

Class				M.Sc. (Final)			
Semester/Year				II Year			
Subject & Paper Code				Zoology - MZOOL20Y201			
Paper				Chordata and Developmental Biology of Chordates - I			
Max. Marks				60 (ETE) + 40 (IA) =100			
Credit			Total Credits				
L	T	P	4				
4	0	0					
<p>Course Objectives: The course is a walk for the student's entrant through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms arose and how did they establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades</p>							
<p>Course Outcome: After successfully completing this course, the students will be able to:</p> <ol style="list-style-type: none"> 1. Develop understanding on the diversity of life with regard to protists, non chordates and chordates. 2. Group animals on the basis of their morphological characteristics/ structures. 3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan. 4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic / cladistics treeir. 5. Understand types of regeneration. 							
<p>Student Learning Outcomes (SLO): Students will:</p> <ol style="list-style-type: none"> 1. Understand how morphological change due to change in environment helps drive evolution over a long period of time. 2. Do the he project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. 3. Be able to think and interpret individually due to different animal species chosen. 4. Be able understand the Theories of development. 5. Understand differentiation and differential Cells activity. 							

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Unit	Syllabus	Periods
UNIT - I	1. Origin and outline classification of chordates. 2. Interrelationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes. 3. Life histories of sessile and pelagic tunicates (ascidian), Pyrosoma, Salpa, Doliolum and Oikoplpeura. 4. Origin, evolution and adaptive radiations of vertebrates: (a) Geological time scale and fossils. (b) Origin, evolution and general characters of Agnatha.(Ostracoderms and Cyclostomes). (c) Early gnathostomes (Placoderms). (d) A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi. (e) Adaptive radiation in bony fishes.	15
UNIT - II	1. Origin, evolution and adaptive radiation of Amphibia. 2. Origin and evolution of reptiles; the conquest of land Seymouria and related forms; Cotylosauria; basic skull types and outline classification of reptiles. 3. Dinosaurs : Types and evolutionary significance. 4. Living reptiles : a brief account of Rhynchocephalia, Chelonia, Squamata & Crocodilia. 5. Origin and evolution of birds. 6. Origin of flight; flight adaptations. 7. Origin of mammals, primitive mammals (Prototheria & Metatheria) 8. A general survey of main radiations in eutherian mammals, excluding detailed reference to individual orders. 9. Evolution of man; relationships of man with other primates; fossil record of ancestry of man.	15
UNIT - III	1. Theories of development : Preformation and epigenesis. 2. Oogenesis: (a) Growth of oocyte and vitellogenesis. (b) Organization of egg cytoplasm; role of the egg cortex. (c) Morphogenetic determination in egg cytoplasm. 3. Fertilization : Significance of fertilization in development and the essence of activation of the egg. 4. Early embryonic development. (a) Patterns of cleavage, blastulation and gastrulation in chordates (tunicates to mammals). (b) Fate maps. (c) Morphogenetic movements. (d) Mechanics and significance of gastrulation. 5. Causal basis of development and primary embryonic induction: (a) Concepts of potencies; prospective fates; progressive determination, totipotency and pluripotency, nuclear transfer experiment. (b) Induction of the primitive nervous system (Spemann's primary organizer) (c) Nature & regionally specific properties of inductor . (d) Competence. (e) Abnormal (heterogeneous) inductors. (f) Chemistry and mechanism of action of inducing substances.	15

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UNIT - IV	1. Cell differentiation and differential activity. 2. Organogenesis : (a) Morphogenetic processes in epithelia and mesenchyme in organ formation. (b) Morphogenesis of brain, neural crest cells and their derivatives. (c) Development of the eye, heart, alimentary canal and its accessory organs. 3. Maternal contributions in early embryonic development. 4. Genetic regulations of early embryo development.	15
UNIT - V	1. Embryonic adaptations : (a) Evolution of cleidoic egg and its structural and physiological adaptations. (b) Development and physiology of extra-embryonic membranes in amniotes. (c) Evolution of viviparity. (d) Development, types and physiology of mammalian placenta. 2. Metamorphosis in amphibia : (a) Structural and physiological changes during metamorphosis. (b) Endocrine control of metamorphosis. 3. Types of regeneration, physiological, reparative and compensatory hypertrophy, regenerative ability in chordates.	15

References:

- 1 L.H. Hyman „The Invertebrates’ Vol I, II and V. – M.C. Graw Hill Company Ltd.
- 2 Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
- 3 E.L. Jordan and P.S. Verma „Invertebrate Zoology’ S. Chand and Company.
- 4 R.D. Barnes „Invertebrate Zoology’ by: W.B. Saunders CO., 1986.
- 5 Barrington. E.J.W., „Invertebrate structure and Function’ by ELBS.
- 6 P.S. Dhama and J.K. Dhama. Invertebrate Zoology. S. Chand and Co. New Delhi.

Class		M.Sc. (Final)	
Semester/Year		II Year	
Subject & Paper Code		Zoology - MZOOL20Y202	
Paper		Animal Ecology and Ethology - II	
Max. Marks		60 (ETE) + 40 (IA) =100	
Credit		Total Credits	
L	T	P	4
4	0	0	

Course Objectives:

Use the evidences of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They are able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behavior. Explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They are able to relate the physical features of the environment to the structure of populations, communities, and ecosystems. understand the Subject such as invasive or endangered species, embryonic development in mammals and ageing in social insects. Lead to advances in medicine to prevent disease amongst both animals and human beings.

Course Outcome:

After successfully completing this course, the students will be able to:

1. Understand the living process of reproduction and development for the continuity of various species on this planet.
2. It will also help students in understanding ecology as an essential subject in today's world where harsh consequences like climate change and role of genetically modified organisms cannot be ignored.
3. Economic zoology should have aroused the students to ponder upon the importance of various useful and destructive organisms.
4. Distribution of fauna in different realms interaction.
5. Understand Animal behaviour and response of animals to different instincts.

Student Learning Outcomes (SLO):

Students will:

1. Be understanding the various features and aspects of population ecology, community ecology and ecosystem ecology.
2. They might have the knowledge about environmental biology in details.
3. They will acquire knowledge about various tools and techniques of field ecology.
4. Interaction of biota abiota.
5. Various kinds of Animal adaptations.

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Unit	Syllabus	Periods
UNIT - I	1. Concepts of modern ecology. 2. Limiting factors : Leibig's law of minimum, Shelford's law of tolerance; combined concept of limiting factors, conditions of existence as regulatory factors. 3. Analysis of environment : (a) The general environment. (b) Role of physical factors: temperature, light, water, atmospheric gases, media, substratum, climatology. (c) Brief review of important physical factors as limiting factor. (d) Nutrients and environment.	15
UNIT - II	1. Organization at the population level : (a) General properties of population. (b) Population growth form and forces shaping the population growth. (c) Measurement of population; simple numerical problems on population measurement. (d) Animal aggregation and social life. 2. Organization at the community level : (a) Biotic community concept. (b) Community structure and concept of community dominance. (c) Ecotone and concept of "edge effect". (d) Patterns in communities : Stratification, zonation, activity, food web, reproductive and social structure. (e) Community versus continuum. (f) Evolution of communities : Palaecology; community structure in past ages. 3. Ecological regulations : (a) Succession in community : Basic types of succession; convergence and divergence in succession; modifications in succession; concept of climax, monocl意思 versus polyclimax theory; barriers and ecesis in succession; biome. (b) Fluctuations within community : Irruptive cycle, fluctuation, causes of fluctuation, cycles.	15
UNIT - III	1. Environment and animals in ecosystem : (a) Nature and constituents of ecosystem. (b) Fundamental operation of ecosystem. (c) Flow of matter and energy in ecosystem. (d) Homeostasis in the ecosystem. (e) Cycling of chemical elements in ecosystem. (f) Concept of productivity: Productivity of land and water, measurement of productivity. 2. Organization and dynamics of ecological communities : The habitat approach : A detailed knowledge of extent, zonation, environment, biota, adaptations. and communities of fresh water, marine, terrestrial and estuarine ecosystems. 3. The ecological outlook: Space ecology, nuclear radiations, human population explosion, resources; applied human ecology.	15

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UNIT - IV	<p>1. Introduction of animal behaviour.</p> <p>2. Orientation : (a) Classification of various types of taxes and kineses. (b) Flight orientation in locust.</p> <p>3. Methods of studying behaviour : Brain lesions; electrical stimulation, drug administration.</p> <p>4. Types of behaviour and their regulation : (a) Components of feeding behaviour : Hunger drive; directional movement, avoidance, eating, carrying and hoarding. (b) Factors influencing choice of food. (c) Nervous regulation of food and energy intake :</p> <p>i. Motivated behaviour ; drive, satiation and its neurophysiological control.</p> <p>ii. Feeding behaviour.</p> <p>iii. Learning : Habituation conditioned reflex; trial and error; latent learning; learning and discrimination, imprinting; neural mechanism of learning.</p> <p>iv. Instinctive behaviour: Concept, phyletic decent and physiology.</p> <p>v. Hormones and behaviour. Mammalian nervous system and involvement of hypothalamus in the regulation of behavioural patterns.</p>	15
UNIT - V	<p>1. Social behaviour in primates : (a) Primate societies. (b) Social signals, olfactory, tactile, visual, vocal and acoustic. (c) Status : Dominance and hierarchy, territorial behaviour, courtship and mating, aggression.</p> <p>2. Behaviour of domestic and zoo animals.</p> <p>3. Behaviour in birds : Behaviour of Streptopelia (ring dove); homing and migration.</p> <p>4. Reproductive behaviour in fish (Stickle back or any other fish).</p> <p>5. Behaviour in insects : Social behaviour, communications, concealment behaviour, role of pheromones.</p> <p>6. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual; genetics and human behaviour.</p>	15

References:

- 1 Principles and Standards for Measuring Primary Production, Fahey, T.J. and Knapp, A.K., (2007), Oxford University Press, UK.
- 2 Ecological Modeling, Grant, W.E. and Swannack, T.M., (2008), Blackwell.
- 3 Fundamental Processes in Ecology: An Earth system Approach, Wilkinson, D.M., (2007), Oxford University Press, UK.
- 4 Field Sampling: Principles and Practices in Environmental Analysis, Conklin, A.R. Jr., (2004), CRC Press.
- 5 E.L.Jordan and P.S. Verma „Chordate Zoology’ -. S. Chand Publications.
- 6 Mohan P.Arora. „Chordata – I, Himalaya Publishing House Pvt. Ltd.
- 7 Marshal, Parker and Haswell „Text book of Vertebrates“. ELBS and McMillan, England.
- 8 Veer Bala Rastogi, “Ecology and Animal Distribution”
- 9 Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
- 10 Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers

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Class			M.Sc. (Final)
Semester/Year			II Year
Subject & Paper Code			Zoology - MZOOL20Y203
Paper			Cell Biology - III
Max. Marks			60 (ETE) + 40 (IA) =100
Credit		Total Credits	
L	T	P	4
4	0	0	
<p>Course Objectives: Students will understand: Structural and functional aspects of basic unit of life i.e. cell concepts. Mendelian and non Mendelian inheritance. Concept behind genetic disorder, gene mutations- various causes associated with inborn errors of metabolism. Theories of Evolution. Knowledge of eras and evolution of species</p>			
<p>Course Outcome: After successfully completing this course, the students will be able to: 1. Give the overview of cell. 2. Describe the structure and function of plasma membrane. 3. Structure, functions and interactions of cell organelles and inclusions. 4. Detail description of cell division. 5. Describe structure and function of chromosomes.</p>			
<p>Student Learning Outcomes (SLO): Students will: 1. Understand the importance of cell as a structural and functional unit of life. 2. Understands and compares between the prokaryotic and eukaryotic system and extrapolates the life to the aspect of development. 3. Understands the dynamism of bio membranes indicates the dynamism of life. 4. Know the working mechanism and precision are responsible for our performance in life. 5. Understands the cellular mechanisms and its functioning depends on endomembrane and structures. They are best studied with microscopy.</p>			

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Unit	Syllabus	Periods
UNIT - I	1. Concept of Cell Theory 2. Cell Types : Detailed structure of the different types of cells. (a) Nerve Cell (b) Muscle Cell (c) Gland Cell (d) Blood Cell 3. Cell Membrane : a. Study of various models of the molecular structure of the cell membrane as suggested by Devson & Danielli, obertson & Green : Other recent views on the subject. b. Molecular structure of the specialized modifications of the cell membrane (Cilia, flagella, myelin, sheath etc.). c. Concept of cell surface : Electro kinetic properties of cell surface their role in intercellular, inter-action in cell fusion, Cell aggregation etc. d. Properties & functions of the cell membrane, with special reference to permeability.	15
UNIT - II	Cytoplasm : (a) Generalized structure & composition of the cytoplasm. (b) Detailed discussion on the following cytoplasmic components with special reference to the biochemical and physiological aspects. (i) Endoplasmic reticulum (ii) ribosomes (iii) Golgi body (iv) mitochondria (v) Lysosomes, peroxisomes & other related particles (xi) Centrosomes.	15
UNIT - III	Nucleus: (a) Structure & functions of the nuclear envelope . (b) Structure and chemical organization of the resting nucleus. (c) Nucleus & Nucleolar extrusions. (d) Chemistry and biosynthesis of nucleic acids. Chromosomes : (a) Structural, chemical and functional organization of the different types of chromosomes (autosomes, giant chromosomes, sex chromosomes supernumerary, chromosomes etc.). (b) Chromosomal aberration. (c) Variation and evolution of chromosome numbers.	15
UNIT - IV	Cell Division : (a) Detailed structural, chemical & physiological study of mitotic and meiotic divisions, with in special reference to the mechanism of chromosome movement and organization of the spindle apparatus. (b) Mitotic poisons and their action. (c) Polyploidy. (d) Polysomy.	15

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UNIT - V	Gametogenesis: (a) Cytological cytochemical and endocrinological study on the developing male & female germ cells. (b) Physiology of ovum and spermatozoan. (c) Physiology of the union of gametes and the acrosome reaction.	15
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References:

- 1 L.H. Hyman „The Invertebrates’ Vol I, II and V. – M.C. Graw Hill Company Ltd.
- 2 Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
- 3 E.L. Jordan and P.S. Verma „Invertebrate Zoology’ S. Chand and Company.
- 4 R.D. Barnes „Invertebrate Zoology’ by: W.B. Saunders CO., 1986.
- 5 Barrington. E.J.W., „Invertebrate structure and Function’ by ELBS.
- 6 P.S. Dhami and J.K. Dhami. Invertebrate Zoology. S. Chand and Co. New Delhi.
- 7 Parker, T.J. and Haswell „A text book of Zoology’ by, W.A., Mac Millan Co. London.

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Class			M.Sc. (Final)		
Semester/Year			II Year		
Subject & Paper Code			Zoology - MZOOL20Y204		
Paper			Entomology - IV		
Max. Marks			60 (ETE) + 40 (IA) =100		
Credit		Total Credits			
L	T	P	4		
4	0	0			
<p>Course Objectives: Teaching by the Entomology Department reflects the broad nature of the departmental mission, ranging from basic aspects of arthropod ecology, morphology, parasitology, physiology, systematics and toxicology to applied subjects in apiculture, agricultural, medical and veterinary pest management. We offer a wide range of introductory courses aimed at informing and exciting undergraduates about arthropod biology, comprehensive courses for training of undergraduate majors, and advanced course work for outstanding graduate student education. All courses are designed to complement, rather than duplicate, ongoing programs in other departments or divisions at Cornell.</p>					
<p>Course Outcome: At the end of the course, learners will be able to:</p> <ol style="list-style-type: none"> 1. Familiarized with different pests associated with stored commodities and bulk storage, storage structures and safe use of fumigant. 2. Exposure to handle the Agri-horticultural produce for contamination free trading, treatment protocols, and other sanitary and phytosanitary regulations. 3. Design basic statistical analyses and evaluate basic statistical information. 4. Examine insects deeply within a biological level of analysis and compare strategies used by different groups 5. Gain knowledge about the classification of arthropods and hierarchical classification. 					
<p>Student Learning Outcomes (SLO): Students will</p> <ol style="list-style-type: none"> 1. Understand the importance of cell as a structural and Imparts knowledge of beneficial and non-beneficial insects. 2. Get Knowledge of how they interact with their environment, other species and humans 3. Understand Classification of Insects 4. Understand Role of insects in spread of diseases 5. Understand Insect taxonomy to introduce students to fascinating world of insects the general insect morphology the insect physiology. 					

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Unit	Syllabus	Periods
UNIT - I	1. Insect integument : Structure, composition and functions. 2. Biochemistry of sclerotisation. 3. Functional morphology : Head, thorax, abdomen and appendages, head segmentation, wing venation. 4. Muscular system and its functions.	15
UNIT - II	1. Digestive system : Alimentary canal and physiology of digestion. 2. Circulatory system : Anatomy, physiology; composition of haemolymph. 3. Respiratory system : Structure and physiology. 4. Excretory system : Functional architecture.	15
UNIT - III	1. Nervous system : Structure and physiology. 2. Neuro endocrine system. 3. Sense organs : Chemoreceptors, mechanoreceptors, photoreceptors, sound and light producing organs, visual organs and physiology of vision. 4. Reproductive system : Structure and physiology.	15
UNIT - IV	1. Classification of insects upto order and suborders. 2. Comparative study of wing venation in Orthoptera, Hymenoptera (Apis), Diptera (mosquito) and Homoptera (Aphid). 3. Introduction to primitive insects and fossil insects, cause of success of insects. 4. Origin and evolution of insects.	15
UNIT - V	1. Detailed classification of the following orders emphasizing selected superfamilies and families : Orthoptera, Isoptera, Coleoptera, Homoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera. 2. Economic importance of these orders. 3. Social life in Isoptera and Hymenoptera. 4. Caste determination in social insects.	15

References:

- 1 A general text book of entomology, Imms , A. D., Chapman & Hall, UK.
- 2 Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
- 3 Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
- 4 The Insect Societies, Wilson, E. O., Harvard Univ. Press, UK
- 5 Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
- 6 Insect Plant Biology, Schoonhoven, L. M., van Loop, J. A., & Dicke. M. Pub. Oxford Univ. Press. USA

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Class		M.Sc. Zoology (Final)	
Semester/Year		II Year	
Subject & Paper Code		Practical Zoology - MZOOL20Y205	
Paper		Paper- I and II, Practical I- Sitting	
Max. Marks		60 (ETE) + 40 (IA) =100	
Credit		Total Credits	
L	T	P	2
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PRACTICALS

- 1 Study of life cycle of *Drosophila melanogaster*.
- 2 Study of embryogenesis in *Drosophila* and pattern of gene expression in embryogenesis by in situ hybridization technique.
- 3 Immuno histochemical staining to study the expression pattern of gap and pair rule gene proteins.
- 4 Dissection and study of larval and prepupal wing, leg and eye antennal imaginal discs of *Drosophila*.
- 5 Patterning of the adult wing and demonstration of the effect of cell death on the patterning of the adult wing.
- 6 Study of Homeotic gene mutations.
- 7 Influence of temperature and teratogenes on animal development.
- 8 Study of regeneration in Hydra.
- 9 Habitat studies:
 - i. Physical and chemical characteristics of soil.
 - ii. Assessing influence of light, temperature and moisture on plant germination and growth / animal behavior and growth.
 - iii. Assessing influence of soil nutrient status on plant germination and growth. Community / ecosystem studies:
 - iv. Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrat etc.
- 10 Comparison of stands/communities and ordination.
- 11 Profile diagrams.
 - i. Biomass and reproductive allocation under various environments.
 - ii. Nutrient uptake and budget for various communities / Food chain assessment.

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