SYLLABUS

MANONMANIAM SUNDARANAR UNIVERISTY, TIRUNELVELI-12

PG COURSES – AFFILIATED COLLEGES

MSc Zoology

(Choice Based Credit System)
(with effect from the academic year 2021-2022 onwards)

Semester-II				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
III	Core-V	Cell and Molecular Biology		4
	Core-VI	Developmental Biology		4
	Core-VII	Genetics		4
	Core-VIII	Evolution		4
	Core Practical III	Practical III (2.1 & 2.2)		2
	Core Practical IV	Practical IV (2.3 & 2.4)		2
	Field Work	Field work in any core subject4		3

CELL AND MOLECULAR BIOLOGY

Unit I

Microscopy and Cell organelles

Cell theory; Ultrastructure of plant and animal cells. Cytoplasm - Structure and function of organelles - Nucleus, endoplasmic reticulum, Golgi complex, itochondria, ribosomes, lysosomes, cytoskeletal structures - Cell types –epithelial cells, endothelial cells, Organization of cells into tissues.

Unit II

Cell structure

The cell membrane & its properties; Fluid mosaic model of Plasma membrane; Integral & peripheral membrane proteins. Cell junctions- gap junctions, tight junctions & anchoring junctions - Transport of molecules across the membrane- diffusion & facilitated diffusion & active transport (Sodium, Potassium ATPase pumps). Intracellular Vesicular Trafficking Structural organization of Eukaryotic Chromosome; giant chromosomes.

Unit III

Cell communication, Cell cycle and oncogenesis

Cell signalling- signal molecules-Surface membrane and cytoplasmic receptors; Cell-cell Communication, Intracellular signalling. Cell cycle stages G0 – G1– Check points -Cell cycle and cancer. Spindle organization – Regulation and synchronization of cell division – Oncogenesis - Molecular and biochemical characteristics of cancer cells Cell ageing, Cell death and its regulation

Unit IV

Nucleic acids

Experimental evidence for DNA as genetic material- Griffith experiment, Herschey and Chase experiment - DNA- structure and forms of DNA - Genetic Code- Characteristics. Replication (both prokaryotes and eukaryotes) types. - RNA – structure, types and function DNA damage & repair mechanisms - Plasmids – types and function

Unit V

Protein synthesis

Transcription of mRNA prokaryotes and eukaryotes & post transcriptional modification. Translation in prokaryotes and eukaryotes & Post translational modifications. Bacterial Genetics- Regulation of gene expression -

prokaryotes: lac and trp operon - Mechanisms of Gene transfer in bacteria - transformation, conjugation and transduction.

Suggested Reading materials:

1. Power, C.B. 2009. Cell Biology. Himalayan Publishing House, New Delhi.
2. Paul, A. 2009. Cell and Molecular Biology. Books and Allied (P) ltd, India.
3. Prakash S.L. 2007.Cell and Molecular Biology. M.J.P. publishers, Chennai
4. Gupta, P.K. 2004. Cell and molecular Biology. Rastogi Publications, Meerut.
5. Frifelder, D. 2000. Molecular Biology 2nd edition. Narosa Publishing House, New Delhi.
6. Alberts, B. et al., 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York
7. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc
8. De Roberties E.D.P and E.M.F.De Roberties. 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India
9. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc
10. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc.
11. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company.
12. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett publishers Inc, London UK
13. Watson, J.D., Basker, T. A.,Bell, S.P., Gann, A., Levine, M. and Losick, R. 2004. Molecular Biology of the Gene. Pearson Education (Singapore) Pvt., Ltd.
14. Harvey Lodish, 2000. Molecular Cell Biology 4th Edition, W.H Freeman and Company, New York
15. Allison LA. 2007. Fundamental Molecular Biology. Blackwell Publishing Ltd., USA.

DEVELOPMENTAL BIOLOGY

Unit: I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

Unit: II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry.

Unit: III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit: IV

Neoteny: Occurrence and significance – Regeneration: Regenerative capacity in the Animal Kingdom – Factors influencing regeneration – Stimulation and Suppression – Polarity and Gradients – Development of immune system in vertebrates.

Unit: V

Asexual reproduction - Assisted Reproductive Technology (ART) – Male infertility – Sperm abnormalities – Superovulation – IVF, ICSI, GIFT – Screening of genetic disorders.

Suggested Reading Material

1. Belinsky. B. I. An Introduction to Embryology 5th edition 2012, Cengage India publishers.
2. Grant, Philip. 1979. Biology of Developing Systems. Holt, Rinehart & Winston of Canada Ltd.

3. Austin, C.R. and Short, R.V., Reproduction in Mammals. 1982. Cambridge University Press, London.
4. Schatten, H. and Schatten, G. 2012. The Molecular Biology of Fertilization. Academic Press.
5. Longo. F.J. 1997. Fertilization, 1st edition, Garland Science Publishers.
6. R.G. Edwards and S. A. Brody. 1995 Principles and practice of Assisted Human Reproduction. Saunders publishers.
7. Shumway Waldo, Introduction to Vertebrate Embryology, 2001. Biotech Books publishers.
8. Subhasmita Panda, Fundamentals of Genetics and Embryology, 2017. Kunal Books Publishers.
9. Sabita Mishra, 2019 Langman's Medical Embryology, South Asia Edition, Wolters Kluwer India Pvt Ltd
10. Pawar B. A., Kakade V. B. and Shaikh, M. A. J. General Embryology, 2015. Success Publications

GENETICS

Unit I:

Mendelian genetics

Definition and scope of Genetics - Monohybrid Cross & laws of Dominance and segregation. Dihybrid cross & law of Independent Assortment. Deviations from Mendelian Inheritance: Incomplete Dominance, Co-dominance-Multiple Allelic Inheritance - Gene interaction, epistasis, pleiotropy. Non –Mendelian Inheritance-polygenic Inheritance, Cytoplasmic Inheritance

Unit II:

Linkage and crossing over

Concepts of Linkage, recombination & crossing over, Autosomal linkage - cytological basis of crossing over. gene mapping in prokaryotes and eukaryotes - two-point test cross; Determination of gene order- Three-point test cross in Drosophila. gene mapping in humans by linkage analysis in pedigrees – Tetrad analysis in Neurospora - Sex determination in humans and Drosophila. Sex-linked inheritance-Conceptual basis - X- Linked Inheritance in Humans- Hemophilia, Colour blindness; Y -linkage - hairy pinna in males.

Unit III:

Cytogenetics

Chromosomes-structure and function of chromatin – Euchromatic and heterochromatin – Polytene and Lamp brush – Chromosomal aberrations- Numerical aberrations- Chromosomal non-disjunction, Euploidy & Aneuploidy; Down syndrome, Turner syndrome, Edward Syndrome, Klinefelter Syndrome. Structural aberrations- Inversion, Translocation, Deletion, Duplication. Pedigree analysis - Chromosome anomalies and diseases: Prenatal diagnostics: Amniocentesis, Chorionic Villus sampling. Karyotyping Concepts of Eugenics & Euthenics.

Unit IV:

Population genetics.

Genetic structure of populations –Gene pool, Genotype Frequency, Allelic frequency, kinds of selection, Fisher's theorem, genetic variability, genetic load. Gene Frequency and Genetic Equilibrium – Hardy Weinberg Law, conservation of gene frequency co- dominance and dominance in natural populations. Changes in gene frequency - genetic drift, migration, selection, heterozygous advantage, inbreeding depression.

Unit V

Mutation

Terminology-Mutagenesis, Mutagens, Mutants; Types of mutagens- Base analogues, Chemical mutagens, Intercalating genes, mutator genes. Types of mutation- spontaneous and induced mutation, point mutation, frame shift mutation, sickle-cell anaemia, site directed mutagenesis, forward and reverse mutation, transposable elements and transposition, and evolutionary significance. Inborn errors of metabolism.

Suggested reading materials:

1. Verma,P.S and Agarwal,V.K.2012. Genetics, S. Chand& Co publishers, New Delhi, India
2. Gupta,P.K. 2011. Genetics, Rastogi Publications, New Delhi, India
3. Sinnott E.W.1995. Principles of Genetics, 5th Edition, Tata - McGraw Hill Publishers. New Delhi, India
4. Peter J. Russell. 2010.Genetics: A Molecular Approach,3rd Ed., Pearson Publications, New York. USA
5. Peter Snustad, D. and Michael J. Simmons, 2015. Principles of Genetics, 7th Edition, John Wiley & Sons, Inc., New York, USA
6. Pierce Benjamin A. 2020.Genetics: A Conceptual Approach, 7th Edition. W.H. Freeman and Company Publishers. USA.
7. Gardner Eldon.J., D. Peter Snustad 2006, Principles of Genetics 8Ed. John Wiley & Sons,New York, U.S.A.
8. Strickberger, M.W. 1996. Genetics (3rd Edn.), Prentice Hall, India Ltd., New Delhi.
9. Griffths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R. C. and W.M. Gelbart. 2000. An Introduction to Genetic Analysis (7th Edn.). W.H. Freeman & Co.
10. Hartl, D.L. and E.W. Jones. 2001. Genetics: Analysis of Genes and Genomes (5th Edn.), Jones and Bartlett Publishers, Sadbury, Massachusetts.
11. 1Snustad, D.P. and M.J. Simmons. 2008. Principles of Genetics (5th Edn.). John Wiley & Sons Ltd. New York.

EVOLUTION

Unit: I

Emergence of evolutionary theories: Lamarck – Darwin – Concepts – evolutionary synthesis – evolutionary time scale – eras – periods – epoch. Human evolution: Stages of primate evolution including Homo. Behavioral Evolution: Altruism and evolution – Group selection and kin selection.

Unit: II

Molecular Evolution: Role of gene in evolution - Evolution of gene families, Molecular drive - Assessment of molecular variation Origin of higher categories Phylogenetic gradualism and punctuated equilibrium - Major trends in the origin of higher categories - Micro- and Macro-evolution – speciation.

Unit: III

Molecular phylogenetics: How to construct phylogenetic tress? - Phylogenetic inference –Distance methods, parsimony methods, maximum likelihood method - Immunological techniques

Unit: IV

Protein and Nucleic acid sequences: Amino acid sequences and phylogeny - Nucleic acid phylogeny-DNA-DNA hybridizations, Restriction Enzyme sites, Nucleotide sequence - comparisons and homologies - Molecular clocks

Unit: V

Population genetics and Ecology: Meta populations - Monitoring natural populations - Why small populations become extinct? - Loss of genetic variations - Conservation of genetic resources in diverse taxa – Artificial evolution (in vitro).

Suggested Reading Materials

1. Dobzhansky, Th. Genetic and Origin of Species. Columbia University Press.
2. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M Valentine. Evolution. Surjeet Publication, Delhi
3. Futuyama, D.J. Evolution Biology, Suinuaer Associates, INC Publishers, Dunderland.
4. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates. Inc, Massachusetts.
5. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
6. King, M. Species Evolution –The role of chromosomal change. The Cambridge University Press, Cambridge.

7. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
8. Smith, J.M. Evolutionary Genetics. Oxford University Press, New York.
9. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston London.

PRACTICAL -3

Cell and Molecular biology

1. Observation of Barr body
2. Observation of the stages of mitosis
3. Observation of the stages of meiosis
4. Quantitative estimation of nucleic acids
5. Cytological techniques- Micrometry.
6. Human buccal smear and blood smear.
7. Histological techniques- demonstration
8. Mounting of polytene chromosomes

Models/Spotters/Slides:

Observation of different types of tissues - Nucleic acids models - Griffith experiment - Bacterial transformation - Conjugation experiment - Karyotype of man

Developmental Biology

1. Dissection –Mylabris insect reproductive system
2. Temporary mounting of chick blastoderm
3. Spermatogenesis and Oogenesis (vertebrate) – chart
4. Study of different types of eggs – Amphibia, frog, chick, man – models / chart
5. Frog early development– two-celled stage, four-celled stage, blastula, gastrula with yolk plug stage – slide / model
6. Observation of insect / frog metamorphosis
7. Larval forms of Invertebrata - Redia, Cercaria, Zoea, Mysis, Veliger, Bipinnaria
8. Observations of whole mounts of chick embryos – 24, 48, 72 & 96 h - slides / chart
9. Observation different types of placenta: Diffuse placenta of pig, Cotyledonary placenta of calf, zonary placenta of dog, monodiscoidal placenta of man and bidiscoidal placenta of monkey.
10. Slides showing the uterine cycle in a mammal.

PRACTICAL -4

Genetics

1. Identification of Colour blindness among the students using Ishihara's colour chart.
2. Survey of simple Mendelian traits among the students.
3. Study of polygenetic inheritance among the students using finger print.
4. Study of Hardy-Weinberg Equilibrium using two different colour beads.
5. Action of Natural Selection in population using colour beads.
6. Genetic drift in a small population using colour beads.
7. Human pedigree construction for a family data.

Demonstration/Models/Spotters:

Monohybrid and Dihybrid crosses - Down Syndromes - Turner syndrome - Edward Syndromes - Klinefelter Syndromes - Sickle cell anaemia - Isolation of mutant colonies by Gradient plate method. Isolation of mutant colonies by Replica plate method. Karyotype – pedigree chart – sex-linked inheritance and x linked inheritance.

Lab on Evolution

1. Morphological evidences – fore limbs and hind limbs of vertebrates, Mouth parts of insects,
2. Serial homology in prawn appendages
3. Homology and Analogy in limbs and in wings.
4. Fossil evidences – Ammonites, Nautilus, Belemnites and fossil wood.
5. Tracing the voyage of the H. M. S. beagle on a world map, with dates and important discoveries.
6. Adaptive radiation – breaks on various birds.
7. Museum specimens for adaptive colouration – cryptic and warning.
8. Mimicry – Monarch and viceroy butterfly.
9. Demonstration of natural selection with coloured beads.
10. Demonstration of genetic drift with coloured beads.
11. Variations – Fingerprints of the students of the classes.