course are:

1. To understand the ultrastructures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2. To realize involvement of various cellular components in accomplishing cell division.
3. To enable a successful performance in cell biology component of CSIR-UGC NET.
4. To understand the ultrastructures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

Pre-requisite:

Students should have knowledge of the basic cellular structures and their salient functions in prokaryotic and eukaryotic cells.

Expected Course Outcome:

Upon completion of this course, students could

1. Understand the general concepts of cell and molecular biology.
2. Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.
3. Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.
4. Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.

5. Understand the general concepts of cell and molecular biology.

UNITS I

General features of the cell: Basic structure of prokaryotic and eukaryotic cells - Protoplasm and deutoplasm - cell organelles; cell theory; Diversity of cell size and shapes.

UNITS II

Cellular organization: Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts.

UNITS III

Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription and translation in pro- and eukaryotic cells; Genetic maps.

UNITS IV

Cell communication and cell signaling: Membrane-associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.

UNIT V

Cancer cells: Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.

Reading list

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. *Lewin's Cells* (Third Edition), Jones & Bartlett, New Delhi, pp-1056.
2. Plopper, G. 2013. *Principles of Cell Biology*, Jones & Bartlett, Maryland, pp-510.

Recommended texts

1. Karp, G. 2010. *Cell Biology* (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al.*, 2013. *Molecular Cell Biology* (Seventh Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 1987. *Cell and Molecular Biology*. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, *Cell and Molecular Immunology* (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al.*, 1991, *Cell Structure and Function* (Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al.*, 1987, *Molecular Biology of the Gene* (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, *Cell Biology*, McGraw Hill, pp-319

8. Alberts, B., A. Johnson, J. Lewis, *et al.*, 2015, *Molecular Biology of the Cell* (Sixth Edition), Garland Science, New York, pp-1342

9. Clark, D.P., 2005. *Molecular Biology*, Elsevier, China, pp-784

Tropp, B. 2008. *Molecular Biology Genes to Proteins* (Third Edition), Jones & Bartlett, US, pp-1000

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	S	S	S	M	M	M
CO2	M	M	M	S	S	S	S	M	S	M
CO3	S	S	S	M	M	S	M	M	L	S
CO4	M	M	S	L	S	S	L	M	S	S
CO5	S	M	M	S	S	S	S	M	S	S

*S - Strong; M - Medium; L – Low

GENETICS

SUB CODE: P23ZC205

Course Objectives:

The main objectives of this course are:

1. Understanding DNA as genetic material, fine structure of DNA & RNA molecules, as well as physico-chemical properties of macromolecules.
2. Gain insight into sequential events occurs during protein synthesis.
3. Learn the structure and function of chromosome and chromosomal basis of genetic disorders.
4. To acquire knowledge about microbial genetics
5. To provide information about rDNA technology and its application.

Pre-requisite:

Basic knowledge on molecular biology and genetics

Expected Course Outcome:

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

1. Explain the organization and functions of genetic material in the living system.
2. Understand various sequential processes in protein synthesis
3. Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.
4. Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.
5. Understand the principle and application of rDNA technology for the welfare of human being.

UNIT I

Structure, properties and functions of genetic materials:DNA as the genetic Materials - Basic structure of DNA and RNA, alternate and unusual forms of DNA - Physical and Chemical properties of nucleic acid, base properties, denaturation and renaturation, T_m and cot values, hybridization.

UNITS II

Genetic code - Methods of deciphering the genetic code and general features of the code word dictionary. Chromosomal genetics:Molecular structure of chromosomes - Variation in chromosome number and structure - Chromosome nomenclature - Chromosomal syndromes.

UNITS III

Microbial Genetics:Genetics of Virus - Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome - Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation.

UNITS IV

Recombinant DNA technology:Recombinant DNA technology - Overview - Tools for Recombinant DNA Technology – Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases.

Units V

Introduction of rDNA into host cell - calcium chloride mediated gene transfer - *Agrobacterium* mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment - Selection and screening of transformed cells - Expression of cloned gene; Application

of rDNA technology in human welfare - Environment, Medicine and Agriculture

Reading list

1. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
2. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publsiher, pp-880.
3. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.
4. https://onlinecourses.swayam2.ac.in/cec21_bt02/previ ew
5. <https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code>

Recommended texts

1. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart. 2012. An Introduction to Genetic Analysis. 11th Edition, W. H. Greeman. New York.
2. Snustad, D.P., Simmons, M.J. 2015. Principles of Genetics, John Wiley Publications, pp-784.
3. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5th Edition). Cold Spring Harbor Laboratory Press, pp-912.
4. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.
5. Harti, D. L. 2002. Essential Genetics, A Genomic Perspective, Jones & Bartlet.

6. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin’s Genes XII, Jones & Bartlet Publisher, pp-613.
7. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India.

Mapping with Programme Outcomes*										
Co s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	L	L	S	S	S	L	M	S
CO 2	S	M	M	M	S	M	M	M	L	S
CO 3	M	S	L	L	M	S	M	L	S	L
CO 4	S	M	S	M	M	S	S	S	S	S
CO 5	S	S	S	M	E	S	M	S	M	M

*S - Strong; M - Medium; L - Low

LAB COURSE IN CELL AND MOLECULAR BIOLOGY AND GENETICS SUB CODE: P23ZC206P

CELL AND MOLECULAR BIOLOGY

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Identification of various stages of meiosis in the testes of grasshopper
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
5. Detection of sex chromatin
6. Identification of blood cells in the haemolymph of the cockroach
7. Isolation of genomic DNA from eukaryotic tissue
8. Isolation of total RNA from bacterial cells/tissues
9. Agarose gel electrophoresis of DNA
10. SDS-Polyacrylamide gel electrophoresis

GENETICS

1. Drosophila culture.
2. Identifications of sex.
3. Identifications of mutants.
4. Identification of Blood groups ABO and Rh factors.
5. Pedigree analysis.
6. Human karyotyping.
7. Chromosomal abnormalities.
8. Hardy Weinberg law and Calculation of gene frequencies for dominant, recessive and codominant traits and Multiple alleles.

Upon completion of the course, the students are able to

CO1: Obtain soft skills through dissection and mounting

CO2: Obtain knowledge on observation and analysis of fossils and other evolutionary important animals

CO3: Acquire skill to identify blood groups.

CO4: Skill for pedigree chart preparation and identification of chromosomal abnormalities.

CO5: Gain the skill to execute microtechniques

COURSE OUTCOMES:

MICROBIOLOGY AND IMMUNOLOGY

SUB CODE: P23ZDE7

UNIT I

Innate and Acquired Immune systems.

Organs of immune system: Primary – Thymus, Bone marrow, Secondary – Spleen, Lymphnodes, Tonsils. GALT and MALT.

Cells of Immune system :Haematopoetic stem cells, cells of lymphoid lineages – Lymphocytes, NK cells, K cells, Myeloid lineage – granulocytes, Neutrophils, Eosiphils, Accessory cells.

Major effectors: Major effector components of cellular immune system: Lymphocytes – types, morphology, clones; sub-populations, distribution, B and T cell receptors, B and T cell epitopes, Toll like receptors

UNIT II

Antigens: Definition, Characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications. Major effector components of humoral immune system: Antibodies – Primary structure, Classification, Varients and antigen- antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Complement system – Components, three major activation pathways and immune functions including anaphylaxis and inflammation. Cytokines – Definition and salient functional features; Interleukins; definition, types (lymphokines and monokines), and functions. Interferons – Origin, types and functions.

UNIT III

Immune Responses – Humoral and Cell mediated Immune responses. Antigen presenting cells; antigen processing and presentation, MHC molecules and their immunological significance. Disease and immune response: Hypersensitivity: definition, types I to V and mechanism of Anaphylaxis. Auto immune diseases; onset, spectrum of diseases and major immune responses. Transplantation Immunology – Types of graft, mechanism of allograft rejection, Graft versus. Host reaction, Prevention of graft rejection. Tumour Immunology – Tumour antigens, Immune responses to tumours – immune surveillance- Escape mechanism from immune response, Immunotherapy for tumours. Immune prophylaxis: Vaccines: types, preparations, efficacies and recent developments.

UNIT IV

Scope and history of microbiology – Classification of microorganisms, general methods of classifying bacteria, Morphology and fine structure of bacterial cells – cell wall and peptidoglycan in Gram positive and Gram negative bacteria – Reproduction of bacteria and viruses (Lytic and lysogenic cycles). Bacterial growth and nutritional requirements, Culture media and growth conditions.

UNIT V

Mixed and Pure cultures – Streak plate, pour plate and spread plate techniques. Food as a medium for the growth of microorganism - Food preservation by high and low temperature- Infections – Types, Methods of transmission of infections, Sources of Infections. Nosocomial infections -Bacterial infections- Cholera, Viral infections- AIDS. Fungal infections – Candidasis, Antibiotics – penicillin and tetracycline.

Text Books:

1. Gupta S.K (1999). Immunology.Narosa Publishing House, New Delhi.
2. Annadurai B (2013). A Text book of Immunotechnology,S.Chand publication. (Add place)
3. Pelczer M.J., Reid R.D and E.C.S Chan (1996).Microbiology. V Ed., TataMcGraw Hill Publishing Company Ltd., New Delhi.
4. Ananthanarayanan T and C.K JayaramPaniker (2000). Text Book of Microbiology. VI Ed., Orient Longman Ltd., Madras.
5. Dubey,R.C.andMaheswari.D.K.(1999),Text book of Microbiology, S. Chand and Company Ltd., New Delhi.
6. Michel. J,Pelczar,Jr.,Chan,E.C.S,Krieg,R(1993)Tata Mccraw-Hill edition,New Delhi.

References Books:

1. Ivan Roitt (1994). Essential Immunology (8th Edition).Blackwell Scientific Publication. Immunology W.H. Freeman and Company.
2. Weir D.M and Stewart J (1997). Immunology. 8th Edn., Churchill Livingstone, New York.
3. Kuby J (1994). Immunology. W.H. Freeman and Co., New York. 4. AshimK and Chakravarthy. Immunology and Immunotechnology.Oxford Publications. (Add year & place)
5. Abbas A.K., Lichtman A.K., JordanSandJ.S.Pober(1997). Cellular and Molecular Immunology. Harcourt Brace and Co., Asia Pvt. Ltd., Singapore.
6. Coleman, Lombard and Sicard(1992). Fundamentals Immunology.W.M.C. Brown Publishers.
7. Srivastava R., Ram B.P and P. Tyle (1991). Molecular Mechanisms of Immune Regulation. VCH Publishers Inc., New York.
8. Sells S (1987). Basic Immunology. Elsevier Science Publishing Co., New York.
9. Tizard I.R (1995). Immunology – An Introduction. IV Ed., Saunders College Publications, Philadelphia.
10. David Freifelder (1998). Microbial Genetics.Narosa Publishing House, NewDelhi.
11. Powar C.B and Diginawala H.F (1982). General Microbiology. Volume I and II, Himalaya Publishing House, Bombay.
12. Michael T. Madigan, John M. Martinkl and Jack Parker (1997).Biology of Microorganisms. VIII Ed., Prentice Hall International Inc., USA.

COURSE OUTCOMES:

Upon completion of the course, the students are able to

CO1: Understand the types and functions of immune system.

CO2: Induct basic concepts of antigenecity and immunogenicity. **CO3:**Understand the principles of hypersensitivity and develop theoretical knowledge on tissue and organ transplantation. Integrate knowledge of immune prophylaxis (Vaccine),Auto immunity Andtumour immunology.

CO4:Understand the classification and structure of microorganisms. Obtain the knowledge of nutritional requirements for growth of microbes.

CO5:Attain the knowledge of infectious diseases caused by microbes.

BIOTECHNOLOGY AND BIOINFORMATICS

Objectives:

1. To acquire knowledge on the application of biotechnology in various fields.
2. learn gene cloning, gene transfer technique,
3. Applications of biotechnology in bioremediation for the industrial wastes.
4. Applications of biotechnology in agriculture and transgenic animals
5. awareness on GMOs

UNIT-I

Basic Tools for Gene Manipulation

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). **Restriction enzymes:** Nomenclature, Types. **Transformation techniques:** Calcium chloride method, electroporation and biolistic method. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

UNIT-II

Advance Tools and Techniques

Southern, Northern and Western blotting DNA sequencing: Sanger method, Polymerase Chain Reaction, DNA Finger Printing and DNA micro array.

Genetically Modified Organisms

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection; Applications of transgenic animals: Production of

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pharmaceuticals, production of donor organs, knock out mice.

UNIT-III

Applications of biotechnology in agriculture (Agrobacterium-mediated transformation. Applications of transgenic plants: insect and herbicide resistant plants, Biopesticides and Biofertilizers) medicine (insulin) and food science. Genetically modified organism (GMO'S) - GM foods.

Bioremediation - bioremediation of hydrocarbons - Industrial wastes - Heavy metals - Xenobiotics - bioleaching - biomining - biofuels.

UNIT-IV

Introduction to Bioinformatics, Databases-Nucleic acid databases, Protein sequence databases, Databases of structures, Specialized databases, Bibliographic databases. Outline of Genomics and Proteomics.

Steps involved in Drug Discovery.

UNIT-V

Structure based Protein classification, Protein structure databases-PDB, NCBI. Visualization databases - Rasmol, Swiss-PDB and PDBsum. Structure visualization database

Recommended Text Books:

1. Dubey R.C (2008). A text Book of Biotechnology. S. Chand and Company, New Delhi.
2. Sathyanarayana U (2005). Biotechnology. Books and Allied P. Ltd. Kolkata.
3. B.D.Singh(2003).Biotechnology,Kalyanipublishers.Ludhiana,New Delhi
4. Prakash.S.Lohar(201`7),Bio informatics,MJPPublishers,Chennai.

References Books:

1. Brown C.M., Campbel I and F.G Priest (1988). Introduction to Biotechnology. Blackwell Scientific Publications, UK.
2. Primrose S.B (2000). Modern Biotechnology. Blackwell Scientific Publications, Oxford, London.
3. KeshavTrehan (1996). Biotechnology. New Age International Pvt. Ltd. Publishers, New Delhi.
4. Watson *et.al.*, (1999). Recombinant DNA. Freeman and Company, New York
5. Ignacimuthu S (1998). Basic Biotechnology. Tata McGraw Hill Publishing Co., New Delhi.
6. Sharma.Munjal.Shanker(2016) Text book of Bioinformatics, Rastogi publication, Meerut.
7. Arthur M.Lesk(2003).Introduction to Bioinformatics, University of Cambridge, Oxford University Press.

COURSE OUTCOMES:

Upon completion of the course, the students are able to

CO1:Master the theoretical knowledge of various field in biotechnology.

CO2: Acquire and perform various experiment related aspects of biotechnology.

CO3: Understand and acquire the knowledge of cloning vector, gene transfer techniques and equip the students to get job opportunity in these field of biotechnology based companies.

CO4: Understand and acquire the knowledge of data base, types, and drug discovery with bioinformatics tools and equip the students to get job opportunity in these field

CO5: Understand and carry out the bioinformatics applications in the field of medicine And environmental fields.

APICULTURE

Course Objectives:

The main objectives of this course are:

1. Students should know basic concepts in Apiculture.

Pre-requisite:

Students should be aware of importance of honey bees and their impacts on the ecosystem.

Expected Course Outcome:

Upon completion of this course, Students would have

1. Clear understanding of morphology, life cycle, characteristics of honey bees and bee keeping.
2. Acquired skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.
3. Knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.

UNITS I

Introduction to Apiculture. History, classification, types, life Cycle of different species of Honey Bees and their behavioural patterns. Social organization of bee colony

UNITS II

Bee-keeping system, tools and equipment's needed for bee keeping. Types of bee hives, structure and functional features. Criteria for site selection for apiculture and factors affecting them.

UNITS III

Identification and characteristics and Preventive measures to be taken against of different bee enemies. Diseases affecting

SUB CODE: P23Z2SE2

honey bees and their control measures. Colony collapse disorder and its management.

UNITS IV

Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom. Harvesting, Processing, Packaging and Marketing of bee products.

UNITS V

Apiculture industry around the world and Role of Central Bee Research & Training institute in India. Apiculture as an Entrepreneurial venture.

Reading list

1. Singh, D., Singh, D. Pratap. 2006. A Handbook of Beekeeping. AGROBIOS (INDIA)
2. Sharma P.L. and Singh, S.H. Book of Bee keeping.
3. Cherian and Ramanathan, S. Bee keeping in south India.
4. Prospective in Indian Apiculture - R.C. Mishra.

Recommended texts

1. Caron, D.W. 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. Cheshire, CT, 368 pp.
2. Kaspar, R., C. Cook, and M. D. Breed. 2018. Animal Behaviour 142: 69-76.
3. Hendriksma, H. P., A. L. Toth, and S. Shafir. 2019. Individual and Colony Level Foraging decisions of Bumble Bees and Honey Bees in Relation to Balancing of Nutrient Needs. Frontiers in Ecology and Evolution 7: 177.
4. Steinhauer, N. et al. 2018. Drivers of Colony Loss. Current Opinion in Insect Science 26: 142-148.
5. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.

6. ABC & XYZ of Bee culture - A. I. Root.

Mapping with Programme Outcomes*

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	M	L	L	S	L	S	S	L
CO2	S	S	S	S	S	S	L	L	S
CO3	S	L	M	M	S	M	M	L	L
CO4	M	S	L	S	L	M	L	M	M
CO5	S	L	L	S	L	M	L	L	M

*S - Strong; M - Medium; L-Low