SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN

(AUTONOMOUS),

MADURAI-625002

DEPARTMENT OF ZOOLOGY

Syllabus

M.Sc. Zoology

For students who are admitted in the academic year 2023-2024

SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN

(AUTONOMOUS), MADURAI-2

M. Sc. ZOOLOGY Programme

SEMESTER – I

Course Type	Course Code	Title of Courses	No. of Hours	Credits	Marks		
					Int	Ext	Total
CC1	**P23CZ1**	Structure and Function of Invertebrates	6	6	25	75	100
CC2	**P23CZ2**	Comparative Anatomy of Vertebrates	6	6	25	75	100
CC3 (P)	**P23CZ3P**	Lab Course in Invertebrates & Vertebrates	6	4	25	75	100
DSEC1	**P23DZ01**	Molecules and their interactions relevant to Biology	6	3	25	75	100
DSEC2	**P23DZ02**	Biostatistics	6	3	25	75	100
		Total	**30**	**22**			**500**

SEMESTER – II

Course Type	Course Code	Title of Courses	No. of Hours	Credits	Marks		
					Int	Ext	Total
CC4	**P23CZ4**	Cellular and Molecular Biology	6	5	25	75	100
CC5	**P23CZ5**	Developmental Biology	6	5	25	75	100
CC6 (P)	**P23CZ6P**	Lab Course in Cell Biology and Developmental Biology	6	4	25	75	100
DSEC3	**P23DZ03**	Economic Entomology	5	3	25	75	100
DSEC4	**P23DZ04**	Research Methodology	5	3	25	75	100
SEC1	**P23SEZ1**	Vector Borne diseases	2	2	25	75	100
		Total	**30**	**22**			**500**

*** Internship during Summer Vacation. The Credits shall be awarded in Semester – III Statement of Marks**

SEMESTER-III

Course Type	Course Code	Title of Courses	No. of Hours	Credits	Marks		
					Int	Ext	Total
CC7	**P23CZ7**	Genetics and Evolution	6	5	25	75	100
CC8	**P23CZ8**	Animal Physiology	6	5	25	75	100
CC9 (P)	**P23CZ9P**	Lab Course in Genetics, Evolution and Animal Physiology	6	4	25	75	100
CC10	**P23CZ10**	Entrepreneurship for Zoologists	5	3	25	75	100
DSEC5	**P23DZ05**	Forensic Biology	5	3	25	75	100
SEC2	**P23SEZ2**	Climate change and human health	2	2	25	75	100
		Internship/Industrial Activity	-	2			
		Total	**30**	**24**			**500**

SEMESTER-IV

Course Type	Course Code	Title of Courses	No. of Hours	Credits	Marks		
					Int	Ext	Total
CC11	**P23CZ11**	Immunology	6	5	25	75	100
CC12	**P23CZ12**	Biotechnology	6	5	25	75	100
CC13	**P23ZPW**	Project with Viva voce	10	7	60	40	100
DSEC6	**P23DZ08**	Ecology	5	3	25	75	100
SEC3	**P23SEZ3**	Professional Competency Skill - IPR	3	2	25	75	100
	P23EAZ	Extension Activity	-	1			
		Total	**30**	**23**			**500**

M.Sc. Zoology Program

List of Discipline Specific Elective Courses (DSECs)

Sl. no.	Course Code	Course Title
1	**P23DZ01**	Molecules and their interactions relevant to Biology
2	**P23DZ02**	Biostatitics
3	**P23DZ03**	Economic Entomology
4	**P23DZ04**	Research Methodology
5	**P23DZ05**	Forensic Biology
6	**P23DZ06**	Stem cell biology
7	**P23DZ07**	Aquaculture
8	**P23DZ08**	Ecology

Credit Distribution for all PG Courses

S.No	Course Details	Credit
1	Core Course [12 Courses X 4 Credits]	48
2	Elective Course [6 Courses X 3 Credits]	18
3	Skill Enhancement Course [3 Courses X 2 Credits]	6
4A	Professional Competency Course & Industry Module	4
4B	Project Work VIVA VOCE	4
5	Ability Enhancement Compulsory Course [4 Courses X 2]	8
6	Internship	2
7	Extension Activity	1
		91

Credit Distribution for all PG Courses

S. No	Course Details	Credit
1	Core Course [12 Courses X 4 Credits]	48
2	Elective Course [6 Courses X 3 Credits]	18
3	Skill Enhancement Course [3 Courses X 2 Credits]	6
4A	Professional Competency Course & Industry Module	4
4B	Project Work VIVA VOCE	4
5	Ability Enhancement Compulsory Course [4 Courses X 2]	8
6	Internship	2
7	Extension Activity	1
		91

Method of Evaluation:

Test I	Test II	Assignment	End Semester Examination	Total

10	10	5	75	100

SEMESTER-I

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.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core I**
Course title	**:**	**Structure and Function of Invertebrates**
Credits	**:**	**6**

Pre-requisite:

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

Expected Course Outcome:

Units	
I	Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy
II	Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata
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
IV	Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malphigian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neural evolution

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

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.

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

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

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.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core II**
Course title	**:**	**Comparative Anatomy of Vertebrates**
Credits	**:**	**6**

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.	**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 of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.
II	Origin and classification of vertebrates; Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

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
IV	Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.
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. Swayam Prabha 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. Ekambaranatha Ayyar 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

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.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core III**
Course title	**:**	**Lab Course in Invertebrates &Vertebrates**
Credits	**:**	**4**

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.	Understanding the different systems in invertebrates &vertebrates.	**K1 & K2**
2.	Learning about various animal species, their phylogenetic affinities and their adaptive features	**K2 & K4**
3.	Imparting conceptual knowledge about the salient features and functional anatomy.	**K3 & K5**
4.	Developing the skill in mounting techniques of the biological samples.	**K4 & K6**
5.	Gaining fundamental knowledge on the skeletal system	**K5 & K6**

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

UNIT	**Details**		**Course Objectives**
I	**Dissection :** Earthworm : Nervous system Cockroach : Nervous system, Digestive system Prawn : Appendages.		K1

II	**Study of the following slides with special reference to their salient features and their modes of life** 1. *Amoeba* 2. *Entamoeba histolytica* 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		K2
III	**Spotters** 1. Scorpion 2. *Penaeus indicus* 3. *Emerita* (*Hippa*) 4. *Perna viridis* **Mounting** Earthworm : Bodysetae Cockroach : Mouth parts		K3
IV	**Study the nervous system of Indian dog shark - Dissection** 1. Nervous system of *Scoliodon laticaudatus* – 5th or Trigeminal nerve (demo) **Mounting** 1. Cycloid scale 2. Ctenoid scale 3. Placoid scale		K4
V	**Study of the following specimens with special reference to their salient features and their modes of life** 1. Indian Major carps (Catla, Rhou, Mrigal 2. Fresh water Exotic carps (Common carps, Tilapia, Sliver carp, Grass carp) 3. Common marine fishes (Sardines, Tuna) **Study of the frog skeleton system (Representative samples)** 1. Entire skeleton 2. Skull 3. Pectoral girdle 4. Pelvic girdle 5. Fore limb 6. Hind limb		K5

Course Outcomes	
Course Outcomes	On completion of this course, students will;

CO1	Understand the structure and functions of various systems in animals	**K2 & K4**
CO2	Learn the adaptive features of different groups of animals	**K1 & K2**
CO3	Learn the mounting techniques	**K2 & K3**
CO4	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

Text Books (Latest Editions)	
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
References Books	
1.	Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2.	Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen 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

Course Objectives:	
The main objectives of this course are:	
1.	Students should know the fundamentals of biochemistry

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

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

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

Course Objectives:
The main objectives of this course are:

1.	Students should know basic concepts in Biostatistics.

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

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;
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	Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart. Analysis of variance: one way and two way classification.

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.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

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

SEMESTER II

SEMESTER II

Course Objectives:	
The main objectives of this course are:	
1.	To understand the ultra structures 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 ultra structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core IV**
Course title	**:**	**Cellular and Molecular Biology**
Credits	**:**	**5**

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.	**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 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, ribosomes and endoplasmic reticulum
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 prokaryotoic and eukaryotic cells.
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
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
10. 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

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.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core V**
Course title	**:**	**Developmental Biology**
Credits	**:**	**5**

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

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 (Sea urchin, *Amphioxus*, Amphibians, Aves, Mammals); 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 - Endocrine control of moulting and growth in crustaceans and insects - 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 – Biochemical changes assosciated with 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

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

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.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core VI**
Course title	**:**	**Lab Course in Cell and Molecular 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

UNIT	Details		Course Objectives
I	Determination of cell size using micrometer Mitosis in root meristematic cells of plants Identification of various stages of meiosis in the testes of grasshopper Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomous Detection of Barbodies		K1
II	Human blood smear preparation Isolation of genomic DNA from liver Demonstration to extract of total RNA from bacterial cells/tissues Agarose gel electrophoresis of DNA SDS-Polyacrylamide gel electrophoresis		K2
III	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 Spotters: 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*		K3
IV	Embryogenesis Observation and whole mount preparation of the chick blastoderm (48-96 hours) of development		K4

	Spotters: vii Chick embryonic stage - 18 hours of development viii Chick embryonic stage - 24 hours of development ix Chick embryonic stage - 48 hours of development x Chick embryonic stage - 72 hours of development xi Chick embryonic stage - 96 hours of development Histological observation: Section through various developmental stages in chick embryo		
V	Experimental Embryology Regeneration in Frog Tadpoles Spotters: xii Blastema formation xiii Demonstration of regenerative process in tadpole Metamorphosis xiv Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine Cryopreservation xv Demonstration of cryopreservation of gametes of fin fish/shell fish		K5

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the structure and functions of various systems in animals	**K2 & K4**
CO2	Learn the adaptive features of different groups of animals	**K1 & K2**
CO3	Learn the mounting techniques	**K2 & K3**
CO4	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

Text Books

(Latest Editions)

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 4. 5.	Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528 Poddar T,Mohopadhyay Band Das SK.An advanced laboratory Manual of Zoology.Macmillan Pub.,2010. K.V.Chaitanya.Cell and Molecular Biology,A Lab Mannual.Kindle Edition.PHI Publishers.,2013.
References Books	
1.	Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2.	Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

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

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.

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

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 – Any three Pests: 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 in cattle and poultry: Vectors (Mosquitoes, ticks and flies) causing diseases and control measures in cattle. Vectors (Insects, flies and nematodes) causing diseases, transmission and control measures in poultry.

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. Simpsonand A.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

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.

Relevant to Global need	✓	Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Elective IV**
Course title	**:**	**Research Methodology**
Credits	**:**	**3**

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 the implications 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	Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry.

II	Histology, Histochemistry, Bioinformatics and Electron microscopy.
III	Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.
IV	Centrifuges, Chromatography, Electrophoresis, ELISA and blotting.
V	Principles and Applications of tracer techniques in biology, Animal cell culture techniques.

Reading list

1. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
2. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.
3. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

Recommended texts

1. Chandler, D.E. and Roberson R.W. 2009. Bioimaging: Current Concepts in Light and Electron Microscopy, Jones and Bartlet Publishers, Sudbury, MA, USA, pp440.
2. Engelbert, B. 1960. Radioactive Isotopes in Biochemistry, Elsevier Applied Science, pp-376.
3. Wolf, G. 1964. Isotopes in Biology, Academic Press, pp-173.
4. Srivastava, B. B. 2005. Fundamentals of Nuclear Physics, Rastogi Publications, pp-500.
5. Pantin, C. F. A. 1948. Microscopical Techniques, Cambridge University Press, London.

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

Course Objectives:	
The main objectives of this course are:	
1.	Students should know basic concepts in Vermiculture.

Relevant to Global need	✓	Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Skill Enhancement Course [SEC] - I**
Course title	**:**	**VECTOR BORNE DISEASES**
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	Define, describe and write about the details of vector habitats, interaction in the food chain, biotic and abiotic factors Explain and paraphrase Anthroponotic vector diseases and its health impact on humans	**K2 & K3**
II	Discuss and summarize Zoonotic vectors diseases and its health impact on humans	**K1, K2 & K3**
III	Include & prepare themselves and prepare the community on the awareness about arthropods of public importance Correlate and apply vector control strategies in household and at community level	**K5 & K6**

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

Units	
I	**Vector Ecology:** Introduction to Habits and habitats relevant to vectors - Species diversity - Food chain, food web, ecological niche, prey predator relationships - factors influencing vector dispersal and migration.
II	**Anthroponotic diseases:** Filariasis, Trypanosomiasis, tick typhus - Disease vectors - Life cycle of pathogens and transmission - health impact on human population.
III	**Zoonotic diseases:** Cutaneous leishmaniasis, Plague, Leptospirosis - Disease vectors - life cycle and transmission - health impact on human population.
IV	**Arthropods of Public health importance:** Houseflies, cockroaches, lice, bugs, scorpions, centipede, millipede, wasps, bees, beetles, spiders, ants - distribution and impact on human health -toxins, venoms - allergy, asthma.
V	**Vector Control Measures:** Vector Control: objectives. Alternatives to chemical & microbial insecticides – Vector control at individual and community - Selection of appropriate control measures - Self protection measures - Types of vector control - Selective, integrated and comprehensive vector control

Reading list

1. Tyagi B K., 2008. Vector Borne diseases: Epidemiology and Control; Scientific publishers.
2. David Claborn, 2020. Vector Borne diseases: Recent developments in Epidemiology and Control; Ebook – 978-83880-038-3

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	L	L	L	L	L	S	S	L	L
CO 2	S	L	M	M	S	M	M	M	S	S
CO 3	S	M	M	M	S	S	S	S	M	M
CO 4	S	S	S	L	S	S	S	S	S	S
CO 5	S	S	M	S	S	S	M	L	S	M

*S - Strong; M - Medium; L – Low

SEMESTER III

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.	Understand the factors responsible for origin and generation of diversity among living beings
5	To critically analyze the concepts of evolution

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I		Core VII
Course title		**Genetics and Evolution**
Credits		**5**

Pre-requisite:

Expected Course Outcome: Basic knowledge on Genetics and Evolution

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.	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	K2 & K4
4.	understand the concept of evolution, Understand the major events in the evolutionary timescale, Origins of unicellular and multi-cellular organisms.	K1 & K3
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	Mendelian genetics -ABO blood groups ,multiple Alles, Structure, properties and functions of genetic materials: DNA as the genetic Materials - Basic structure of DNA and RNA, alternate and unusual forms of DNA
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.
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
IV	Emergence of evolutionary thoughts: Lamarck and Darwin – concepts of variation, The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes, Molecular evolution- Origin of new genes and proteins - Gene duplication and divergence
V	The mechanisms-concepts and rate of change in gene frequency through natural selection, migration and random genetic drift- Adaptive radiation - Isolating mechanisms – Speciation - Allopatric and Sympatric - Convergent evolution - Sexual selection - Co-evolution .

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/preview
5. https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code
6. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
7. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.

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

8. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.

9. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

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	M	S							
CO 2		S		M	S					
CO 3	S		M	S			S			
CO 4			S		M	S		S		
CO 5	S			S		M		S		

*S – (13) Strong; M – (5) Medium ; L - Low

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.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core VIII**

Course title	**:**	**Animal Physiology**
Credits	**:**	**5**

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 of all above
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: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense 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, gametogenesis, ovulation, neuroendocrine regulation.

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. French and 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

Course Objectives:	
The main objectives of this course are:	
1.	To understand basic knowledge on mendelian principles, Analyze and interpret the characteristics of autosomal dominant and recessive inheritance
2.	To Describe the preparation of karyotype and chromosomal aberrations. and itsimportance
3.	To determine the gene frequency and its relation in explaining population enetics

4.	To Incorporate the fundamentals of blood and its components
5	To distinguish the various excretory products their formation and its physiological importance

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I		Core IX
Course title		**Lab course in Genetics, Evolution and Physiology**
Credits		4

Pre-requisite:

Expected Course Outcome: Basic knowledge on Genetics and Evolution

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

1.	Reveal fundamental principles of genetics and development	K1 , K2
2.	Understand chromosome structure, arrangements and its significance	K2, K5
3.	Calculate genotype frequencies under random mating	K2, K3
4.	Know how to determine the blood grouping and measure blood pressure and its importance	K2 , K4
5.	Distinguish various types of excretory products in animal kingdom	K4 , K5

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

Units	
I	Method of culturing of Drosophila and identification of wild and mutant strains
II	Monohybrid and Dihybrid Cross Verification using Beads Spotters – Klinfelter's Syndrome, Turner's Syndrome and Down Syndrome. Human Karyotype
III	Experiment with beads to explain genetic drift Spotters – Types of Fossils, Peppered Moth, Finger print variation
IV	Determination of blood groups .measurement of human blood pressure Differential Count – WBC

V	Analysis of various excretory products among vertebrates Estimation of Oxygen consumption using Fish, Estimating the Q10 value in fish with respect to opercular activity Spotters: Animal Physiology – Haemoglobinimeter, Sphygmomanometer, Uric acid crystals

Reading list

1.Christoper Blair,2018.Genetics Laboratory Manual, City University of New York
2.Shweta Singh .2003.APractical manual on Fundamentals of Genetics, Rai Jharkhand University.
3.Worku N .Mhiret.2019.Laboratory Manual for Principles of Genetics. LAP LAMBERT Academic Publishing, Mauritius
4.Liliana Busconi, Joel Kowit ,Anupama Seshan .2016.Introduction to Organismic and Evolutionary Biology-Laboratoy Manual. Emmnuel College
5.Jennifer Gibson.2021.Lab Manual :Ecology,Evolution&BioDiversity,XANEDU/UNH.New Hampshire.
6.John Alcock .1990.Laboratory Manual for Ecology,EvolutionandBehaviour,Kendel/Hunt Publishing Company
7.Carl Gottfried Hartman 2008 .Laboratory Manual for Human Physiology.Kessinger Publishing
8. Stuart Ira Fox .2013.Laboratory Manual Human Physiology .McGraw-Hill
9.Kevin T.Patton and Frank B.Bell.D.C .2023.Anatomy & Physiology Laboratory Manual.ELSEVIER

Recommended texts

1.William Klug ,Michael Cummings,CharlotteSpencer,MichaelPalladino,Darrell Killian .2017.Concepts of Genetics.American Medical Association.

2.Brian and Deborah Charlesworth .2001.Oxford University Press

3.Guyton and Hall ,2003. Textbook of Medical Physiology.ELSEVIER

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Mapping with Programme Outcomes*										
COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**
CO1	S		S			M				
CO2	S			S	M					
CO3		S		S		S	M			
CO4	S		S		S	M				
CO5		S	M		S		S			

*S – (13)Strong; M –(5) Medium; L - Low

Course Objectives:	
The main objectives of this course are:	
1.	To sensitize and motivate students to become Women entrepreneurs and Agripreneurs.
2.	To Enhance Women entrepreneurs

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented	✔	Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core X**
Course title	**:**	**ENTREPRENEURSHIP FOR ZOOLOGISTS**
Credits	**:**	**3**

Pre-requisite:

Students should be apply the business ideas and utilize opportunities

Expected Course Outcome:

At the end of the semester, the Students will be able to

1.	Define, describe and identify the characteristics of entrepreneurs and entrepreneurship	K1
2.	Explain and comprehend the functional roles of governmental and non-governmental agencies promoting entrepreneurship	K2 & K3
3.	Discuss and interpret the challenges of women entrepreneurs and also learn marketing and promotional strategies	K2 & K4
4.	Prepare &Establish themselves as Agripreneurs utilizing the opportunities	K3 & K5
5.	Correlate & apply the business ideas, utilize opportunities to transform into an entrepreneur	K3

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

Units	
I	Entrepreneur- Definition, Characteristics of Entrepreneurship, Classification of Entrepreneur, Factors influencing Entrepreneurship. Agencies promoting entreprenurship - EDP, KVIC, NIESBUD, SISI, SIPCOT, IDBI, NABARD, ICICI
II	Women Entrepreneur - Problems of Women entrepreneurs- Rural Entrepreneurship – Self Help Groups - Marketing Feasibility - Product Strategies.
III	Agripreneurship – Definition. Characteristics of Agripreneur. Scope and Opportunity – Brief account on beekeeping, fisheries, sericulture, poultry, dairy farming,- products and by products- marketing Strategies.

IV	Horticulture, medicinal plant cultivation, Food processing, honey agribusiness, Plant clinics, Landscaping and Nursery, Animal feed unit - Promotional Strategies.
V	Business idea and opportunities- Starting a Small Scale Industry- Bank Loan- Benefits of SSI- Incentives and Subsidies.

Reading list :

Jayashree Suresh : Entrepreneurial Development. 2nd Edn; Margham pub; 2008

Recommended texts

1. Rengarajan L. Entrepreneurial Development; Sree Renga Pub; 2008
2. https://openeducationonline.com/magazine/what-does-agripreneurship-mean/

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	L	L	L	L	L	S	S	L	L
CO 2	S	L	M	M	S	M	M	M	S	S
CO 3	S	M	M	M	S	S	S	S	M	M
CO 4	S	S	S	L	S	S	S	S	S	S
CO 5	S	S	M	S	S	S	M	L	S	M

*S-Strong; M-Medium; L – Low

Course Objectives:

The main objectives of this course are:

1.	Students will be introduced the basic concepts of forensics, crime related applications and legal aspects of forensic law

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Elective V**

Course title	**:**	**Forensic Biology**
Credits	**:**	**3**

Pre-requisite:

Students will understand the basics of forensics and its applications

Expected Course Outcome:

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

I	List & categorize forensic evidences and crime scene identity; analyze and relate socio economic offences to the present societal scenario	**K1 & K2**
II	Classify finger prints, describe post mortem changes, understand and interpret blood group and DNA paternity test	**K2, K3 & K4**
III	Generalize and explain about insects of forensics, venoms and poisons. Discuss and summarize related medico-legal issues	**K2 & K4**
IV	Describe narcotic drugs and cosmetics; Associate the symptoms and explain its effects on humans	**K1 & K5**
V	Distinguish and apply information technology and legal aspects related to forensics; gain knowledge about Enforcement agencies	**K2 & K3**

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

Units	
I	Scope of forensics - history - evidences and their classification - specific socio-economic offences against human body, property, terrorism, pollution, adulteration - crime scene - establishment of identity.
II	Finger printing - primary classification and computerized prints - Types of injuries - wounds - signs and symptoms of death time - post mortem changes- Blood stains, grouping, and identification- disputed paternity and DNA tests.
III	Forensic entomology and forensic medicine - biology of insects of forensic importance - study of maggots – sarcophagi - venoms and poisons - Medico legal issues of organ transplantation - organ racketing - euthanasia- sexual offences- rape, semen analysis.
IV	Food poisons and narcoanalysis - classification and sources of drugs, narcotics, cosmetics and abortificients- physiological and psychological effects - toxic nature of poisoning - sources of poisons - Narco analysis.
V	Information technology and legal aspects - cybercrime - law of robotics - super imposing techniques - e-com and intelligent systems - laws of copyrights and patents. Forensic sourcing - Enforcement agencies - public and private - police, CBI - National Institute of criminology and forensic science - Interpol, prisons and rehabilitation.

Reading list	

1. Forensic Biology, Lesson notes prepared by DDE, Madurai Kamaraj University, 2014.
Recommended texts
1. Ignatius, P.C, Forensic Medicine and Toxicology, 2nd edn, Letterwave Books, 2016

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

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

Course Objectives:	
The main objectives of this course are:	
1.	Students should know basic concepts in Vermiculture

Relevant to Global need	✓	Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I		**Skill Enhancement Course [SEC] - II**
Course title	**:**	**CLIMATE CHANGE AND HUMAN HEALTH**
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	Define, describe and write about the details of Climate Change, Global warming, variability, natural disasters and IPCC Explain and paraphrase Water and Air quality , pollutants and related disease impact on humans	**K2 & K3**
II	Discuss and summarize Climate change impact on food quality, security and Food borne diseases Include & prepare themselves and prepare the community on the awareness about the Physiological impacts influenced by	**K1, K2 & K3**

	climate change	
III	Correlate, recognize and distinguish mental health related issues impacted by disasters and climate change	**K5 & K6**

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

Units	
I	Concepts and definition of Climate Change, Global warming and Climate change – climate variability – Impact on environment – Natural disasters – Storm, Cyclone, Flood, fire, drought, heatwave. The Inter-governmental Panel on Climate Change (IPCC) – Acts and Policies.
II	Water and Air quality – types of pollutants / contaminants – allergens, dust, ground level ozone, temperature, chemicals, pathogens - climate change impact, Air borne diseases –respiratory disorders – droplet infection, asthma, bronchitis; Water borne diseases – cholera, typhoid
III	Climate change impact on food quality and security; health challenges – malnutrition, Food borne diseases – diarrhoea, colitis infection
IV	Physiological impacts – Morbidity and Mortality, Brief account on the occurrence of climate change influenced cardiovascular, dermatological diseases, birth outcome, fertility issues, pubertal timing, cancer, neurological disorder, diabetes and obesity.
V	Mental health and Climate change: Disasters and mental health – acute impacts of flood, heatwave and drought – mental health issues – Brief account on Post traumatic stress disorder, anxiety, major depressive disorder, substance abuse, suicidal ideation, survivors issues
Reading list	
1. Mridula Ramesh , The Climate Solution: India's Climate Change Crisis and What We Can Do About It by, Hachette India (2018). 2. Malancha Chakrabarty, Climate change and food security in India; ORF issue brief, 2016	

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	M	S	L	L	S	S	M	S	L	M
CO 2	M	S	S	S	M	S	M	L	S	S
CO 3	M	S	S	S	S	S	S	S	S	M
CO 4	M	S	S	S	M	M	L	L	M	M
CO 5	S	S	S	M	S	M	S	L	S	S

*S - Strong; M - Medium; L – Low

SEMESTER IV

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 learn how immunology is applied to a range of areas in the biomedical sciences.
3.	To enable a successful performance in Immunology component of CSIR-UGC NET.

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core XI**
Course title	**:**	**Immunology**
Credits	**:**	**5**

Pre-requisite:

Students would have basic knowledge in animal science, particularly functional anatomy, cell biology, molecular biology, biochemistry 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 humoral immune response and its application in the diagnosis of diseases	K2 & K4
3.	Mechanisms of cell mediated immune response and the role of various components produced during the immune reaction	K3 & K5
4.	the immune responses in major health issues such as transplantation and cancer	K4 & K5
5.	the immune reactions against various pathogens, allergens, self antigens and vaccines and its importance in disease management	K3 & K5

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

Units

I	Introduction to Immunology: An overview; Scope of immunology Historical perspectives of Immunology. Types of immunity - Innate Immunity, acquired immunity - active and passive immunity. Cells and organs of immune system -structure and functions.
II	Antigens: characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: types and applications. Major effector components of humoral immune system: Antibodies - structure, functions and isotypes of immunoglobulin. Mechanism of humoral immune response - production of antibodies. Antigen and antibody interactions – Precipitation and Agglutination. Monoclonal antibodies: definition, production and applications.
III	Complement - activation - classical, alternative and lectin pathways. Regulation of complement activation - Biological consequences of complement activation. Cell mediated immune response - types of T cells - Mechanism of CMI. Cytokines - Definition and salient functional features. - T cell activation and differentiation - B cell activation and differentiation
IV	Major Histo compatibility Complex (MHC) - Structure and functions of MHC class I and class II Molecules. Transplantation Immunology - Graft rejection - Graft versus Host reaction - HLA Tissue typing. Tumor immunology - types of Tumor - Tumor antigens - Immune response to tumors - Immunodiagnosis of tumor.
V	Hyper sensitive reactions – types. Auto immunity - Organ specific and systemic auto immune diseases. Host immune response to bacteria (*Mycobacterium tuberculosis*), virus (HIV) and parasite (*Plasmodium vivax*). Vaccines - types

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**	**PO 5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**
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

Course Objectives:	
The main objectives of this course are:	
1.	The impart the skills required to explain about the tools of genetic engineering. To encourage the use of molecular techniques in genetic engineering
2.	To study the methods and applications of gene transfer in animals. To motivate the students to study the transgenesis

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Core XII**
Course title	**:**	**BIOTECHNOLOGY**
Credits	**:**	**5**
Pre-requisite:		

Students have fundamental knowledge in Biotechonoly.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1.	Acquire knowledge on the tools of Genetic Engineering	**K1**
2.	Understanding the principles and methodology of basic Techniques in Genetic Engineering	**K2 & K3**
3.	Learn advanced techniques in Genetic Engineering	**K4**
4.	Apply skills to develop Genetically modified organisms	**K3 & K5**
5.	Access and Analyze the bio safety and other regulations in biotechnology	**K4**

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

Units	
I	Tools of Genetic Engineering - Vectors - plasmids, bacteriophage, cosmids, shuttle vectors, yeast vectors. Enzymes - exonucleases, endonucleases, restriction endonucleases, ligases, reverse transcriptases, polymerases, terminal transferases, isozymes. Probes and molecular markers - RFLP, RAPD.
II	Techniques in Genetic Engineering - selection and isolation of desired genes, gene splicing, introduction of rDNA into host, selection of clone containing DNA insert, PCR, DNA finger printing, blotting techniques, DNA sequencing, genomic library, cDNA library
III	Gene cloning - Gene transfer in animals - gene transfer technology, expression of induced genes. Animal cell culture- cell culture, culture media, monolayer and suspension culture, cell lines, somatic cell fusion and Hybridoma technology. Organ culture - techniques, advantages and applications.
IV	Transgenic Animal Technology - production of transgenic animals, Genetically Modified Organisms - Gene knockouts, Gene silencing, Transgenic Mice, Sheep and Fishes, uses of transgenic animals
V	Medical Biotechnology - production of recombinant vaccines. Problems related to biotechnology - social, cultural, economic and legal problems, safety in biotechnology, Bioethics, Intellectual Property Rights, and Patenting.

Reading list

1. Dubey RC. A Text Book of Biotechnology. Multicolor IllustratuiveEdn., S. Chand Pub., New Delhi, 2006
2. Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.
3. Sasidhara, R., 2015. Animal biotechnology, MJP publishers. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
4. Sathyanarayran U., 2008. Biotechnology, Books and Allied, Kolkata.

Recommended texts

4. Brown TA. Gene Cloning - An Introduction. 4thEdn., Black Bell Science Ltd., New Delhi, 2001
5. Primrose SB. Principles of Gene manipulation. Old R.N. and 6thEdn., Black Bell Science Ltd., New Delhi, 2003
6. Veer BalaRastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA

7. Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley- Blackwell, UK.

	Mapping with Programme Outcomes*									
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	S	S	M	S	S	L	S	M	L	M
CO2	S	S	S	S	S	L	S	S	M	S
CO3	S	M	M	M	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	M	S	M	S	S	S	L	L	M

*S-Strong; M-Medium; L – Low

Course Objectives:	
The main objectives of this course are:	
1.	Knowing the ecology and climatic changes at world level and its impact on natural resources.
2.	Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need	✓	Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**ELECTIVE VI**
Course title	**:**	**Ecology**
Credits	**:**	**3**

Pre-requisite:

Students should know about the fundamentals and studied the ecology of living organisms.

Expected Course Outcome:

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

1.	Learn about the ecosystem, biotic communities and utilizing the energy processing	**K2**
2.	Study the various community and population and population control	**K2 & K3**
3.	Understand the fundamentals of climatic conditions and its impact on environment	**K2 & K6**

4.	Realizing the nature of pollution and the ways for its control/reduction	**K4 & K5**
5.	Impact of environmental studies on solid waste management	**K2 & K6**

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

Units	
I	The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
II	Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.
III	Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax
IV	Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
V	Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reading list

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/preview
6. Class central.com/course/swayam -ecology - and environment – 14021.

Recommended texts

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

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

*S - Strong; M - Medium; L – Low

Professional competency courses:

Course Objectives:	
The main objectives of this course are:	
1.	Students should gain basic knowledge intellectual property.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	✓
Relevant to National need		Entrepreneurship oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses human Values	

Course I	**:**	**Professional Competency Course I**
Course title	**:**	**Intellectual Property Rights**
Credits	**:**	**2**

Pre-requisite:		
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
I	Claim the rights for the protection of their invention done in their project work.	**K1 & K3**
II	Identify criterias' to fit one's own intellectual work in particular form of IPRs	**K4 & K5**

III	To get registration in our country and foreign countries of their invention, designs and thesis or theory written by students during their project.	**K1, K2 & K3**

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

Units	
I	Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad - Genesis and Development - the way from WTO to WIPO - TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations - Important examples of IPR.
II	Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad
III	International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.
IV	Digital Innovations and Developments as Knowledge Assets - IP Laws, Cyber Law and Digital Content Protection - Unfair Competition - Meaning and Relationship between Unfair Competition and IP Laws - Case Studies.
V	Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies.

Reading list

5. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
6. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
7. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

Recommended texts

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S.V Satakar Intellectual property Rights and Copy Rights, Ess Publication, New Delhi, 2002.

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	M	M	M	S	S	M	M	M
CO 2	S	S	M	S	M	S	S	S	M	L
CO 3	S	M	M	S	M	L	L	S	L	S
CO 4	M	M	S	L	M	S	S	S	S	S
CO 5	M	S	S	L	S	M	M	L	L	S

*S - Strong; M - Medium; L – Low