GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

M.Sc., ZOOLOGY

SYLLABUS

FROM THE ACADMIC YEAR

2023-2024

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.

Course Structure Under CBCS for Science (2023-2024 onwards)

M.Sc Zoology-Syllabus

Semester	List of Courses	Title	Credit	No. of Hours	Marks		Total
					Int.	Ext.	
I	Core Course - I	Structure and Function of Invertebrates	5	6	25	75	100
	Core Course - II	Comparative Anatomy of Vertebrates	5	6	25	75	100
	Core Practical – I	Practical – I	4	6	40	60	100
	Elective Course - I	Molecules and their interaction relevant to Biology	3	6	25	75	100
	Elective Course - II	Biostatistics	3	6	25	75	100
Total			20	30			500
II	Core Course - III	Cellular and Molecular Biology	5	6	25	75	100
	Core Course - IV	Developmental Biology	5	6	25	75	100
	Core Practical -II	Practical – II	4	5	40	75	100
	Elective Course - III	Economic Entomology	3	5	25	75	100
	Elective Course - IV	Research Methodology	3	4	25	75	100
	Skill Enhancement Course - I	Poultry Farming	2	4	25	75	100
Total			22	30			600
III	Core Course- V	Genetics	5	6	25	75	100
	Core Course-VI	Evolution	5	6	25	75	100
	Core Course-VII	Animal Physiology	5	6	25	75	100
	Core Practical -III	Practical – III	4	6	40	75	100
	Elective Course - V	Stem cell Biology	4	3	25	75	100
	Skill Enhancement Course - II	Dairy Farming	2	3	25	75	100
	Internship / Industrial Activity		2				
Total			27	30			600

Semester	List of Courses	Title	Credit	No. of Hours	Marks		Total
					Int.	Ext.	
IV	Core Course-VIII	Immunology	5	6	25	75	100
	Core Practical -IV	Practical – IV	5	6	40	60	100
	Elective Course - VI	Aquaculture	4	4	25	75	100
	Skill Enhancement Course - III	Medical Laboratory Techniques	3	4	25	75	100
	Project with VIVA VOCE	Project Work	7	10	20	80	100
	Extension Activity	Extension Activities	1				
Total			24	30			500
Net total			93	120			2200

SUBJECT	TOTAL PAPERS	CREDITS
Core Course	8	40
Core Practical	4	17
Elective	6	18
Skill Enhancement Course	3	8
Project with Viva-voce	1	7
Internship / Industrial Activity		2
Extension Activity		1
Total	22	93

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER - I

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.	
Course I	**:**	**Core I**
Course title	**:**	**STRUCTURE AND FUNCTION OF INVERTEBRATES**
Credits	**:**	**4**
Pre-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.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

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

Units	
I	**Structure and function in invertebrates**: Principles of Animaltaxonomy; Speciesconcept;Internationalcodeofzoologicalnomenclature; Taxonomic procedures; New trends intaxonomy
II	**Organization ofcoelom**: Acoelomates; Pseudocoelomates; Coelomates: Protostomia andDeuterostomia; Locomotion: Flagella and ciliary movement inProtozoa; Hydrostatic movement in Coelenterata, Annelida andEchinodermata
III	**Nutrition andDigestion**: Patterns of feeding and digestion in lowermetazoan; Filter feeding in Polychaeta, Mollusca andEchinodermata. Respiration: Organs of respiration: Gills, lungs andtrachea; Respiratorypigments; Mechanism of respiration
IV	**Nervous system**: Primitive nervous system: Coelenterata andEchinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neuralevolution. **Excretion**: Organsofexcretion:Coelomoducts,NephridiaandMalphigiantubules; Mechanisms ofexcretion - osmoregulation.
V	**Invertebratelarvae**: Larval forms of free livinginvertebrates - Larval forms ofparasites; Strategies and Evolutionary significance of larvalforms. **MinorPhyla:** Concept andsignificance; Organization and generalcharacters.

Reading list

1. 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	S	S	M	M	S	S
CO4	S	M	S	M	S	S	M	M	S	M
CO5	S	M	S	M	S	S	M	M	S	M

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – I

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 behaviours.	
5.	Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.	
Course I	**:**	**Core II**
Course title	**:**	**COMPARATIVE ANATOMY OF VERTEBRATES**
Credits	**:**	**4**
Pre-requisite:		
Students withknowledge 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.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

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

Units	
I	Origin of vertebrates: Concept ofProtochordata; The nature of vertebratemorphology; Definition,scopeandrelationtootherdisciplines; Importance of the study of vertebratemorphology.
II	Classification ofvertebrates; Vertebrate integument and itsderivatives. Development,generalstructureandfunctionsofskinanditsderivatives; Glands, scales, horns, claws, nails, hoofs, feathers andhairs.
III	General plan of circulation in variousgroups; Blood; Evolution ofheart; Evolution of aortic arches and portalsystems. Respiratorysystem: Characters of respiratorytissue; Internal and external respiration; Comparative account of respiratoryorgans.
IV	**Skeletalsystem**: Origin, Function, body size and skeletal elements of thebody; Comparative account of jawsuspensorium, Vertebral column; Limbs andgirdles; Evolution of Urinogenital system in vertebrateseries.
V	**Senseorgans**: Simplereceptors; Organs of Olfaction andtaste; Lateral linesystem; Electroreception. Nervous system: Comparative anatomy of the brain in relation to itsfunctions; Comparative anatomy of spinalcord; Nerves-Cranial, Peripheral and Autonomous nervoussystems.

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. Ananthakrishnan. 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*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	S	M	S	M	S	M	S
CO2	S	L	L	S	M	S	M	M	M	M
CO3	S	M	L	S	M	S	M	L	M	M
CO4	S	L	L	S	L	S	M	L	M	L
CO5	S	M	L	S	S	S	M	S	M	M

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – 1
Core Practical – I

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	
Course I	**:**	**Core III**
Course title	**:**	**LAB COURSE IN INVERTEBRATES & VERTEBRATES**
Credits	**:**	**4**
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	**K2 & K4**
2.	Learn the adaptive features of different groups of animals	**K1 & K2**
3.	Learn the mounting techniques	**K2 & K3**
4.	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

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

INVERTEBRATES

Dissection

Earthworm : Digestive and Nervous system
Pila : Digestive and nervous systems (virtual)
Cockroach : Digestive and Nervous system
Grasshopper : Digestive system and mouth parts (virtual)
Prawn : Appendages, nervous and digestive systems

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

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

Spotters

1. Scorpion
2. *Penaeusindicus*
3. *Emerita* (*Hippa*)
4. *Pernaviridis*
5. *Rotifer*
6. *Sagita*
7. *Pleurobranchia*

Mounting

Earthworm : Body setae& Pineal setae

Pila : Radula

Mouth parts

Cockroach, Grasshopper, Mosquito, House fly, Honey bee

CHORDATES

Study the nervous system of Indian dog shark – Dissection(Virtual)

1. Nervous system of *Scoliodonlaticaudatus* – 5^{th} or Trigeminal nerve
2. Nervous system of *Scoliodonlaticaudatus* – 7^{th} or Facial nerve
3. Nervous system of *Scoliodonlaticaudatus* – 9^{th} and 10^{th} 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 maculates* (Cat fish)
7. *Belone cancila*(Flute fish)
8. *Exocoetuspoecilopterus*(Flying fish)
9. *Mugilcephalus*(Mullet)
10. *Tilapia mossambicus*(Tilapia)
11. *Rachycentroncanadum*(Cobia)
12. *Tetrodon punctatus* (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. Weberian ossicles 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.

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002
DEPARTMENT OF ZOOLOGY
SEMESTER – I

Course Objectives:		
The main objectives of this course are:		
1.	Students should know the fundamentals of biochemistry	
Course I	**:**	**Elective I**
Course title	**:**	**MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY**
Credits	**:**	**3**
Pre-requisite:		
Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to:		

I	Learn the structure, properties, metabolism and bioenergetics of biomolecules	**K1 & K3**
II	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K1 & K2**
III	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	**K2 & K3**
IV	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K2 & K4**
V	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	**K5 & K6**

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

Elective I :Molecules and their interaction relevant to Biology

Units	
I	Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
II	Biomolecular interactions and their properties:Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
III	Bioenergetics and enzymology:Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes.

IV	Structural conformation of proteins and nucleic acids:Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).
V	Stabilizing interactions in biomolecules:Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.

Reading list

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

Recommended texts

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002
DEPARTMENT OF ZOOLOGY
SEMESTER – I

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Biostatistics.	
Course I	**:**	**Elective II**
Course title	**:**	**BIOSTATISTICS**
Credits	**:**	**3**
Pre-requisite:		
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	**K2 & K3**
II	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	**K3 & K4**
III	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5 & K6**

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

Units	
I	Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.
II	Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error and coefficient of variation.
III	Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.
IV	Hypothesis testing: Student'*t*' test - paired sample and mean difference'*t*' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.
V	Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

Reading list

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

Recommended texts

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	M	S	S	M	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	M	M	S	L	M	M	M	S	L	M
CO5	M	M	S	L	M	S	M	L	S	M

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – II

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.	
Course I	**:**	**Core IV**
Course title	**:**	**CELLULAR AND MOLECULAR BIOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students should haveknowledge 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.	**K2**
2.	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	**K1 & K2**
3.	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	**K3 & K4**
4.	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	**K5**
5.	Understand the general concepts of cell and molecular biology.	**K2**

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

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002
DEPARTMENT OF ZOOLOGY
SEMESTER -II

Course Objectives:		
The main objectives of this course are:		
1.	Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.	
2.	Learn the principles, methods and applications of cryo-preservation of gametes and embryo.	
Course I	**:**	**Core V**
Course title	**:**	**DEVELOPMENTAL BIOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students have fundamental knowledge in developmental biology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Define the concepts of embryonic development	**K1**
2.	Observe various stages of cell divisions under microscope	**K2 & K3**
3.	Understand the formation of zygote	**K4**
4.	Differentiate the blastula and gastrula stages	**K4 & K5**
5.	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	**K4**

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

Core course: IV: **DEVELOPMENTAL BIOLOGY**

Units	
I	Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, permatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians
II	Fertilization:Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion in mammals, Acrosome reaction. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release - Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation - Parthenogenesis
III	Cleavage and gastrulation:Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition - Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Amphibians and Chick); Fate maps - (Amphibian and Chick),Epigenesis and preformation – Formation of primary germ layers

IV	Embryonic Development; Embryonic development of fish and birds, formation of extra embryonic membranes in mammalian – Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives. Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation. Gene and development; Anterior- posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes
V	Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Neoteny and pedogenesis. Regeneration: Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups, Factors stimulating regeneration –Aging and senescences: Biology of senescences- cause of aging- mechanism involved in apoptosis. Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation

Reading list

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. www.easybiologyclass.com › developmental-biology-e
7. www.studocu.com › document › lecture-notes › view
8. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.

Recommended texts

1. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
2. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
3. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

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

*S-Strong; M-Medium; L – Low

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER -II - PRACTICAL

Course Objectives:		
The main objectives of this course are:		
1.	Practical course aims at demonstrating significant cellular and molecular biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology, genetics and developmental biology into practical understanding.	
Course I	**:**	**Core VI**
Course title	**:**	**LAB COURSE IN CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students should have acquired basic knowledge relevant to this particular lab course.		
Expected Course Outcome:		
Upon completion of this lab course, students		

1.	Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.	**K2**
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	**K3**
3.	Develop handling - skills through the wet-lab course.	**K6**
4.	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains	**K1 & K2**
5.	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities	**K1 & K2**

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

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 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

DEVELOPMENTAL BIOLOGY

Gametogenesis - Observation of gametes from gonadal tissue sections

i. Oogenesis:

✓ Section through ovary of shrimp, fish, frog and mammals

ii Spermatogenesis:

✓ Section through testis of shrimp, fish, calotes and mammals

Fertilization

iii Induced spawning in polycheate worm *Hydroids elegans*

iv *In vitro* fertilization and development in a polycheate worm *Hydroids elegans*

v Observation of egg developmental stages in *Emerita emeritus*

Embryogenesis

vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development

vii Chick embryonic stage - 24 hours of development

viii Chick embryonic stage - 48 hours of development

ix Chick embryonic stage - 72 hours of development

x Chick embryonic stage - 96 hours of development

Histological observation: Section through various developmental stages in chick embryo

Experimental Embryology

Regeneration in Frog Tadpoles

xi Blastema formation

xii Demonstration of regenerative process in tadpole

Metamorphosis

xiii Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine

Cryopreservation

xiv Demonstration of cryopreservation of gametes of fin fish/shell fish

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

*S-Strong; M-Medium; L – Low

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002
DEPARTMENT OF ZOOLOGY

SEMESTER – II

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.	
Course I	**:**	**Elective III**
Course title	**:**	**ECONOMIC ENTOMOLOGY**
Credits	**:**	**3**

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

I	Understand taxonomy, classification and life of insects in the animal kingdom.	**K1 & K2**
II	Know the life cycle, rearing and management of diseases of beneficial insects.	**K2 & K3**
III	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	**K2 & K3**
IV	Recognize insects which act as vectors causing diseases in animals and human.	**K2 & K4**
	Overall understanding on the importance of insects in human life.	**K2 & K6**

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

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

IV	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.
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. Mc Graw-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.
7. 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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002
DEPARTMENT OF ZOOLOGY

SEMESTER – II

Course Objectives:		
The main objectives of this course are:		
1.	Students understand the basic principle, methodology and applications of widely used instruments in biological sciences.	
Course I	**:**	**Elective IV**
Course title	**:**	**RESEARCH METHODOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students should know the fundamentals of basic methods employed in experimental biology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Understand theimplications of GLP	**K1**
2.	Learn the working principles of different instruments	**K2**
3.	Gain the knowledge on techniques of histology and histochemistry	**K2 & K4**
4.	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy	**K3 & K5**

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

Units	
I	**Introduction to Research**: Concept of scientific research – selection of a research problem – research design – sampling methods – hypothesis testing- null hypothesis-alternate hypothesisdata collection – making observation and records. Preparation of index cards – reference collection and alignment – refereed journals -impact factor - citation index - science direct – H-index. Intellectual Property Rights (IPR) – trademarks and copyright.
II	Preparation of scientific papers for publication in a journal. Preparation and presentation of research paper for symposia -seminar and conferences. Technical papers and monographs. Internet and e-journals. Preparation of thesis – components of thesis.
III	Using computers in research – computer aided techniques for data analysis - data interpretation and presentation. Levels of significance - regression and correlation - plagiarism detecting software and multivariate statistics. Analysis of data using SPSS.
IV	Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry.Histology, Histochemistry, Bioinformatics and Electron microscopy.Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.
V	Centrifuges, Chromatography, Electrophoresis, ELISA and blotting.Principles and Applications of tracer techniques in biology, Animal cell culture techniques.
Reading list	
1. Guramani, N. (2019). Research Methodology for Biological sciences. MJP publishers, Chennai. 2. Kothari, C. R. (2019). Research Methodology-Methods and Techniques. New Age international	

publishers.
3. Wilson, K. and Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology. (VIII Edition), Cambridge University Press.
4. Johnson, T. R. and Case, C.L. (2019). Laboratory Experiments in Microbiology. (XII Edition), The Benjamin Cummings Pub. Co., London.
5. Panneerselvam, R. (2013). Research Methodology. Prentice Hall India Learning Private Limited.

Recommended texts

6. Fritschen, L. J. and Gay, L. W. (1979). Environmental Instrumentation. Springer Verlag, New York.
7. Humason, G. L. (1979). Animal Tissue Techniques. (IV Edition), Freeman WH and Co., San Francisco.
8. Osterman, A. (1984). Methods of Protein and Nucleic acid Research. Springer Verlag, New York.
9. Plumber, D.T. (1971). An Introduction to Practical Biochemistry. Tata McGraw Hill Co.,
10. Sharma, B. A. V. Ravindra Prasad, D. and Sathyanarayana, P. (1989). Research Methods in Social Sciences. Sterling Pub. Pvt. LtdPearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
11. Lillie, R.D. 1954. Histopathologic Technique and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.
12. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – II

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Vermiculture.	
Course I	**:**	**Skill Enhancement Course [SEC] - I**
Course title	**:**	**POULTRY FARMING**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of economic and cultural importance of Poultry farming.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed or Poultry farming.	**K1, K2 & K3**
III	To know the difficulties in Poultry farming and be able to propose plans against it.	**K5 & K6**

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

Units	
I	General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming
II	Management of chicks - growers and layers - Management of Broilers.- Preparation of project report for banking and insurance.
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.
IV	Poultry diseases-viral, bacterial, fungal and parasitic(two each); symptoms, control and management; Vaccination programme.
V	Selection, care and handling of hatching eggs - Egg testing.Methods of hatching.- Brooding andrearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.

Reading list

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi 2.
2. Jull A. Morley, 2007. Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow."
4. Life and General Insurance Management"

Recommended texts

1. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
2. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
3.https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf

4. http://ecoursesonline.iasri.res.in/course/view.php?id=335
5. https://swayam.gov.in/nd2_nou19_ag09/preview

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

*S-Strong; M-Medium; L – Low

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – III

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.	
Course I	**:**	**Core VII**
Course title	**:**	**GENETICS**
Credits	**:**	**4**
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.	**K1 & K2**
2.	Understand various sequential processes in protein synthesis	**K1 & K2**
3.	Explicate the structures and functions of chromosomes and identify the diseasescaused by the chromosomal abnormalities.	**K2 & K4**
4.	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	**K2 & K5**
5.	Understand the principle and application of rDNA technology for the welfare of human being.	**K2 & K3**

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

Units	
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, hybridization.
II	**G**enetic 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.
III	Microbial Genetics:Genetics of Virus - Viral chromosome, Bacteriophage - Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome - Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation
IV	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.
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 Publisher, 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/preview
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, (5^{th} 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*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	S	S	S	L	M	S
CO2	S	M	M	M	S	M	M	M	L	S
CO3	M	S	L	L	M	S	M	L	S	L
CO4	S	M	S	M	M	S	S	S	S	S
CO5	S	S	S	M	E	S	M	S	M	M

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – III

Course Objectives:		
The main objectives of this course are:		
1.	To critically analyze the concepts of evolution in order to	
2.	Understand the factors responsible for origin and generation of diversity among living beings and	
3.	To develop strategies for sustenance of life on this planet	
4.	To critically analyze the concepts of evolution in order to	
Course I	**:**	**Core VIII**
Course title	**:**	**EVOLUTION**
Credits	**:**	**4**

Pre-requisite:

Students shall have basic knowledge on the diversity of animals, biology including morphological, anatomical, physiological and embryological features of various phyla and their environment.

Expected Course Outcome:

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

1.	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	**K1 & K3**
2.	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	**K1 & K2**
3.	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.	**K2 & K3**
4.	Comprehend the origin of new genes and proteins; Gene duplication and divergence.	**K2 & K4**
5.	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	**K4 & K5**

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

Units	
I	Emergence of evolutionary thoughts:Lamarck and Darwin–concepts of variation, adaptation, struggle, fitness and natural selection – Mendelism - Spontaneity of mutations - The evolutionary synthesis.
II	Origin of cells and unicellular evolution: Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Urey Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes -

	Anaerobic metabolism, photosynthesis and aerobic metabolism.
III	Paleontology and evolutionary history: Major events in the evolutionary time scale- Eras, periods and epoch - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including *Homosapiens.*
IV	Molecular evolution: Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis - Origin of new genes and proteins - Gene duplication and divergence.
V	The mechanisms: Population genetics - Populations, Gene pool, Gene frequency - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift- Adaptive radiation - Isolating mechanisms – Speciation - Allopatrism and Sympatrism - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution.

Reading list

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution,Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T.Kivisild and C. T.Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
5. http://www.evolution-textbook.org/
6. https://onlinelibrary.wiley.com/journal/15585646
7. http://darwin-online.org.uk/

Recommended texts

1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
2. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
3. Barton, N.H., D. Briggs, J.A. EisenDavid,D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – III

Course Objectives:		
The main objectives of this course are:		
1.	Students acquire the basic knowledge on physiology of different organs in animals and human.	
2.	Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.	
Course I	**:**	**Core IX**
Course title	**:**	**ANIMAL PHYSIOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students should know the fundamentals of structure and functions of organs and organ systems of animals.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Understand the functions of different systems of animals	**K1**
2.	Learn the comparative anatomy of heart structure and functions	**K2**
3.	Know the transport and exchange of gases, neural and chemical regulation of respiration	**K2 & K4**
4.	Acquire knowledge on the organization and structure of central and peripheral nervous systems	**K3 & K5**

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

Units	
I	**Blood and circulation**: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular system : Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation.
II	**Respiratory system:** Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
III	**Nervous system**: Central and peripheral nervous system, gross neuro-anatomy of the brain and spinal cord, Neurons, Glial cells, action potential, neural control of muscle tone and posture. Sensory organs: Vision, hearing and tactile response.
IV	**Digestive system:** Digestion, absorption, energy balance, BMR. Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

V	**Endocrinology and reproduction**: Endocrine glands, basic mechanism of hormone action, hormones and diseases; Reproductive processes, male and female reproductive hormones, neuroendocrine regulation. Stress and adaptation. **Thermoregulation**: Comfort zone, Body temperature - Neural regulation, Acclimatization.

Reading list

1. Prosser C. L. 1991, Comparative Animal Physiology. Part A: Environmental and Metabolic Animal Physiology. Wiley-Liss Publishers, pp-592
2. Hoar, S.W. 1983,General and Comparative Physiology,Prentice Hall Publication, pp-928.
3. Randall, D., W. Burggren, K. Frenchand R. Eckert.2001, Animal Physiology Mechanisms and Adaptations, New York : W.H. Freeman and Co., pp-
4. Nelson K. S. 1997. Animal Physiology: Adaptation and Environment, Cambridge University Press, pp- 617.
5. Dantzler, W.H. 1997. Comparative Physiology (Handbook of Physiology), Volumes I and II. Edited by William H. Dantzler. pp - 1824 Published for the American Physiological Society by Oxford University Press Inc., New York. Oxford University Press Canada, Toronto.
6. https://swayam.gov.in/nd1_noc20_bt42/preview
7. https://www.classcentral.com/course/swayam-animal-physiology-12894
8. https://swayam.gov.in/nd1_noc20_hs33/preview

Recommended texts

1. Shepherd, G. M. 1994.Neurobiology, OUP USA Publsiher, pp-774.
2. Hainsworth , F.R. 1981. Animal Physilogy: Adaptation in function, Addison Wesley Longman Publishers, pp-669.
3. Mcfarland, D. 1999. Animal Behaviour: Psychobiology, Ethology and Evolution, Longman Publisher, pp-592.
4. Gorden, M.S. *et al.*, 1977. Animal Physiology: Principles and Adaptation, New York, Third Edition.
5. Ahearn, G.A. *et al*., 1988. Advances in Comparative and Environmental Physiology – 2, Springer Publishers, pp-252.
6. Hill, R.W. 1976. Comparative Physiology of Animals: Environmental Approach, Longman Higher Education Publisher, pp-656.
7. Withers, P.C. 1992. Comparative Animal Physiology, Brooks/Cole Publisher, pp-900.

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – III

Course Objectives:		
The main objectives of this course are:		
1.	To provide hands-on training to perform specific lab courses in immunology and research methodology.	
2.	To enable clear understanding of the methodology through wet – lab courses.	
Course I	**:**	**CORE PRACTICAL- III**
Course title	**:**	**Lab Course in Genetics, Evolution and Animal Physiology**
Credits	**:**	**4**
Pre-requisite:		
Students should acquire the basic knowledge relevant to a particular lab course.		
Expected Course Outcome:		
Upon completion of this lab course, the students		

1.	Acquire ability to perform/ demonstrate various basic concepts in immunology as well as applications of research methods for quantitative/ qualitative analysis of biochemical components.	**K3 & K4**

GENETICS

1. Sex differentiation of Drosophila
2. Mutant varieties of drosophila
3. Human blood grouping
4. Human karyotype
5. Pedigree analysis
6. Differentiation of human finger printings
7. Mendelian characters in human
8. PTC test for Taster and Non-Taster

PHYSIOLOGY

1. Effect of thyroxine in oxygen consumption by a fish
2. Preparation and staining of blood film with Leishman's stain.
3. Identification of blood corpuscles.
4. Total count of RBC and WBC.
5. Differential count of WBC
6. Haemoglobin estimation
7. Salivary amylase activity of human saliva in relation to temperature and pH
8. Identification of Nitrogenous Excretory products in the sample
9. Test for Urea and Sugar in urine sample
10. Qualitative Test for 1. Carbohydrate 2. Protein 3. Lipid
11. Sphygmomanometric measurement of arterial blood pressure at rest and after exercise
12. Calculation of Body Surface Area, Body Mass Index and anthropometric measurements.

Spotters: Haemoglobinometer, Haemocytometer, Kymograph, Sphygmomanometer

EVOLUTION

1. Homologous,Analogous organs and vestigial organs
2. Connecting link –Peripatus – Archaeopteryx
3. Fossils – Ammonites – Nautiloids - Belemnoides

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – III

Course Objectives:		
The main objectives of this course are:		
1.	Students should know understand the basics of stem cells	
Course I	**:**	**Elective V**
Course title	**:**	**STEM CELL BIOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students should understand the basics of stem cells and its applications		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

I	Understand the basic knowledge of stem cells and their origin	**K1 & K2**
II	Differentiating the embryonic and adult stem cells	**K3 & K4**
III	Understand and apply the current stem cell therapies for their research	**K5**

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

Units	
I	Introduction to stem cell biology: Stem cell definition, origin and hierarchy, stem cell properties, Identification and Characterization, potency and differentiation, niche of stem cell, overview of different stem cell types (embryonic stem cells, adult stem cells, induced pluripotent stem cells and cancer stem cells).
II	Embryonic stem (ES) cell: Characterization and properties of ES cells, pluripotency and self-renewal of ES cells; molecular mechanisms regulating pluripotency and maintenance of the stem state, progressive differentiation of ES cells into ectoderm lineage organs (skin, brain and nerve), mesoderm lineage organs (heart, kidney, muscle, bone and blood), and endoderm lineage organs (lung, liver, stomach, pancreas and intestine).
III	Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cells (HSCs) - sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cells (iPSCs); role of Yamanaka factor in iPSCs.
IV	Stem cell and aging: aging theory; cell cycle; telomere and telomerase; senescence of

	stem cell; role of stem cell in aging; tissue repair and regeneration of adult organs.
V	Current stem cell therapies: Advantages and disadvantages of ES cells and adult stem cells (MSCs and HSCs) therapy; Ethical concern on stem cell therapy; current stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cells for various diseases.

Reading list

1. Kiessling, A.A. 2006. Human Embryonic Stem Cells (Second Ed.), Jones & Barlett Publishers.
2. Lanza, R. and A. Atala. 2005. Essentials of Stem Cell Biology. Academic Press, pp-712.
3. Turksen, K. 2004. Adult Stem Cells. Humana Press, Inc, pp-429.
4. Lanza, R. *et al*. 2004. Handbook of Stem Cells: Embryonic/Adult and Fetal Stem Cells (Vol. 1 & 2). Academic Press, pp-1626.
5. Institute of Medicine, 2002. Stem cells and the future of regenerative medicine. National Academy Press, pp-112.
6. Marshak, D., R.L. Gardener and D. Gottlieb. 2001. Stem Cell Biology, Cold Spring Harbour Monograph Series, 40, pp-550.
7. Booth, C. 2003. Stem Cell Biology and Gene Therapy, Cell Biology International, Academic Press.

Recommended texts

1. Quesenberry, P.J., G.S. Stein, B. Forget and S. Weissman.2001. Stem Cell Biology and Gene Therapy, Wiley Publishers, pp-584.
2. Sell, S. and Totowa, N.J.2004. Stem Cells Handbook, Humana Press, pp-534.
3. Sullivan, S., C. A. Cowan and K. Eggan. 2007. Human Embryonic Stem Cells: The Practical Handbook, Wiley Publishers, pp-424.
4. Battler, A., and Leo, J. 2007. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Springer Publication, pp-422.

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

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – III

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Vermiculture	
Course I	**:**	**Skill Enhancement Course [SEC] - II**
Course title	**:**	**DAIRY FARMING**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of economic and cultural importance of Dairy farming.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed for Dairy farming.	**K1, K2 & K3**
III	To know the difficulties in Dairy farming and be able to propose plans against it.	**K5 & K6**

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

Units	
I	Introduction to Dairy Farming-Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding types - artificial insemination.
II	Construction of Model Dairy House - Types of Housing - Different Management Parameters - Winter Management - Summer Management
III	Feedstuffs available for livestock- Roughages -Concentrates - Energy rich concentrates -Protein rich concentrates - Mineral Supplements - Vitamin Supplements -Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.
IV	Milk-Composition of milk-milk spoilage-pasteurization - Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.
V	Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.

Reading list

1.The Veterinary Books for Dairy Farmers by Roger W. Blowey.

2. Hand Book of Dairy Farming by Board Eiri.

3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990

4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.

5. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

Recommended texts

1. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html
2. https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22
3. 15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
4. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

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

*S-Strong; M-Medium; L – Low

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – IV

Course Objectives:		
The main objectives of this course are:		
1.	To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.	
2.	To enable a successful performance in Immunology component of CSIR-UGC NET.	
Course I	**:**	**Core X**
Course title	**:**	**IMMUNOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students would have basic knowledge in animal science, particularly functional anatomy, cell biology and developmental biology.		
Expected Course Outcome:		
Students would have acquired clear knowledge on		

1.	Various basic concepts in immunology and organization of immune systems.	K2
2.	Mechanisms of immune response in health and their defects in various diseases.	K2 & K4
3.	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	K3 & K5
4.	Vaccinology and its importance in disease management	K3

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

Units	
I	Introduction to Immunology: An overview; Scope of immunology, recognition of self and non-self as a basic functional feature of immune system; Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system: cellular and humoral immune components-distribution, salient functions-primary and secondary immune responses; Immune tissues / organs: types, anatomical location, structure and development; lymphocyte traffic during development; Types of immunity: innate and acquired - types, functional features; concept of adaptive immunity
II	Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications
III	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; Antigen presenting cells: antigen processing

	and presentation, MHC molecules and their immunologic significance
IV	Major effector components of humoral immune system: Antibodies - Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications. 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
V	Diseases and immune responses:Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases: onset, spectrum of diseases, and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens; Vaccines: types, preparations, efficacies and recent developments

Reading list

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

Recommended texts

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. *et al*., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
9. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – IV

Course Objectives:		
The main objectives of this course are:		
1.	To provide hands-on training to perform specific lab courses in immunology and research methodology.	
2.	To enable clear understanding of the methodology through wet – lab courses.	
Course I	**:**	**Core XII**
Course title	**:**	**LAB COURSE IN IMMUNOLOGY, & MEDICAL LABORATORY TECHNIQUES**
Credits	**:**	**4**
Pre-requisite:		
Students should acquire the basic knowledge relevant to a particular lab course.		
Expected Course Outcome:		
Upon completion of this lab course, the students		

1.	Acquire ability to perform/ demonstrate various basic concepts in immunology as well as applications of research methods for quantitative/ qualitative analysis of biochemical components.	**K3 & K4**

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

1. Identification of various immune tissues and organs in rat (virtual)
2. Identification of various types of immune cells in peripheral blood smear
3. Separation of RBC as intact cellular antigen for immunization
4. Methods of blood sampling
5. Preparation and storage of antiserum
6. Agglutination reaction: Qualitative analysis of antigen-antibody reaction using human blood group system
7. HEMATOLOGY 1.BMI. 2. Methods of sterilization. 3. Haemoglobin Estimation. 4. Erythrocyte sedimentation Rate [ESR]. 5. Haematocrit Value [packed cell volume-PCV]. 6. Bleeding Time by Duke's Methods. 7. Coagulation [Clotting Time] by Capillary Tube methods.
8. SEROLOGY 1. Estimation of Serum Cholesterol by Zak Method. 2. Estimation of Serum Urea by Dactyl Monoxime Method.

9. URINE ANALYSIS 1. Estimation of Urine Albumin. 2. Estimation of Urine Bile Salt. 3. Estimation of Urine Sugar. 4. Specific Gravity of Urine. 5. Microscopic Examination of Urine: Blood Cells, Casts, Bacteria, Yeast cells, Parasites, Squamous cells.
10. Spotters: 1. Electro Cardio Gram (ECG). 2. Electro Encephalo Gram (EEG). 3. Ryle's Tube. 4. Catheter 5. MRI scan 6. CT scan 7. PET 8. TMT.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – IV

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Aquaculture.	
Course I	**:**	**Elective VI**
Course title	**:**	**AQUACULTURE**
Credits	**:**	**4**
Pre-requisite:		
Students should know the fin fishes and shell fishes of commercially importantcandidate species.		

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	To develop knowledge on the fish farm and their maintenance.Understand the methods of fish seed and feed production anddevelops knowledge on hatchery techniques	**K1& K2**
II	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	**K3 & K4**
III	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	**K5 & K6**

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

Units	
I	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.
II	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 feeds Types, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.

III	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 –Aquaponics - 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
IV	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.
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	S0	M	S0	M	S	M	L	S	S

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

DEPARTMENT OF ZOOLOGY

SEMESTER – IV

Course Objectives:		
The main objectives of this course are:		
1.	Students should understand the different protocols and procedures to collect clinical samples.	
Course I	**:**	**Core Industry Module**
Course title	**:**	**MEDICAL LABORATORY TECHNIQUES**
Credits	**:**	**2**
Pre-requisite:		
Students should have a basic knowledge about medical laboratories and the works carried out by them.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	**K2 & K3**
II	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	**K3, K4 & K5**
III	Evaluate the hematological and histological parameters of biological samples.	**K3, K4, K5 & K6**

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

Units	
I	Laboratory safety - toxic chemicals and biohazards waste- biosafety levels- Standard operating procedure, good laboratory practice - hygiene and health issue –patho physiological effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.
II	Composition of blood and their function- collection of blood & lab procedure-haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of heamoglobin-erythrocyte sedimentations rate- packed cell volume- Blood donation procedures- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count. Auto analyser of blood, flow cytometry.
III	Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosoma. Principles and application of Computer tomography(CT scan) - Magnetic Resonance imaging (MRI scan)–Positron Emission Tomography (PET).
IV	Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG), Treadmill test.
V	Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Cryo section techniques- freezing microtome.
Reading list	

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

Recommended texts

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

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

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PROJECT WORK