CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK

M.Sc Zoology

Part		Course	Code	Cr.	Hrs
SEMESTER I					
A	CC – 1	Structure and Functions of Invertebrates	232304101	4	6
	CC – 2	Comparative Anatomy of Vertebrates	232304102	4	6
	CC – 3	Lab Course in Invertebrates and Vertebrates	232304103	4	6
	EC –I (Generic/DS)	Molecules and their Interaction relevant to Biology	232304104	3	4
	Elective - II	Biostatistics	232304105	3	4
B	SEC I	Intellectual Property Rights	232304106	2	2
	AECC 1 – Soft Skill	Sericulture	232304107	2	2
	Total			**22**	**30**
SEMESTER II					
A	CC – 4	Cell and Molecular Biology	232304201	4	5
	CC – 5	Developmental Biology	232304202	4	5
	CC – 6	Lab Course in Cell Biology and Developmental Biology	232304203	4	5
	EC – III	Economic Entomology	232304204	3	5
	EC - IV	Research Methodology	232304205	3	5
B	SEC – II	Poultry Farming	232304206	2	3
	AECC 2	Apiculture	232304207	2	2
	*Internship	Internship / Industrial Activity		-	-
				22	**30**
SEMESTER III					
A	CC – 7	Genetics	232304301	4	5
	CC – 8	Evolution	232304302	4	5
	CC – 9	Animal Physiology	232304303	4	5
	EC - V	Stem Cell Biology	232304304	3	5
	Core	Medical Laboratory	232304305	3	4
B	SEC – III	Diary Farming	232304306	2	4
	ACEE – 3	Vermiculture	232304307	2	2
	Internship	**Internship / Industrial Activity**	232304308	2	-
				24	**30**
SEMESTER IV					
A	CC – 10	Immunology	232304401	4	5
	CC – 11	Ecology	232304402	4	5
	CC - 12	Lab Course in Immunology	232304403	4	5
	CC – 13	Project with Viva voce	232304404	3	4
	EC VI	Aquaculture	232304405	3	5
B	SEC	Animal Behaviour	232304406	2	4
	AECC – 4	Bio-compositing	232304407	2	2
C	EA	Extension Activity	232304408	1	
	Total			**23**	**30**

* Internship will be carried out during the summer vacation of the first year and marks will be included in the Third Semester Marks Statement.

Title of the Course		**GENETICS**						
Category	Core – 7	**Year**	II	**Credits**	4	**Course Code**	**232304301**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives

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

UNIT	**Details**	**No. of Periods for the Unit**
I	Structure, properties and functions of genetic materials: DNA as the genetic Materials - Basic structure of DNA and RNA, alternate and unusual forms of DNA - Physical and Chemical properties of nucleic acid, base properties, denaturation and renaturation.	**15**
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.	**15**
III	Microbial Genetics: Genetics of Virus - Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome - Gene transfer mechanisms in bacteria - conjugation, transduction and transformation	**15**
IV	Recombinant DNA technology: Recombinant DNA technology - Overview - Tools for Recombinant DNA Technology – Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases	**15**
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	**15**

Course Outcomes

Course Outcomes	On completion of this course, students will be able;
CO1	Explain the organization and functions of genetic material in the living system.
CO2	Understand various sequential processes in protein synthesis
CO3	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.
CO4	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.
CO5	Understand the principle and application of rDNA technology for the welfare of human being.

Text Books (Latest Editions)	
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
References Books (Latest editions, and the style as given below must be strictly adhered to)	
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.	
Web resources	
1. https://onlinecourses.swayam2.ac.in/cec21_bt02/preview 2. https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code	

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**

Title of the Course		**EVOLUTION**						
Category	Core - 8	**Year**	II	**Credits**	4	**Course Code**	**232304302**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives

- ✍ To critically analyze the concepts of evolution in order to
- ✍ Understand the factors responsible for origin and generation of diversity among living beings and
- ✍ To develop strategies for sustenance of life on this planet
- ✍ To critically analyze the concepts of evolution in order to

UNIT	Details	No. of Periods for the Unit
I	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 Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, photosynthesis and aerobic metabolism.	**15**
II	Emergence of evolutionary thoughts: Lamarck and Darwin – concepts of variation, adaptation, struggle, fitness and natural selection – Mendelism - Spontaneity of mutations - The evolutionary synthesis.	**15**
III	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.	**15**
IV	Paleontology and evolutionary history: The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including *Homo sapiens.*	**15**
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 driftb- Adaptive radiation - Isolating mechanisms – Speciation - Allopatricity and Sympatricity - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	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.
CO2	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.
CO3	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.
CO4	Comprehend the origin of new genes and proteins; Gene duplication and divergence.
CO5	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift

Text Books (Latest Editions)	
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. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

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.

Web Resources

1. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
2. http://www.evolution-textbook.org/
3. https://onlinelibrary.wiley.com/journal/15585646
4. http://darwin-online.org.uk/

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**

Title of the Course		**ANIMAL PHYSIOLOGY**						
Category	Core - 9	**Year**	II	**Credits**	4	**Course Code**	**232304303**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives

- ✍ Students acquire the basic knowledge on physiology of different organs in animals and human.
- ✍ 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.

UNIT	**Details**	**No. of Periods for the Unit**
I	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.	**15**
II	Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, chemical regulation of respiration	**15**
III	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.	**15**
IV	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	**15**
V	Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. Thermoregulation: Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization: Stress and adaptation	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Understand the functions of different systems of animals
CO2	Learn the comparative anatomy of heart structure and functions
CO3	Know the transport and exchange of gases, neural and chemical regulation of respiration
CO4	Acquire knowledge on the organization and structure of central and peripheral nervous systems
CO5	Understand the structure, function and regulation of endocrine and neurocrine glands

Text Books (Latest Editions)

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.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

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.

Web Resources

1. https://swayam.gov.in/nd1_noc20_bt42/preview
2. https://www.classcentral.com/course/swayam-animal-physiology-12894
3. https://swayam.gov.in/nd1_noc20_hs33/preview

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

Title of the Course		**STEM CELL BIOLOGY**						
Category	EC V	**Year**	II	**Credits**	3	**Course Code**	**232304304**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives		
	Students should know understand the basics of stem cells	
UNIT	**Details**	**No. of Periods for the Unit**
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 and induced pluripotent stem cells).	**15**
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).	**15**
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.	**15**
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 stem cell.	**15**
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.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Understand the basic knowledge of stem cells and their origin
CO2	Differentiating the embryonic and adult stem cells
CO3	Know and compare the characteristics of embryonic tissue specific and induced pluripotent stem cells, mesenchymal stem cells and hematopoietic stem cells.
CO4	Explain the development roles of stem cells and basic cellular mechanism involved in their maintenance and regulation.
CO5	Understand and apply the current stem cell therapies for their research

Text Books (Latest Editions)

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.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

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.

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

Title of the Course		**MEDICAL LABORATORY**						
		Core Industry Module						
Category	Core Industry Module	**Year**	II	**Credits**	3	**Course Code**	**232304305**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	-	--	4	25	75	100

Learning Objectives

- ✍ Students should understand the different protocols and procedures to collect clinical samples.

UNIT	Details	No. of Periods for the Unit
I	Laboratory safety - toxic chemicals and biohazards waste- biosafety level- good laboratory practice - hygiene and health issue - physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.	**12**
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 hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.	**12**
III	Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) - Magnetic Resonance imaging - flowcytometry - treadmill test - PET.	**12**
IV	Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG).	**12**
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 - Frozen section techniques- freezing microtome.	**12**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
CO2	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.
CO3	Understand the principles and practice of clinical study design, implementation and dissemination of results.
CO4	Identify and troubleshoot pre-analytical and post-analytical components of the testing process and evaluation of new test systems and interpretive algorithms
CO5	Evaluate the hematological and histological parameters of biological samples.

Text Books (Latest Editions)

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.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

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.

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

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

Title of the Course		**DIARY FARMING**						
Category	SEC III	**Year**	II	**Credits**	2	**Course Code**	**232304306**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

✍ Students should be aware of economic and cultural importance of Dairy farming.

UNIT	Details	No. of Periods for the Unit
I	Introduction to Dairy Farming- Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination-Dairy cattle management-General Anatomy.	**6**
II	Construction of Model Dairy House - Types of Housing - Different Managemental Parameters - Winter Management - Summer Management	**6**
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.	**6**
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, funding agency – ICAR, DBT, DST, NABARD.	**6**
V	Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.	**6**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.
CO2	Importing knowledge and technical proficiency in dairy form management practices and Animal health management.
CO3	Importing knowledge and technical proficiency in fodder production and clean milk production.
CO4	Development of necessary human resource for dairy farming system on scientific lines and encouraging entrepreneurs among the youth for self employment
CO5	To know the difficulties in Dairy farming and be able to propose plans against it.

Text Books (Latest Editions)

1. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
2. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

References Books **(Latest editions, and the style as given below must be strictly adhered to)**
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.
Web Resources
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

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

Title of the Course		**VERMICULTURE**						
Category	AECC - 3	**Year**	II	**Credits**	2	**Course Code**	**232304307**	
		Semester	III					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- ✍ Students should know basic concepts in Vermiculture.

UNIT	Details	No. of Periods for the Unit
I	Earthworms - Taxonomic position, external features - shape, size, colour, segmentation, setae & clitellum. Body wall, coelom-locomotion,digestive, circulatory, respiratory, excretory & nervous system. Reproductive system-Male & Female, copulation, cocoon formation & fertilization, development of earth worm. Vermitechnology- Definition, history, growth and development in other countries & India, significance, funding agency – ICAR, DBT, DST, NABARD.	**6**
II	Vermiculture - definition, common species for culture; Environmental parmeters; culture methods – wormery - breeding techniques; indoor and outdoor cultures - monoculture and polyculture - merits and demerits.	**6**
III	Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage.	**6**
IV	Applications of vermiculture - Vermiculture Bio-technology, vermicomposting, use of vermicastings in organic farming/horticulture, earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries; forest regeneration.	**6**
V	Potentials and constraints for vermiculture in India. Marketing the products of vermiculture - quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Economic importance of Earthworms: In sustainable agriculture, organic farming, earthworm activities, soil fertility & texture, soil aeration, water impercolation, decomposition & moisture, bait & food.	**6**

Course Outcomes

Course Outcomes	On completion of this course, students will be able;
CO1	To understand the various practices in vermiculture. To know the needs for Vermiculture and the status of India in global market.
CO2	Able to apply the techniques and practices needed for vermiculture.
CO3	To know the difficulties in Vermiculture and be able to propose plans against it.
CO4	Understanding the potential of vermicompost as an alternative to chemical fertilizer and economic importance of vermiculture.
CO5	Know the economic importance of vermiculture and encouraging entrepreneurs among the youth for self employment.

Text Books (Latest Editions)
1. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
Reference Book
1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India. 2. Bhatnagar & Patla, 2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers,New Delhi 3. Mary Violet Christy, 2008. Vermitechnology,MJP Publishers, Chennai. 4. Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi. 5. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
Web Resources
1. https://agritech.tnau.ac.in/sericulture/ **2.** https://www.agrifarming.in/vermiculture-process-techniques-worm-farming

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

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

Title of the Course		**IMMUNOLOGY**						
Category	Core 10	**Year**	II	**Credits**	4	**Course Code**	**232304401**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives

- ✍ To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.
- ✍ To enable a successful performance in Immunology component of CSIR-UGC NET.

UNIT	Details	No. of Periods for the Unit
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.	**15**
II	Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications.	**15**
III	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.	**15**
IV	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.	**15**
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.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Various basic concepts in immunology and organization of immune systems.
CO2	Describe surface membrane barriers and their protection functions.
CO3	Mechanisms of immune response in health and describe the role of different types of T cells, B Cells & MHC Molecules
CO4	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.
CO5	Vaccinology and its importance in disease management

Text Books (Latest Editions)	
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.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
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.

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

Title of the Course		**ECOLOGY**						
Category	Core - 12	**Year**	II	**Credits**	4	**Course Code**	**232304402**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives

- ✍ Knowing the ecology and climatic changes at world level and its impact on natural resources.
- ✍ Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions

UNIT	**Details**	**No. of Periods for the Unit**
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.	**15**
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.	**15**
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	**15**
IV	Ecosystem: Structure and function; energy flow and bio-geo chemical cycle (C, N, P & S); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; bio-geographical zones of India.	**15**
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).	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Learn about the ecosystem, biotic communities and utilizing the energy processing
CO2	Study the various community and population and population control
CO3	Understand the fundamentals of climatic conditions and its impact on environment
CO4	Realizing the nature of pollution and the ways for its control/reduction
CO5	Impact of environmental studies on solid waste management

Text Books (Latest Editions)
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.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**
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

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

Title of the Course		**LAB COURSE IN IMMUNOLOGY**						
Category	Core 12	**Year**	II	**Credits**	4	**Course Code**	**232304403**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		-	1	4	5	25	75	100

Learning Objectives

- ✍ To provide hands-on training to perform specific lab courses in immunology and research methodology.
- ✍ To enable clear understanding of the methodology through wet – lab courses.

Details

1. Identification of various immune tissues and organs in rat
2. Identification of various types of immune cells in peripheral blood smear
3. Separation of RBC as intact cellular antigen for immunization
4. Antigenic challenge of mammalian hosts through different routes, and comparative evaluation of their merits and demerits
5. Methods of blood sampling
6. Preparation and storage of antiserum
7. Agglutination reaction: Qualitative analysis of antigen-antibody reaction using human blood group system
8. Agglutination reactions: Determination of hemagglutination titer of IgM antibodies using human RBC
9. Detection of IgG by precipitation ring test
10. Detection of IgG by Ouchterlony double immuno-diffusion test
11. Detection of reactivity of IgG with fractionated antigens by immune - electrophoresis
12. Separation of lymphocytes from peripheral blood and identification of T and B cells

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Acquire ability to perform/ demonstrate various basic concepts in immunology as well as applications of research methods for quantitative/ qualitative analysis of biochemical components.

Core **PROJECT WITH VIVA VOCE** **Code: 232304404**

SEMESTER IV **Credits 3**

Objectives:

- Every student must complete a project work in the Fourth semester.
- Every student will be assigned to a staff member who will provide necessary guidance for preparation.
- Every student shall be asked to maintain work diary relating to the project work.
- Every student must submit the project report at the end of the Fourth semester before the last working day.
- The report will be signed by the staff guide and countersigned by the Head of the Department of Commerce.
- The distribution mark for the Project:

Evaluation

	Internal	External	Total
Project	15	50	65
Viva	10	25	35
Total	25	75	100

Title of the Course		**AQUACULTURE**						
Category	EC 6	**Year**	II	**Credits**	3	**Course Code**	**232304405**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		5	-	--	5	25	75	100

Learning Objectives

- ✍ Students should know basic concepts in Aquaculture.

UNIT	Details	No. of Periods for the Unit
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.	**15**
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 transportationCommercial substitute for pituitary extracts. Classification of fish feed- Artificial feedsTypes, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.	**15**
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 - 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	**15**
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.	**15**
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.	**15**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	To develop knowledge on the fish farm and their maintenance and know the needs & Status of aqua culture in India and global Market.
CO2	Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques

CO3	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture
CO4	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations
CO5	Know the importance of commercially importance fishes and breeding of fishes and know the resources of Aquaculture and encouraging entrepreneurs among the youth for self employment.

Text Books (Latest Editions)

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).

References Books
(Latest editions, and the style as given below must be strictly adhered to)

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.

Web Resources

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1608.pdf
2. https://aurora.auburn.edu/bitstream/handle/11200/49640/English%20Intro%20to%20Aquaculture.pdf?sequence=1

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

Title of the Course		**ANIMAL BEHAVIOUR**						
Category	SEC -IV	**Year**	II	**Credits**	2	**Course Code**	**232304406**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		4	-	--	4	25	75	100

Learning Objectives

- Students should understand basic concepts in Animal behaviour.

UNIT	Details	No. of Periods for the Unit
I	Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of hobey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images,Intelligence, tool use and culture, Animal awareness and Emotion.	**12**
II	Organization of circadian system in multicellularanimals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.	**12**
III	Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.	**12**
IV	xual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.	**12**
V	Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.	**12**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.
CO2	Discuss the rhythmicity of behavioural expressions and the scientific concets in behaviour and behaviour ecology.
CO3	Recall and record genetic basis and evolutionary history of behaviour.
CO4	Asses complexity involved in behavioural traits and evaluate hormones and their role in aggression and reproduction.
CO5	Classify movement and migration behaviours and explain environmental influence upon behaviour.

Text Books (Latest Editions)	
1	Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2	Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.

3	Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4	Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp.
3. Hoshang S.Gundevia and Hare Goving Singh, 1996. Animal Behaviour,S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Web Resources

1. https://www.bbau.ac.in/dept/dz/TM/ZL%20202%20Animal%20Behaviour.pdf
2. https://www.uou.ac.in/sites/default/files/slm/MSCZO-509.pdf

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

*S - Strong; M - Medium; L – Lo

Title of the Course		**BIO-COMPOSITING**						
Category	AECC 4	**Year**	II	**Credits**	2	**Course Code**	**232304407**	
		Semester	IV					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	**CIA**	**External**	**Total**
		2	-	--	2	25	75	100

Learning Objectives

- ✍ To highlight the importance of biocomposting in waste management.
- ✍ To enable students for setting up biocompost units and bins for waste reduction

UNIT	Details	No. of Periods for the Unit
I	Biocomposting - Definition, types and ecological importance.	**6**
II	Types of biocomposting technology - Field pits/ground heaps/ tank/large-scale/batch and continuous methods.	**6**
III	Preparation of biocompost pit and bed using different amendments.	**6**
IV	Applications of biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.	**6**
V	Establishments of small biocompost unit - project report proposal for Self Help Group (Income and employment generation).	**6**

Course Outcomes	
Course Outcomes	On completion of this course, students will be able;
CO1	Gained knowledge on the process of biocomposting
CO2	The ability to demonstrate biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.
CO3	Knowledge, gain on the economic cost of establishing small biocompost units in the cottage industry.
CO4	Understanding the Application management of biocomposting.
CO5	Explain the entrepreneurship and self-employment

Text Books (Latest Editions)

1. Bikas R. Pati& Santi M. Mandal (2016). Recent trends in composting technology.
2. Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors). 2016. Handbook for Composting and Compost Use in Organic Horticulture.
3. BioGreenhouse COST Action FA 1105,

References Books
(Latest editions, and the style as given below must be strictly adhered to)

01.

Web Resources

www.biogreenhouse.org

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

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

EXTENSION ACTIVITY

Course Code: 232304408

Credit: 1

The Students should undergo any of the following activities during the period of the program (Two Years) outside the college or in any other institutions. This Extension Activity will be evaluated through the certificate (minimum one) submitted by the students. As per the norms, students must carry out any one of the activity for obtaining the PG Degree. The concern Head of the Department will evaluate the students and submit the report to the Controller of Examinations at the end of the IV semester.

List of Extension Activity:

a) Conducting rally, awareness program etc.

b) Seed ball, tree plantation, cleaning work etc.

c) Blood donation, medical camp, organ donation etc.

d) Assisting school children, tribals, and illiterate in learning.

e) Giving assistance to orphanages and old age homes and patients.

f) Awareness program on financial literacy, gender equality, women education etc.

Any other activities which are relevant to develop nearby localities.