As per NEP 2020

M.Sc. Zoology

(Effective from Academic Year 2024-2025 onwards)

Pandit Deendayal Upadhyaya Shekhawati University

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Final Credit Summary

PG in Zoology

Yr	Sem	Credits							Total
		DSC	DSE/ P/D	GEC	AEC	SEC	VAC	Seminar / Internship / Dissertation	
First	Pawas	16	4	---	---	---	2	---	22
	Vasant	16	4	---	---	---	2	---	22
Second	Pawas	8	16	---	---	---	2	---	26
	Vasant	4	8	---	---	---	---	8	20
		44	32	---	---	---	6	8	90

Proposed Distribution of Credits for PG Programme				
Courses	SEM I	SEM II	SEM III	SEM IV
Major DSC	DSC1(4) DSC2(4) DSC3(4) DSC4(4)	DSC5(4) DSC6(4) DSC7(4) DSC8(4)	DSC9(4) DSC10(4)	DSC11(4)
DSE	DSE1(4)	DSE2(4)	DSE3(4) DSE4(4) DSE5(4) DSE6(4)	DSE7(4) DSE8(4)
GEC	---	---	---	---
AEC	---	---	---	---
SEC	---	---	---	---
VAC	VAC1(2)	VAC2(2)	VAC3(2)	---
Seminar / Internship / Dissertation	---	---	---	Dissertation(8)
Total	22	22	26	20
	44		46	
	90			

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Curriculum Structure										
Session 2024-2025 onwards										
Name of the Programme: M.Sc. Zoology										
Year: First							Semester:I (Pawas)			
	Course Code	Course Title	Contact Hrs per Week			Credits	Weightage (%)			
			L	T	P		CW$	MTE	ETE	
Pawas Semester I	**Discipline Specific Core(DSC):**									
	24MZO9101 T	Structure and Function of Invertebrate	4	0	0	4	10	20	70	
	24MZO9102 T	Mendalian, Microbial and Human Genetics	4	0	0	4	10	20	70	
	24MZO9103 T	Fundamentals of Biochemistry	4	0	0	4	30	-	70	
	24MZO9104 P	Zoology Laboratory	0	0	4	4			100	
	Discipline Specific Elective(DSE):									
	24MZO9105 T	Wild Life Biology	4	0	0	4	10	20	70	
	OR									
	24MZO9106 T	Animal Biotechnology	4	0	0	4	10	20	70	
	OR									
	24MZO9107 T	Methods in Biostatistics	4	0	0	4	10	20	70	
	Value Added Course (VAC):									
			2	0	0	2	10	20	70	
	Seminar/Intership/Dissertation (S/I/D):									
	--	--	--	--	--	--	--	--	--	
		Total				**22**				

Summary: I Semester		
S.N.	**Particulars**	**Credits**
1.	Discipline Specific Core(DSC):	**16**
2.	Discipline Specific Elective(DSE):	**04**
3.	Value Added Course(VAC):	**02**
4.	Seminar/Intership/Dissertation(S/I/D):	--
	Total	**22**
$CW (Class work): It would include attendance, assignments, class test/ quiz test/ assignements, ppt, play, learn by fun activities etc.		

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Curriculum Structure									
Session 2024-2025 onwards									
Name of the Programme: M.Sc. Zoology									
Year: First						Semester:II (Vasant)			
	Course Code	Course Title	Contact Hrs per Week			Credits	Weightage (%)		
			L	T	P		CW$	MTE	ETE
Vasant Semester II	**Discipline Specific Core(DSC):**								
	24MZO9201T	Cell and Molecular Biology	4	0	0	4	10	20	70
	24MZO9202T	Research Methodology	4	0	0	4	10	20	70
	24MZO9203T	Animal Physiology	4	0	0	4	10	20	70
	24MZO9204P	Zoology Laboratory	0	0	4	2	30	-	70
	Discipline Specific Elective(DSE):								
	24MZO9205T	Basic of Immunology	4	0	0	4	10	20	70
	OR								
	24MZO9206T	Biology 0f Insecta	4	0	0	4	10	20	70
	OR								
	24MZO9207T	Fish and Fisheries	4	0	0	4	10	20	70
	Value Added Course (VAC):								
			2	0	0	2	20	10	70
	Seminar/Intership/Dissertation (S/I/D):								
	--	--	--	--	--	--	--	--	--
		Total				**22**			

Summary: II Semester		
S.N.	**Particulars**	**Credits**
1.	Discipline Specific Core(DSC):	**16**
2.	Discipline Specific Elective(DSE):	**04**
3.	Value Added Course(VAC):	**02**
4.	Seminar/Intership/Dissertation(S/I/D):	**--**
	Total	**22**
$CW (Class work): It would include attendance, assignments, class test/ quiz test/ assignements, ppt, play, learn by fun activities etc.		

Master of Zoology

(CBCS) As per the NEP 2020 (Semester I to IV)
w.e.f. the Academic Session 2024-25
Discipline: Zoology
Faculty: Science
Paper-1

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Structure and Function of Invertebrate	**DSC-1 (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives

- This course is aimed towards generating fundamental knowledge, concepts related to Non Chordates
- To make students aware about the diversity of Animals present on the planet and how are they possibly related to each other in light of evolution.
- To make students aware about the structure and function of invertebrates

Learning Outcomes

By studying this course students will gain basic knowledge on

- The diversity of animals
- Their general characteristics
- Various groups of animals and their structure, function and evolutionary relationships
- Basic principles and concepts of evolution that contribute to animal diversity

Course Title:	**Structure and Function of Invertebrate**	Course Code: 24MZO9101T
Total Lecture hour 60		**Hours**
Unit I	Origin of Protozoa, parazoa and metazoa. Origin of radiata and bilateria. Origin, characters and types of metamerism. Origin and evolution of coelom. Locomotory organs and mechanisms of locomotion in Nonchordates, flight mechanism of insects, modification of foot organelles in Mollusca., Patterns of feeding and digestion in lower metazoan. Filter feeding in polycheata, Mollusca and Echinodermata.	**20**
Unit II	Organs of respiration: Gills, lungs and trachea. Mechanism of respiration, respiratory pigments, Excretory and osmo-regulatory organs and their mechanisms in nonchordates.	**13**
Unit III	Nervous system in nonchordates : Primitive nervous system- Coelenterata and Echinodermata, Aadvanced nervous system: Annelida, Crustacea, Insecta and	**12**

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	Mollusca. Vision in insects, Mouth parts of Insects.	
Unit IV	Reproduction: Larval forms of free-living and parasites nonchordates, Evolutionary significance of larval forms, Introduction to minor phyla, their salient features and characters, Origin and significance of Mesozoa, Rotifera Rhynchocoela and Sipunculida.	**15**

Reference Books:

1	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
2	Barrington,E.J.W.(1979).Invertebrate Structure and Functions.II Edition,E.L.B.S.and Nelson
3	Richard C Brusca,Gonzalo Giribet, Wendy Moore Invertebrates 4th Edition Oxford University Press
4	Richard Fox , Robert D. Barnes, Edward E. Ruppert, Invertebrate Zoology: A Functional Evolutionary Approach, Brooks/Cole; 7th edition edition2003
5	Hyman, L.H. Invertebrate Series (Recent edition)
6	Parker JJ and WA Haswel Textbook of Zoology. Vol I and II
7	Kotpal, R.L.2022 Series of Invertebrates. Rastogi Publication, Meerut.

Paper-2

Mendelian, Microbial and Human Genetics

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Mendelian, Microbial and Human Genetics	**DSC-2(4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives

The learning objectives of this course are as follows:

- to be able to list some of the distinguishing features of prokaryotes versus eukaryotes.
- to provide an understanding of the basic patterns of inheritance.
- to explain how genotype is related to phenotype?
- to describe how a mutation can change the phenotype.

Learning Outcomes

By studying this course, students will be able to

- Enhance knowledge of the basic principles of inheritance.
- Develop analytical skills and critical thinking through pedigree analysis.
- Understand the mechanism of gene transfer and mapping in both prokaryotes and eukaryotes.
- Learn the mechanisms of mutations and harmful and beneficial effects of mutagens, which help evolve new species over time.
- Be able to grasp basic concepts of human chromosomal disorders.

Course Title:	Mendelian, Microbial and Human Genetics	Course Code: 24MZO9102T
Total Lecture hour 60		**Hours**
Unit I	Mendelian principles : Dominance, segregation, independent assortment. ,Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian principles:Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.	**15**
Unit II	Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids,. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Microbial genetics : Methods of genetic transfers transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.	**15**
Unit III	Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping, Basis of Sex determination: Genetic and environmental; Sex determination in Drosophila and human; Mechanism of dosage compensation..	**15**
Unit IV	Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis,Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications., Recombination Homologous and non-homologous recombination including transposition:Transposons in bacteria, Ty elements in yeast, Ac-Ds elements in maize, P elements in *Drosophila*, Transposons in humans, Significance of Transposons	**15**

Reference Books:

1	Principles of Genetics, Grdner E.J., VIII edition, Simmons M.J. and Snustad D.P, Willey India, 2008.
2	Concepts of Genetics. XI edition. Klug WS, Cummings M.R., Spencer C.A. Benjamin Cummings, 2009.
3	Genetics- A Conceptual Approach. Pierce B.A. W.H. Freeman & Co., NY, 2008.
4	A Conceptual Approach. Russell P. J. Ill edition. Benjamin Cummings, 2009.
5	Genetics of populations, Hedrick, R. W. Jones and Bartelt publisher, Sudbury, Massacluseltts.
6	Human Genetics: problems and approaches, Vogel F and Motulsky A. Springer Verlof, 1997.
7	Human Molecular Genetics, Strachan T and Read A, III ed. Garland Science, 2003
8	Snustad, D.P., Simmons, M.J. (2019). Principles of Genetics. V Edition. John Wiley and Sons In

Paper-3
Fundamentals of Biochemistry

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Fundamentals of Biochemistry	**DSC-3(4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

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Learning Objectives

The learning objectives of this course are as follows:

- to be able to list some of the distinguishing features of prokaryotes versus eukaryotes.
- to provide an understanding of the basic patterns of inheritance.
- to explain how genotype is related to phenotype?
- to describe how a mutation can change the phenotype.

Learning Outcomes

By studying this course, students will be able to

- Enhance knowledge of the basic principles of inheritance.
- Develop analytical skills and critical thinking through pedigree analysis.
- Understand the mechanism of gene transfer and mapping in both prokaryotes and eukaryotes.
- Learn the mechanisms of mutations and harmful and beneficial effects of mutagens, which help evolve new species over time.
- Be able to grasp basic concepts of human chromosomal disorders.

Course Title:	Fundamentals of Biochemistry	Course Code: 24MZO9103T
Total Lecture hour 52		Hours
Unit I	Structure of atoms, molecules and chemical bonds. , Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins)., Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.),Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties)	10
Unit II	**Proteins:** Covalent properties of protein: Structure and chemistry of amino acid, isolation and purification of protein, protein sequencing, covalent modifications, protein splicing, Secondary and tertiary structures of proteins, peptide and peptide bonds, Ramchandaran plots and amino acid properties, common secondary structures, protein tertiary structure and folding patterns, common tertiary structural motifs,Protein folding and thermodynamics. Levinthal paradox, Molten globule, Chaperon assisted protein folding, Protein misfolding disease allostery(Hemoglobin),Myoglobin structure and oxygen binding, Hemoglobin subunits cooperatively, The Hill coefficient, Quaternary structural change and Sickle cell anemia.	20
Unit III	**Cabohydrates: Structure and biological importance:** Monosaccharides, Oligosaccharides, Polysacharides (Storage and structural polysaccharides, glycosaminoglycans), Glycoconjugates (glycoprotein and proteoglycans). **Lipids:** Fatty acids: Structure, nomenclature, acyl glycerols, wax, phospholipids, sphinogolipids, glycolipids, lipoproteins, Terpenoids and sterols: Structure, Properties and functions, Functions of lipids.	15

	Enzymes: Enzyme as biocatalyst, Enzyme kinetics, Mechanism of enzyme catalysis , Co-enzymes and co-factors, Isozymes, Enzyme inhibition, allosteric enzyme. RNA catalysis: chemistry and structure of ribozymes.	
Unit IV	. **Metabolism:** Catabolism, anabolism, metabolic pathway, regulation, concept of free energy, Carbohydrate metabolism: Enzymatic reaction, regulation importance of Glycolysis, Citric acid cycle, Oxidative phosphorylation and mechanism of ATP biosynathesis., Pentose phosphate pathway, glycogenolysis, Lipid metabolism: fatty acid oxidation and biosynathesis, Beta-oxidation. **Amino acid metabolism:** Catabolism of amino acid, Transamination, Deamination biosynthesis of non essential amino acid, fate of carbon skeleton, Nucleotide metabolism : Defradation of purine and pyrimidine nucleotides, biosynthesis (de novo, salvage pathways) of purine and pyrimidine nucleotides. Inborn error of metabolism	**15**

Reference Books:

1	Biochemistry, Albert's R.H. Frey, P.A. and Jencks, W.P. Jones, and Bartlett Publisher, Boston/London 1992.
2	Lehninger Principles of Biochemistry, Nelson D.L. And Cox, M.M. Acmillan/Worth Publishers 2021, 8th edition
3	Biochemistry, Berg J.M,Stryer L. et al. W.H. Freeman and Co. New York 2023, 10th edition
4	Fundamentals of Biochemistry, Voet D., Voet J.G. and Pratt C.W. Johan Wiley and Sons Inc. New York, 1999.
5	Principles of Biochemistry, Horton, H R. Morsanl. A Scringeour, K.G., Perry, M.D. Rawn, J.D. Pearsons Educations, International, 2011, 5th edition
6	Principles of Biochemistry, Zubay G.L. Pearson W. W. and Vence. D.E. Win. C Brown Publishers, Oxford, England 2020, 5th edition
7	Harper's Biochemistry, Murray, Granner, May Rodwell, McGraw Hill Publication, 2022,32th edition.

Paper-IV
Zoology Laboratory

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Zoology Laboratory	**DSC-4(4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Course Title:	Zoology Laboratory	Course Code: 24MZO9104P

Total Lecture hour 60		
1	**Collection and Culture Methods** i. Collection of animals from their natural habitat during field trips. e.g.. Amoeba, Paramecium, Euglena, Planaria, earthwonn. Daphnia, Cyclops. etc. **ii.** Culture of Paramecium in the laboratory and study of its structure. lifc processes and behaviour in the living state.	
2	**Anatomy:** i. Leech : Alimentary canal, nephridial and reproductive system ii. Crab: Nervous system. iii. Grasshopper: Nervous system and reproductive system. iv. Aplyisa, Sepia and Loligo- Nervous system. v. Sea Urchin - Aristotle's lantern. vi. Holothuria ~ General anatomy, alimentary canal. vii. Mouth parts of Insects (Butterfly / House Fly / Wasp / Honey Bee / Mosquito or any available). viii. Sting Apparatus: Wasp / Honey Bee **** Dissections may be demonstrated using computer software.**	
	Collection, culture, live study & **permanent mounting:** (i) *Amoeba, Paramecium* (ii) *Hydra,* Obelia colony and medusa. (iii) Trematodes. (. estodes and Nematodes.) (iv) Permanent Mounting - *Sertulria, Companularia,* Cercaria, *Daphnia, Cyclops,* Zoea, Megalopa, Mysis, Lucifer (v) Parapodium of Nereis	
3	**Study of Specimen:** Spongilla Leucosolenia Sycon Euspongia Euplectella Hyalonema Physalia Porpita Sea anemone(Metridium) Alcyonium Gorgonia Pennetula Renilla Jelly Fish Beroe Cestum Ctenoplana Dugesia/Plannaria Taenia Solium Ascaris Male Ascaris Female Aphrodite Arenicola Chaetopterus Sabella Polynoe Eunice Neries Heteroneries Acanthobdella Pantobdella Polygordius Serpula Bonelia Sipunculus Lingula Apus Balanus Crab Cray Fish Astacus Eupagarus Sacculina with Host Desert Locust Squilla Silk Moth with Development Stage Lac Inset with Development Stage Millipede Peripatus Aplysia Dentallium Chiton Doris Limex Argonauta Nautilus Neopiliana Solen Mantis White Grub Pearl Oyester Cyprea Pentaceros Echinus Ophiothrix Antedon Cucumaria,Star Fish,	
4	**Study of Permanent Slide:** Radiolarian and Forminifera ooze, Euglena, and Paramecium, Binary fission and Conjugation in Paramecium, Monocystis, Nyctotherus Gemmule Sponge spicules,V.S. Sycon, T.S. Sycon, Obelia medusa, Miracidium, Redia and Cercaria larvae of Fasciola, Scolex of Taenia, Mature and gravid proglottids of Taenia solium, Dracanculus Enterobius Wucheria T.S. of Leech through crop pockets, Trochophore larva Daphnia Cyclopus Nauplius, Zoea and Megalopa , Veliger and Glochidium larva of Mollusca, T.S. of arm of star fish, Bipinnaria and Auricularia larva, T.S. Balanoglossus through collar and proboscis, Tornaria larva (Charts and Photographs can be used)	
5	**Permanent Preparation and Study of the following** Paramecium, Euglena, forminiferous shells, sponge spicules, spongin fibres, gemmul . Hydra, Obelia colony and medusa. Parnpodium of Nereis and heteronereis, ovary, nephridia, nerve ring and setae of earthworm salivary glands and trachea of Cockroach, Cyclops and Daphnia (Any other as per the availability)	
6	Visit to local area and study of observed non-chordates,	
1	Kotpal, R.L.2022 Series From Phylum-Protozoa to Echinodermata, Rastogi Publication, Meerut	

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2	Verma P. S. A Manual of Practical Zoology: Invertebrates. S Chand Publication

Genetics and Biochemistry Practical		
7	1. Simulation exercises using beads or seeds to study the gene interactions: 9:3:4; 12:3:1; 9:7; 9:3:3:1 (comb shapes in roosters) and verification of ratios by using chi- square analysis. 2. Pedigree analysis of Autosomal Dominant trait, Autosomal recessive trait, X-linked Dominant traits, X-linked recessive traits, Y-linked traits and mitochondrial traits 3. Use of probability in solving problems of genetics (Sum rule, Multiplication rule & Binomial expansion). 4. Gene mapping (order and distance) using data from interrupted mating experiments in bacteria. 5. .Linkage maps based on data (two - point and three - point crossing over) from Drosophila 6. Human Karyotypes, Human chromosomal disorders & single gene disorders 7. Hardy- Weinberg Problem	
8.	1. Verification of Beer Lambert's Law using any colour solution. 2. Determination of absorption maxima of a coloured solution. 3. Standard curve -cholesterol, protein. 4. Determination of pH of different solution. 5. Quantities estimation of the following in various tissues. 6. Carbohydrates: Glycogen, & Glucose. 7. Proteins: Total protein. 8. Lipids: Total Lipid & Cholesterol. 9. Nucleic Acid: DNA and RNA. 10. Enzymes; Acid and Alkaline Phosphatase. 11. Paper chromatography: Unidimensional chromatography using Amino acids from purified samples and biological materials. Paper/PAGE electrophoresis, determination of serum protein through paper / PAGE electrophoresis	

Reference Books:

1	Principles and Techniques of Practical Biochemistry, Wilson K. and Walker, J. Cambridge University Press Cambridge, 1994.
2	Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co., New Delhi.
3	Peter, J. Russell. (2009), iGenetics: A molecular approach. 3rd Edition. Benjamin Cummin
4	Boye R (2006) Modern Experimental Biochemistry, Pearson Education, Asia, New Delhi

Course title & Code	Credits DSE	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Wild Life Biology	**DSE-1 (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Wild Life Biology

Learning Objectives

Objectives of the Course

To provide students with a profound understanding of the principles, methods, and ethical

1. considerations in conservation biology, empowering them to analyze and contribute to the preservation and sustainable management of biodiversity and ecosystems.and protected area management to species recovery plans, to mitigate threats and enhance biodiversity conservation.
2. Analyze Human Impact: Analyze the complex interactions between human activities and the environment, identifying strategies to promote sustainable resource use and reduce ecological footprints.
3. Ethical Considerations: Grasp the ethical dilemmas associated with conservation decisions, integrating cultural, social, and economic factors into discussions about wildlife protection and ecosystem management.

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4. Interdisciplinary Collaboration: Collaborate across disciplines, combining ecological knowledge, policy understanding, and community engagement to address conservation challenges holistically and contribute to the long-term health of ecosystems and species..

Learning Outcomes

By studying this course students will gain basic knowledge on

1. Evaluate Biodiversity Loss: Assess the causes and consequences of biodiversity decline, understanding the ecological, economic, and social impacts of species extinction and habitat degradation.
2. Apply Conservation Strategies: Apply a range of conservation approaches, from habitat restoration

Course Title:	**Wild Life Biology**	**Course Code: 24MZO9105T**
Total Lecture hour 60		**Hours**
Unit I	Introduction to conservation biology, conservation of biodiversity – patterns and processes. **Ex situ conservation** – role of biological parks and aquariums. **In situ conservation** – national parks and wildlife sanctuaries – formation and management, protection and administration. International conservation bodies – IUCN, UNDP, FAO, WWF	**15**
Unit II	National parks of India – Ranthambore, Ghana, Kaziranga, Kanha, Bandipur, Gir, Corbett, Silent Valley; Marine National Parks of India – Mannar, Gulf of Kutch. Biospheres of India and their concept. Wildlife Sanctuaries in India – Periyar, Mudumalai, Sariska, Jaisamand, Kumbhalgarh, Sitamata, Phulwari ki Nal	**15**
Unit III	**Zoological Parks**: formation, management, food and feeding of captive animals and zoo sanitation. Community reserves and sacred groves. **Red data book and IUCN categories**: Extinct, Extinct in wild, critically endangered, endangered, vulnerable, near threatened, least concern, data deficient and not evaluated. **Some important reptilian species:** Marsh crocodile (*Crocodylus palustris*), Indian Python (*Python molurus*), Red Crowned Roofed Turtle (*Kachuga kachuga*).**Important bird species:** Indian peafowl (*Pavo cristatus*), Siberian white crane (*Grus leucogeranus*), White-rumped vulture (*Gyps bengalensis*)	**15**
Unit IV	**Important mammalian species**: Asiatic lion (*Panthera leo*), Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Indian pangolin (*Manis crassicaudata*), Sloth bear (*Melursus ursinus*), Gaur (*Bos gaurus*), Asian elephant (*Elephas maximus*) Captive breeding and propagation, rehabilitation of animals. Wildlife forensics: Nature of wildlife crimes, investigations and scientific processes. Mammalian pug and hair analysis. DNA banks for endangered animals. Molecular markers used in wildlife forensics. Conservation ethics and values	**15**
Reference Books:		
1	Hunter ML, Gibbs JP, Popescu VD. 2021. Fundamentals of Conservation Biology. 4th edi. Wiley-Blackwell.	

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2	Vardinale B, Primack R, Murdoch J. 2019. Conservation Biology. 1st edi. Oxford University Press.
3	Sher A. 2022. An introduction to conservation biology. 3rd edition. Oxford University Press
4	Primack RB, Sher A. An introduction to conservation biology. 1rd edition. Oxford University Press
5	Sodhi NS, Ehrlich PR. 2010. Conservation Biology for all. Oxford University Press.
6	Dyke FV. 2008. Conservation Biology: Foundation, concepts, applications. Springer
7	**Suggested E-resources** • **https://elphick.lab.uconn.edu/intro-to-conservation-biology/** • **https://**www.wii.gov.in/ • **https://old.amu.ac.in/emp/studym/100005960.pdf** • **https://**www.slideshare.net/**B**ikramsingh106/conservation-biology-note-pdf **https://conbio.org/images/content_publications/ConservationBiologyforAll_reduced size.pdf**

Animal Biotechnology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Animal Biotechnology	**DSE (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives

The learning objectives of this course are as follows:

- to give the students a fundamental understanding of the field of biotechnology.
- to provide a tool kit in the form of a number of techniques and processes developed over time to solve problems involving primarily human welfare with focus on health and medicine.
- to make the students aware of the scope of biotechnology which encompasses almost every field of science like engineering, research, commercialization and academics.
- to empower the students to face research and industrial outlets by nurturing independent thinking, initiating scientific enquiry and developing their entrepreneurship skills.
- to equip the students with basic understanding of the tools and techniques of biotechnology which are a must for anyone interested in pursuing a career in biotechnology.

Learning Outcomes

By studying this course, students will be able to

- have a better understanding of the basic principles and applications of biotechnology.

- appreciate the basic techniques used in genetic manipulation helping them continue with higher studies in this field.
- acquire knowledge of the basic principles, preparations and handling required for animal cell culture.
- have an in-depth understanding of the principles underlying the design of fermenter and fermentation process and its immense use in the industry.
- enable students to design small experiments for successful implementation of the ideas and develop solutions to solve problems related to biotechnology keeping in mind safety factor for environment and society.
- apply knowledge and skills gained in the course to develop new diagnostic kits and to innovate new technologies further in their career.
- enhance their understanding of the various aspects and applications of biotechnology as well as the importance of bio-safety and ethical issues related to it.

Course Title:	**Animal Biotechnology**	**Course Code: 24MZO9106T**
Total Lecture hour 60		**Hours**
Unit I	**Introduction and Techniques in Gene Manipulation :** Concept and Scope of Biotechnology. Outline process of genetic engineering and recombinant DNA technology, Restriction endonucleases, DNA modifying enzymes, Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids (lambda & M13). Shuttle and Expression Vectors. Genomic and cDNA libraries. Transformation techniques: Electroporation and Calcium Chloride method.	**15**
Unit II	**Fermentation:** Different types of Fermentation: Submerged & Solid state; batch, Fed-batch and Continuous; Stirred tank, Air Lift, Downstream Processing: Filtration, centrifugation, extraction, chromatography (Only Principles: Adsorption, Ion exchange, gel filtration, hydrophobic, affinity and size exclusion and lyophilization.	**15**
Unit III	**Transgenic Animal Technology:** Production of transgenic animals: Retroviral method, DNA microinjection method, Nuclear Transplantation: Dolly and Polly.	**15**
Unit IV	rDNA Application in Health: Recombinant vaccines, gene therapy (*in-vivo and ex-vivo*). Production of recombinant Proteins: Monoclonal Antibodies, Insulin and growth hormones, Bio safety:	**15**

	Physical and Biological containment.	

Reference Books:

1	Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology- Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
2	R. Ian Freshney (2021) Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; Wiley-Blackwell.
3	Brown, T.A. (1998). Gene Cloning and DNA Analysis: An Introduction. II Edition, Academic Press, California, USA.
4	Mathur, J.P. and Barnes, D. (1998) Methods in Cell Biology: Animal Cell Culture Methods. Academic Press.
5	Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA
6	Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-Genes and Genomes-A Short Course. III Edition, Freeman and Co., N.Y., USA

METHODS IN BIOSTATISTICS

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
METHODS IN BIOSTATISTICS	**DSE (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives

The learning objectives of this course are as follows:

- to provide an overview of the fundamental concepts of biostatistics.
- to apprise students to the various statistical methods and software tools for understanding data analysis in biological sciences.
- to familiarize students with basic training and develop skills required for analysis of experimental data in biological sciences.
- to encourage students to pursue higher studies or career in biostatistics as Data Analyst, Data Scientist, Software Developer, Machine Learning Analyst, Research Scientist, Academicians, etc.

Learning Outcomes

By studying this course, students will be able to

- better understand the basic concepts of Biostatistics and its various applications in different fields of biological sciences.
- acquire basic skills to set up hypothesis and design research studies.
- enable students to differentiate among various experimental designs and apply appropriate statistical tests.
- develop the skills to collect and represent data in tabular and graphical forms.
- analyze data and interpret experimental results using calculator, spread sheets software and online/offline software tools.

Course Title:	METHODS IN BIOSTATISTICS	Course Code: 24MZO9107T

Total Lecture hour 60		Hours
Unit I	Introduction to Biostatistics and Statistical Data : Aim and scope; applications in biological sciences. Sampling methods; Primary and secondary data; Qualitative and quantitative data; Discrete and continuous data; Presentation of data- graphical representation of data.	15
Unit II	**Descriptive Statistics :** Concepts of statistical population and samples, parameter and statistics; Measures of Central tendency and Dispersion - Mean, Median and Mode (grouped and ungrouped data); Variance, Standard Deviation and Standard Error; Coefficient of Variance.	15
Unit III	**Probability ,Distributions and Testing of Hypothesis :** Normal, Binomial and Poisson; Skewness and Kurtosis.Testing of Hypothesis Null and Alternative hypotheses; Concepts of statistical errors - Type I and Type II errors; Confidence Intervals and Confidence levels.	15
Unit IV	**Statistical tests :** Chi Square tests; Z test, t Tests - paired and unpaired; F test (one way ANOVA). Correlation and Regression ,Correlation Coefficient; Linear regression analysis.	15

Reference Books:

1	Daniel, W.W. and Cross, C.L. (2018) Biostatistics: Basic Concepts and Methodology for the Health Sciences 11th Edition, John Wiley & Sons, Inc.
2	Motulsky, H. (2016) Essential Biostatistics: A Non-mathematical Approach Oxford University Press
3	Zar, Jerrold H. (1999). Biostatistical Analysis, IV Edition, Pearson EducationInc and Dorling Kindersley Publishing Inc. USA

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Semester -II

Research Methodology

Paper-I

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Research Methodology	**DSC-2 (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives

- A basic understanding of how to pursue research.
- A basic understanding of how to learn mathematics.
- A basic understanding of set theory.
- A basic understanding of the software that supports the mathematical research.

Learning Outcomes:

After completion of this course, students will be able to

- Understand mathematics more efficiently and clearly.
- Understand how to write a basic mathematics article.
- Make students analyze a given fact or concept and how to reach a concept.
- Make students curious enough to read the most recent trends in mathematics.
- Understand the basic ideas of how to write an algorithm and related ideas.
- Understand the effective use of open-source software to write mathematical articles.

Course Title:	**Research Methodology**	**Course Code: 24MZO9201T**
Total Lecture hour 60		**Hours**
Unit I	Nature of Scientific Inquiry-Scientific Methods-Induction-Deduction-Hypothesis and Theory and their Interpretation- Nature and Scope of Social Research for Multi-Disciplinary Inter-Disciplinary Approach in Commerce. Planning of Research-Selection of a Problem for Research- Sample design-Census and Sample Surveys-Sampling Techniques-Sample size.	**15**
Unit II	Research Design-Important Aspects of Research Design.	**15**

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	Methods of Data Collection-Sources of data Use of secondary data-Methods of collecting primary data-Observation-Interviews-Questionnaires and Schedules.	
Unit III	Processing and Analysis of Data: Processing Operations – Types of Analysis-Presentation and Interpretation of Data-Editing, Classification and Tabulation-Interpretation. Preparation of a Report-Types of Report-Research Report-Format-Principles of Writing Reports-Documentation-Foonoters and Bibliography	**15**
Unit IV	Quantitative Tools-Measures of Central Tendency-Dispersion-Measures of Correlation-Simple and Multiple Correlation-testing of Hypothesis-Tests based on t-P, Z, and Chisquare-Time Series Analysis-Trend Measurement-Moving Averages	**15**

Reference Books:

1	Srivastava, S. C.: Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990.
2	Sharma H.D. and Mukherji S. P.: Research Methods in Economics and Business, New York: The Macmillan Company, 1992.
3	Gerber R. and Verdoom, P.J.: Research Methods in Economicsand Business, New York, The Macmillan Company, 1992.
4	Krishnaswami O.R.: Methodology of Research in SocialSciences, Himalaya Publishing House, 1993.
5	Menden HYall and Varacity: Reinmuth J.E.: Statistics forManagement and Economics (2nd Edition), 1982.
6	Courtis J.K. (ed.) Research and Methodology in Accounting &Financial Management, 1980.

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Paper-2

Cell and Molecular Biology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Cell and Molecular Biology	**DSC (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Course Title:	**Cell and Molecular Biology**	**Course Code: 24MZO9202T**
Total Lecture hour 60		**Hours**
Unit I	Membrane structure and function,Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes. Structural organization and function of intracellular organelles Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.	**15**
Unit II	Organization of genes and chromosomes , Operon, unique and repetitive DNA, Interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons), Cell division and cell cycle ,Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle	**15**
Unit III	DNA replication, repair and recombination ,Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination. RNA synthesis and processing, Transcription factors and machinery, formation of initiation complex, Transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport	**15**
Unit IV	Protein synthesis and processing ,Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins. Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing	**15**

Reference Books:

1	Karp, G. (2020) Cell and Molecular Biology: Concepts and Experiments. IX Edition. John Wiley and Sons. Inc.
2	Lodish et. al., (2021), Molecular Cell Biology, VII Edition W.H. Freeman and Company, New York, USA
3	Alberts et. al., (2022), Molecular Biology of the Cell Garland Science, Taylor & Francis Group, New York, USA
4	Cooper G. M. and Robert E. Hausman R. E.(2013) The Cell: A Molecular Approach, VI Edition, ASM Press and Sinauer Associates

5	Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2017). The World of the Cell. IX Edition. Pearson Benjamin Cummings Publishing, San Francisco
6	Watson, J. D. Baker T.A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2024) Molecular Biology of the Gene.VIII edition. Cold Spring Harbour Lab. Press, Pearson Pub
7	Lewin's Krebs J,E et. al, . (2017). Gene XII. Jones and Bartlett

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Paper-3
Animal Physiology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Animal Physiology	DSC-3 (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives

Students will learn about the chemical properties of molecules, determine the ways in which they interact and react with each other and understand how body works at system level
Students will learn about the physiology of organs of human

Learning outcomes

At completion of the course the student will be able to:

- Explain human anatomy and physiology: describe cellular levels of organization, and the basics of biochemistry and cell biology.
- Discuss system physiology and their control and regulation mechanisms.
- Explain and examine histological samples and basic laboratory practice in cell culture
- Discover the interaction between body systems and the outside environment for the exchange of materials, the capture of energy, the release of waste, and the overall maintenance of the internal systems that regulate the exchange.
- Will be able to undertake investigations and perform analyses that provide information about biochemistry and solve related problems.

Course Title:	Animal Physilogy	Course Code: 24MZO9203T
Total Lecture hour 60		Hours
Unit I	**Digestive System:** Nature of food-stuff, Various types of digestive enzymes and their action in alimentary canal, Absorption and assimilation of food, Nervous and hormonal control of digestion, Energy balance. **Circulatory System:** Comparative anatomy of heart structure, Blood volume, blood volume regulation, Comparative anatomy of heart structure, Myogenic heart, ECG- its principle and significance, cardiac cycle, Heartbeat, blood pressure and blood groups.	15
Unit II	**Respiratory System:** Transport of O_2 and CO_2 gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. **Excretory System:** Comparative physiology of excretion, Functional architecture of kidney and nephron, Nitrogenous and products, formation of urine and its hormonal control, Role of kidney in osmoregulation, urine concentration, Electrolyte balance, acid-base balance. **Muscular Systems:** Types and properties of muscles, Functional architecture of skeletal muscles, Biophysical and biochemical events during muscular contraction.	15

Unit III	**Nervous System:** Functional architecture of neurons, Origin and propagation of nerve impulse through axon, Action potential, synaptic transmission, Reflex action, Neurotransmitter.. **Thermoregulation and cold tolerance:** Heat balance and exchange, endotherms Vs ectotherm, Counter-current heat exchanger, Torpor, hibernation and aestivation, Adaptations to extreme climate, Comfort zone, body temperature- physical, chemical and neural regulation. **Stress:** Basic concepts of environmental stress and strain, Homeostasis, physiological response to body exercise, Meditation. Yoga and their effects	**15**
Unit IV	**Sense Organs:** Structural architecture and functioning of eyes and ears, Tactile response **Endocrinology:** Endocrine glands in vertebrates,Mechanism of hormone action, hormones and related diseases. **Reproduction:** Reproductive cycle, Reproductive processes (Implantation, Parturition and Lactation), Neuroendocrine regulators in insects and mammals, Pheromones.	**15**

Reference Books:

1	Animal Physiology Mechanisms and Adaptation. R. Eckert (ed), 5th edition, W.H. Freeman and Company, New York
2	Biochemical Adaptation. P.W. Hochachka and G.N. Somero (eds), Priceton Univ. Press, Princeton, New Jersey.
3	Animal Physiology: Adaptation and Environment, K.S. SchiemdtNeilsen (ed), University Press, Cambridge, UK
4	A regulatory Systems Approach. Strand, F.L. Physiology: Macmillan Publishing Co., New York
5	Environmental and Metabolic Animal Physiology, C.L. Prosser (ed), Wiley-Liss Inc., New York
6	Environmental Physiology, P.Willmer, G. Stone, and I. Johnson (eds), Blackwell Publishing, Oxford, UK
7	Guyton and Hall Text book of Medical Physiology, Mario Vaz, Tony Raj(2016), Elsevier Health Sciences

Paper-IV
Zoology Laboratory

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Zoology Laboratory	DSC-4(4)	4	0	0	10+2 from any recognized Board with Biology

Course Title:	Zoology Laboratory	Course Code: 24MZO9104P
Total Lecture hour 60		
A	1.Isolation of genomic DNA from bacteria (E.coli) and human blood 2.Quantification of DNA using spectrophotometric method, 3.Isolation of plasmid DNA from bacteria 4.Transformation of bacteria using CaCl2 heat shock method 5.Digestion of DNA using restriction endonucleases 6.Resolution and molecular weight estimation of fragmented DNA using agarose gel electrophoresis, 7.Construction of restriction map by single and double digestion, Designing DNA probe 8.Southern blot hybridization 9.Amplification of known DNA sequences by Polymerase Chain Reaction. 10. Study of Mitosis in Onion root tip 11. Study of Meiosis in testis of Grasshopper/Cockroach 12. Study of Polytene chromosome in salivary gland of chironomous/Drosophila larva. 13. Project related to topics covered in theory/ project report based on visit to labs/institutions/industry etc. 14. Preparation of tissue culture/medium 15.Separation of a mixture of Aminoacids by Paper/TLC	
B	1. Observe and compare the inherent rhythmicity of the different parts of the heart. 2. Determine the effects of application of parasympathetic or sympathetic agonists/ antagonists. 3. Assessing physical and chemical modifiers of heart rate in frog. 4. Determine the response of the heart to direct electrical stimulation vagal stimulation. 5. Qualitative analysis of carbohydrates 6.Qualitative analysis of polysaccharides 7.Qualitative analysis of proteins 8.Qualitative analysis of lipids 9. Total count of blood corpuscles 10. Differential count of WBCs 11. Estimation of blood clotting time 12. Estimation of protein and hemoglobin 13. Estimation of cholesterol and triglycerides 14. Analysis of pathological contents of urine 15.Estimation of glucose 16. Identification of adulterants	

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	17. Any other practical depending on feasibility. 18. To examine the relative activity of enzymes in the fore, mid, and hindgut of a typical insect and to correlate the enzyme activity with gut regions.	

References:

1.Neilsen, K.S. Animal Physiology: Adaptation & Environment. IV Ed. Cambridge University Press, 1995.

2. Prakash, M & Arora, C.K. Encyclopedia of Animal Physiology. Anmol Publications, New Delhi, 1998.

3. Pestoniee, D.M. Stress and Copping. Sage Publications, London, 1999.

4. Poole, M.C., Pilkey Grant and Johnson.E.C. Biology in Action. Harcourt Brace, Canada, 1995.

5. Hoar, W.S. General and Comparative Animal Physiology. Prentice Hall Inc, New Delhi, 1983.

6. Guyton C. Arthur and Hall J.E. Textbook of Medical Physiology. W.B.Saunders C. London, 1996.

7. Randall David., Burggren. W and French, K. Animal Physiology. W.H. Freeman and Co.New York, 1997.

8. Phisiology by Best & Taylor.

9. Neilsen, K.S. Animal Physiology: Adaptation and Environment. IV Ed. Cambridge University Press, 1995.

10. Prakash, M. and arora C.K. Encyclopedia of Animal Physiology, Anmol Publications New Delhi, 1998.

11.Ausbel FM, Brent R, Kingston RE, Moore DD, Sediman JG, Smith JA, Sruhi V (1989) Current Protocols in Molecular Biology, Greene Publishing and Wiley Interscience, NY

12. Sambrook Joseph and Russell DW (2012) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, NY.

BASICS OF IMMUNOLOGY

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
BASICS OF IMMUNOLOGY	DSE (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives

The learning objectives of this course are as follows:

- to understand the components and functions of immune system of the body.
- to learn how the immune system responds to various infections and foreign substances that adversely affect our body.
- to help comprehend the concept of hypersensitivity and vaccines.
- to acquaint the students on the role of immune system in prevention and altered response to diseases.

Learning Outcomes

By studying this course, students will be able to

- acquire knowledge of immunogenicity and antigenicity.
- better understand innate and acquired immunity.
- appreciate and analyze the various humoral and cellular components of the immune system.
- comprehend the role of immune system in health and disease.
- gain knowledge of autoimmunity, immunodeficiency and hypersensitivity.
- have an enhanced understanding of vaccine and vaccination.

Course Title:	BASICS OF IMMUNOLOGY	Course Code: 24MZO9106T
Total Lecture hour 60		**Hours**
Unit I	**Immune System and its components** Instructional and clonal selection theory; Innate immunity: components and defensive barriers of innate immunity. Adaptive immune system: Components and attributes of acquired immunity, humoral and cell mediated immunity, active and passive immunity, primary and secondary immune response.	**15**
Unit II	**Antigens, Immunogens and Antibodies** Antigens and immunogens; antigenicity and immunogenicity; factors affecting immunogenicity; antigenic determinants (B- and T-cell epitopes); concepts of antigen recognition by B- and T-cells. Structure and function of different classes of antibodies.	**15**
Unit III	**Antigen Processing and Presentation, Cytokines & Complement System** Structure and functions of MHC (MHC I & MHC II); endogenous and	**15**

	exogenous pathways of antigen processing and presentation. Properties and functions of cytokines; Pathways of complement activation and its biological consequences.	
Unit IV	**Role of immune system in Prevention of Diseases** Gell and Coomb's classification of hypersensitivity; autoimmunity; immune dysfunctions and immunodeficiency with suitable examples. Vaccines and their types.	**15**

Reference Books:

1	Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J. (2006) Immunology, VI Edition, W.H. Freeman and Company
2	Abbas, K. Abul and Lechtman H. Andrew (2003) Cellular and Molecular Immunology, V Edition, Saunders Publication.
3	David, M., Jonathan, B., David, R. B. and Ivan, R. (2006) Immunology, VII Edition
4	Janeway's Immunobiology 9th Edition, by Kenneth Murphy, Casey Weaver, Garland Science
5	Kenneth Murphy, Casey Weaver (2016) Janeway's Immunobiology; 9th Edition, Garland Science
6	Punt, J., Stranford, S., Jones, P., Owen, J.A. (2018) Kuby Immunology, VIII Edition, WH Freeman and Company
7	Singh, I. K. and Sharma, P. [Eds.] (2022) An Interplay of Cellular and Molecular Components of Immunology. Taylor & Francis group, CRC Press.
8	Kaur, H., Toteja, R., and Makhija, S. (2021) Textbook of Immunology, I.K International Publishing House and Wiley India Ltd

Biology 0f Insecta

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Biology 0f Insecta	DSE (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives

The learning objectives of this course are as follows:

- to acquaint the students about biology of class Insecta.
- to acquire knowledge of the morphology and physiology of Insects.
- to enable the students to see, appreciate and understand the diversity of insects.

Learning Outcomes

By studying this course, students will be able to:

- better appreciate the diversity of insects.
- better understand the physiology of Insects which has made them the most successful animalsin terms of numbers and variety of species.
- get acquainted with the highly organized social life of insects.
- to make the students aware about the possible scope of the subject which includes research and applied aspects including entrepreneurial skills

Course Title:	Biology 0f Insecta	Course Code: 24MZO9106T
Total Lecture hour 60		**Hours**
Unit I	**Introduction :** General features of Insects and their diversity; Classification of insects up to orders.	**15**
Unit II	**General Morphology of Insects** Head: Eyes, Types of antennae, Mouth parts w.r.t. feeding habits; Thorax: wings- Typical structure of insect wing and its modifications, Types of Legs; Abdomen: Typical structure.	**15**
Unit III	**Physiology of Insects :** General aspects of the Integumentary (structure of integument and process of moulting), digestive, excretory, circulatory, respiratory, reproductive, and nervous system (using cockroach as the type representative); Metamorphosis: Types & hormonal control.	**15**
Unit IV	**Insect behaviour and insect pests** Insect-Plant Interactions: Host-plant selection by phytophagous insects.Bionomics and control of any two phytophagous insect pests of fruits, vegetables, cash crops and stored grains.	**15**

Reference Books:	
1	Chapman, R. F. (1998) The Insects: Structure and Function. Cambridge University Press, UK.
2	Richards, O. W., Davies, R. G. (1977) Imms' General Text Book of Entomology. Vol I & Vol II; Chapman & Hall, UK.
3	Snodgrass, R. E. Principles of Insect Morphology. Cornell Univ. Press, USA.
4	Borror, D. J., Triplehorn, C. A., and Johnson, N. F. Introduction to the Study of Insects. M Saunders College Publication, USA.

FISH AND FISHERIES

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
FISH AND FISHERIES	DSE (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives

The learning objectives of this course are as follows:

- To offer an insight about the climatic conditions that favours fish growth and reproduction.
- to understand the importance of fish as a rich source of animal protein.
- To learn the basic concepts and knowledge of fish biology and its applications.
- to equip the student with a balanced and complete scientific understanding of fisheries.
- to enable students to learn more technical skills to generate entrepreneurial skills and suitable employment opportunities.
- to acquire knowledge of the pathogenic and pathological basis of fish diseases including infectious diseases caused by viruses, prokaryotes, protozoans, helminthes, vector borne and zoonotic diseases.
- To learn about nutritional deficiencies and lifestyle diseases, endocrine diseases and cancer.

Learning Outcomes

By studying this course, students will be able to:

- acquire basic knowledge of physiology and reproduction in fishes.
- analyse different kinds of water and identify/differentiate among various kinds of fishes.
- equip the students with the knowledge on the procedures for artificial and induced breeding which can be learnt by visiting any fish farm or demonstrated in research labs in college/Departments.
- have more knowledge of the in-land and marine Fisheries in India and to explore ways in which it can contribute to the Indian economy.
- know more about the different methods of fishing and fish preservation

Course Title:	FISH AND FISHERIES	Course Code: 24MZO9106T	
Total Lecture hour 60			**Hours**
Unit I	**Introduction and Classification** General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction. Brief introduction to transgenic fishes		**15**
Unit II	**Morphology, Physiology and Behavior** Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales,Gills		**15**
Unit III	**Fisheries** Inland Fisheries; Estuarine Fisheries, Marine Fisheries; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations.		**15**
Unit IV	**Aquaculture** Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish;Management of finfish hatcheries; Preparation of compound diets for fish; Role of water quality in aquaculture; Post harvest handling techniques and Fishery by-products.		**15**

Reference Books:

1. Pandey, K. and Shukla, J.P. (2013) Fish and Fisheries. Rastogi publication,India
2. Chakrabarti, R. and Sharma, J. G. (2008). Aquahouse: New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.
3. Norman, J.R. A History of Fishes. Hill and Wang Publishers. Khanna, S.S.and Singh, H.R. (2014) A text book of Fish Biology and Fisheries. Narendra, Publishing House
4. Bone, Q. and Moore, R. (2008) Biology of Fishes. Talyor and Francis Group, CRC Press, U.K.
5. Srivastava, C.B.L. (2008) Fish Biology. Narendra Publishing House
6. Jhingran, V.G. (1982) Fish and Fisheries in India. Hindustan Publication Cooperation. India.