

**Part A: Introduction**

Program: Certificate Course		Class: B.Sc. II Year	Year: 2023	Session: 2023-2024
1	Course Code	ZOOL - 3T		
2	Course Title	Genetics, Developmental Biology & Evolution		
3	Course Type	Theory		
4	Pre-requisite (if any)	NO		
5	Course Outcome	<p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> <li>• Apply the principles of Mendelian inheritance on interaction of genes.</li> <li>• Various methods of sex determination in animal kingdom.</li> <li>• Understand the cause and effect of alterations in chromosome number and structure.</li> <li>• Know the Recent Assisted Reproductive Techniques</li> <li>• Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.</li> <li>• Understand the general patterns and sequential developmental stages during embryogenesis and understand how the developmental processes lead to establishment of body plan of multicellular organisms.</li> <li>• Understand evolution through natural selection, and other forces.</li> </ul>		
6	Credit Value	Theory : 4		
7	Total Marks: 50	Max. Marks: 50	Min Passing Marks : 17	

**Part B : Content of Course**

Total No. of Periods : 60		
Unit	Topics	No. of Period
I	<p><b>Concept of Genes and The recombination and interaction of Genes :</b>                      Elements of heredity and variation - Classical and Modern concept of Gene (Cistron, muton, recon), Alleles. Mendel's laws of inheritance - Incomplete dominance, Codominance, Multiple alleles. Interaction of Genes - Lethal alleles, Pleiotropy, Epistasis, Supplementary Gene, Complementary genes, Polygenic inheritance. Linkage and crossing over, Linkage Map. Extra chromosomal and Maternal Inheritance. Sex Chromosomes and sex-linkage. Sex Determination</p>	12
II	<p><b>Regulation of Gene expression &amp; Human Population Genetics :</b>                      Gene Expressions and regulation - One gene-one enzyme hypothesis /one polypeptide hypothesis. Concept of Operon - Concept of Operon of bacteria and bacteriophages. Bacterial transposons: Transformation, transfection and transduction. Utility of the model organisms - <i>Escherichia coli</i>, &amp; <i>Drosophila melanogaster</i>. Structural and numerical alterations of chromosomes - meiotic consequences in structural heterozygotes. Genetic disorders - Chromosomal Aneuploidy, Chromosome Translocation and Deletion, Single gene Disorders, Epigenetics, Pedigree analysis. Genetic counselling.</p>	12

  
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III	Gametogenesis, structure of Gametes and types of eggs. Fertilization - external and internal. Structural and biochemical changes in gametes during and after fertilization block to polyspermy, causes of Infertility. Establishment of the major embryonic axis, polarity. Cleavage - Types and patterns. Body plan and symmetries. Development of frog and Chick up to formation of three germ layers. Tubulation. Morphogenesis, Fate maps. Organogenesis - formation of gut, heart, kidney and muscles. Inhibition, induction, and recruitment. Concept of competence, determination and differentiation and growth, Pleuropotency.	12
IV	<b>Biology of development and Recent Techniques :</b> Parthenogenesis. Regeneration - epimorphosis, morphallaxis and compensatory regeneration. Extra embryonic membranes. Amniocentesis. Placenta - Types structure and functions. Recent Assisted Reproductive Techniques (ART) – Stem cell (Types and their uses), Gene bank, Sperm Bank, Superovulation, Cryopreservation, In vitro fertilization (IVF), Embryo transfer (ET).	12
V	<b>Evolution :</b> Origin of Life on Earth, Early life on Earth - Indirect evidences & direct evidence of early life. Evidences of Organic evolution. Theories of Organic evolution. Sources of variation - Mutation, recombination, Isolation, Genetic drift, Neutral and Artificial evolution. Evolution of Human.	12
<b>Keywords:</b> Genetics, Mendel's law, Interaction of Gene, Sex Linkage, Sex Determination, Gametogenesis, Fertilization, Cleavage, Embryology, Regeneration, Parthenogenesis, Extra embryonic membrane, Placenta, Evolution,		

<b>Part C - Learning Resource</b>	
Text Books, Reference Books, Other Resources	
<b>Suggested Readings:</b>	
<b>Text Books:</b>	
<ol style="list-style-type: none"> <li>1. Gardner, E.J. <i>et al.</i> (2006) Principles of Genetics (John Wiley).</li> <li>2. Russell, P.J. (2010) Genetics (Benjamin Cummings).</li> <li>3. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. (VIII edition) Wiley India.</li> <li>4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. (V edition) John Wiley and Sons Inc.</li> <li>5. Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.</li> <li>6. Carroll S.B.; Doebley J.; Griffiths, A.J.F. and Wessler, S.R. (2018) An Introduction to Genetic Analysis. W. H. Freeman and Co. Ltd.</li> <li>7. Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science</li> <li>8. Gilbert, S.F. (2010) Developmental Biology (9th edition).</li> <li>9. Sinauer Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press.</li> <li>10. Campbell, N. and Reece, J. (2014) Biology (10th edition). Benjamin Cummings</li> <li>11. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing.</li> <li>12. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.</li> <li>13. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett</li> </ol>	
<b>Online Resources –</b>	
<ol style="list-style-type: none"> <li>1. National digital Library.-</li> </ol>	

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**Part A: Introduction**

Program: Certificate Course		Class: B.Sc. II Year	Year: 2023	Session: 2023-2024
1	Course Code	ZOOI- 4T		
2	Course Title	Biochemistry and Molecular Biology		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	<p>At the end of this course, the students will be able</p> <ul style="list-style-type: none"> <li>• Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.</li> <li>• Understand the concept of enzyme, its mechanism of action and regulation.</li> <li>• Learn the preparation of models of peptides and nucleotides.</li> <li>• Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.</li> <li>• Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.</li> <li>• Understand the process of DNA replication, transcription and translation.</li> </ul>		
6	Credit Value	4		
7	Total Marks	Max. Marks: 50	Min Passing Marks: 17	

**Part B: Content of the Course**

**Total No. of Periods: 60**

Unit	Topics	No. of Period
I	<p><b>Biomolecules:</b>                      Amino Acids, Peptides, and Proteins- structure of amino acids, peptide bond, Primary, secondary, tertiary and quaternary structure of proteins and their biological functions. Carbohydrates- Biological roles of carbohydrates, Structure of monosaccharides- Hexoses and pentoses. Disaccharides-Sucrose, lactose, maltose. Storage and structural polysaccharides-Glycogen, starch and cellulose. Lipids- Role of lipids in cellular architecture and functions. Definition and classification of lipids. Structure and function of fatty acids, triacylglycerols, phospholipids and sterols. Nucleic Acids- Role of nucleic acids in living system. Composition of nucleic acids-the purine and pyrimidine bases.</p>	12
II	<p><b>Enzymes and Metabolic Pathways:</b>                      Enzyme - Nomenclature and classification, general properties, specificity, cofactors, isozymes and mechanism of enzyme action. Protein metabolism- Transamination and deamination, Urea cycle. Carbohydrate metabolism- Glycolysis, gluconeogenesis, Cori-cycle, TCA cycle, HMP shunt, glycogenolysis &amp; glycogenesis (Glycogen synthesis) . Lipid Metabolism- Mobilization of triglycerides, metabolism of glycerol, <math>\beta</math>-oxidation of fatty acids, Ketogenesis and significance.</p>	12

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III	<b>Structure of chromosomes, Nucleic acids and DNA replication:</b> Structure of nucleic acids- Structure of DNA, forms of DNA, supercoiling of DNA, Nucleosomes, Histones, Structure of chromatin, chromosomes, packaging of DNA in the nucleus. Structure of RNA- Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA. DNA replication- Chemistry of DNA replication, enzymes involved, Unit of replication, replication origin and replication fork, accuracy during flow of genetic information, proof reading activity; Comparison of replication in prokaryotes and eukaryotes.	12
IV	<b>Central dogma, RNA transcription, RNA processing:</b> Central Dogma of Molecular Biology. Transcription (RNA Synthesis) - DNA-dependent RNA polymerases, sigma factor, bacterial promoters, the three stages of RNA synthesis- initiation, elongation and termination, rho dependent and rho-independent termination. Transcription in eukaryotes. RNA processing- splicing of hnRNA into mRNA, 5'-capping and 3'-polyadenylation of mRNA, differential RNA Processing, rRNA and tRNA modifications and processing.	12
V	<b>Ribosomes and Translation (Protein Synthesis):</b> Structure and types of Ribosome. Genetic Code- triplet codons, Wobble base, synonymous codons, degeneracy of codons, missense-, nonsense- and frame shift mutations. Translation- protein synthesis in <i>Prokaryote and its comparison with eukaryote.</i> , Aminoacylation of tRNA, initiation, elongation, peptide bond formation, translocation, termination, recycling of ribosome. Regulation of protein synthesis and codon bias - Post-translational modifications and processing of proteins.	12
<b>Keywords:</b> Biomolecules, biochemical pathways, Metabolism, Central dogma, Nucleic acids, chromosome, DNA replication, RNA Synthesis (Transcription), Protein Synthesis (Translation), Genetic code.		

### Part C - Learning Resource

#### Text Books, Reference Books, Other Resources


#### Suggested Readings:

##### Text Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman & Company (New York), ISBN: 13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
2. Berg, J.M.; Tymoczko, J.L. and Stryer, L. (2012) Biochemistry (7th edition) Freeman.
3. Conn, E.E.; Stumpf, P.K.; Bruening, G. and Doi, R.H. (2006) Principles of Biochemistry (5th edition) Wiley.
4. Stryer, Lubert (1981) Biochemistry, 2<sup>nd</sup> Edition. W. H. Freeman and Company, New York.
5. Watson, J.D. *et al.* (2013) Molecular Biology of the Gene (7th edition) CSHL Press Pearson.
6. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.
7. Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
8. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter(2002) Molecular Biology of the Cell, 4<sup>th</sup> edition. New York: Garland Science.
9. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger,

**Part A: Introduction**

Program: Certificate Course		Class: B.Sc. II Year	Year: 2023	Session: 2023-2024
1	Course Code	ZOOL-2P		
2	Course Title	Lab Course - 2		
3	Course Type	Practical		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	After completion of practical work the outcome will be : <ul style="list-style-type: none"> <li>• Able to understand and explain Mendel's Law of Inheritance</li> <li>• Capable to analyze inheritance of gene by pedigree analysis.</li> <li>• Able to know laboratory culture of Drosophila.</li> <li>• Able to understand cytological, histological and osteological configuration for animal life.</li> <li>• Capable to understand Human keryotype and Numerical alteration in chromosomes</li> <li>• Capable to explain Evolution and evidences</li> <li>• Capable of performing tests for identification of biological macromolecules</li> <li>• Able to estimate nucleic acids and Isolation of DNA</li> </ul>		
6	Credit Value	2		
7	Total Marks	Max. Marks: 50	Min Passing Marks : 17	

  
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**Part B**  
Total No. of Lecturer (one hour per week)

Total Periods: 30

	Contents	No. of period
	<p><b>Tentative list of practical/exercise:</b></p> <ol style="list-style-type: none"> <li>1. Application of probability in the law of segregation with coin tossing.</li> <li>2. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.</li> <li>3. Familiarization with techniques of handling <i>Drosophila</i>, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.</li> <li>4. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).</li> <li>5. Types of eggs based on quantity and distribution of yolk: sea urchin, insect, frog, Chick.</li> <li>6. Comparative study of cleavage patterns in Frog and Amphioxus models.</li> <li>7. How do cells move, change shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick</li> <li>8. Study of development of chick embryo through incubated chick eggs up to 96 h.</li> <li>9. Extra embryonic membranes of chick through permanent slides.</li> <li>10. Some videos to develop understanding on the process of development.</li> <li>11. Study of adaptive radiations in feet of birds and mouth parts of insects. (DARWIN FINCHES)</li> <li>12. Understanding embryological evidence of evolution (through charts and videos).</li> <li>13. Study of types of fossils.</li> <li>14. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit).</li> <li>15. Preparation of models of amino acids and dipeptides.</li> <li>16. Ninhydrin test for <math>\alpha</math>-amino acids.</li> <li>17. Determination of pK and pI values of glycine.</li> <li>18. Benedict's test for reducing sugars.</li> <li>19. Iodine test for starch.</li> <li>20. Determination of acid value of oil</li> <li>21. Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs).</li> <li>22. Estimation of DNA by DPA method.</li> <li>23. Estimation of RNA by Orcinol method.</li> <li>24. Isolation of genomic DNA by ethanol precipitation method.</li> </ol>	30

**Keywords:** Genetics, Mendel's law, Interaction of Gene, Embryology, Regeneration, Evolution.

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