**Scheme of B.Sc.**

**Zoology**

| Year | Course Code | Subject Name | Theory/ Practical | Total Credit | Total Marks | |
|---|---|---|---|---|---|---|
| | | | | | Max | Min |
| First year | ZOOL-1T | Animal Diversity:Non-Chordata and Chordata , Comparative Anatomy and Physiology of Non-chordates | Theory | 4 | 50 | 17 |
| | ZOOL-2T | Cell Biology , Histology and Comparative Anatomy & Physiology Of Chordates | Theory | 4 | 50 | 17 |
| | ZOOL-1P | Practical | Practical | 2 | 50 | 17 |
| Second year | ZOOL-3T | Genetics , Developmental Biology and Evolution | Theory | 4 | 50 | 17 |
| | ZOOL-4T | Biochemistry and Molecular Biology | Theory | 4 | 50 | 17 |
| | ZOOL-2P | Practical | Practical | 2 | 50 | 17 |
| Third year | ZOOL-5T | Animal Behavior , Chronobiology and Ecology | Theory | 4 | 50 | 17 |
| | ZOOL-6T | Microbiology , Parasitology , Immunology and Applied Zoology | Theory | 4 | 50 | 17 |
| | ZOOL-3P | Practical | Practical | 2 | 50 | 17 |
| **Total** | | | | **30** | **450** | |

**Note:** There shall be four extra credits in all the years of under graduation for internship/apprenticeship. The certificate of extra credits would be provided by the university concern.

| 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 | After successfully completing this course, the students will be able to:<br>• Apply the principles of Mendelian inheritance on interaction of genes.<br>• Various methods of sex determination in animal kingdom.<br>• Understand the cause and effect of alterations in chromosome number and structure.<br>• Know the Recent Assisted Reproductive Techniques<br>• 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.<br>• 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.<br>• Understand evolution through natural selection, and other forces. | | |
| 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 | **Concept of Genes and The recombination and interaction of Genes :** 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 | 12 |
| II | **Regulation of Gene expression & Human Population Genetics :** 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 - *Escherichia coli*, & *Drosophila melanogaster*.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. | 12 |

13.6.2022

| | | |
|---|---|---|
| III | **Developmental Biology :**<br>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 | **Biology of development and Recent Techniques :**<br>Parthenogenesis. Regeneration - epimorphosis, morphollaxis 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, Invitro fertilization (IVF), Embryo transfer (ET). | 12 |
| V | **Evolution :**<br>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 |

**Keywords:** Genetics, Mendel's law, Interaction of Gene, Sex Linkage, Sex Determination, Gametogenesis, Fertilization, Cleavage, Embryology, Regeneration, Parthenogenesis, Extra embryonic membrane, Placenta, Evolution,

Part C - **Learning Resource**

Text Books, Reference Books, Other Resources

**Suggested Readings:**

**Text Books:**


1. Gardner, E.J. *et al.* (2006) Principles of Genetics (John Wiley).
2. Russell, P.J. (2010) Genetics (Benjamin Cumm ings).
3. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. (VIII edition) Wiley India.
4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. (V edition) John Wiley and Sons Inc.
5. Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
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.
7. Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
8. Gilbert, S.F. (2010) Developmental Biology (9th edition).
9. Sinauer Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press.
10. Campbell, N. and Reece, J. (2014) Biology (10th edition). Benjamin Cummings
11. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing.
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.
13. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett


**Online Resources –**

1. National digital Library.-

http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YR201R0cwYXJHV25HSHFacGxtS1h3REZGd1ByL28xcmlIeEFFZU5najlCZ1lHdXBBTzBleTBVRGlDSFhkMEtuUkE9PQ

2. E-PG Pathshala.
   https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA
3. eGyankosh- Genetics and Evolutionary Biology
4. eGyanKosh: BZYCT-137 Genetics and Evolutionary Biology

| **Part** D: **Assessment and Evaluation** | |
|---|---|
| University Exam(UE): Maximum Marks: | 50 Marks |

## DECLARATION

This is to certify that the syllabus is framed by the central board of study (Zoology) as per the guidelines of the department of higher education, Chhattisgarh government.

1. Dr. K. R. Sahu - Chairman -
   Assistant Professor, Govt. Pandit Madhav Rao Sapre Collfge, Pendra Road
2. Dr. Ajit Hundet - Member -
   Professor, Govt. D. B. Girls College, Raipur
3. Dr. Prem Prakash Singh - Member -
   Professor, Govt. College, Kusmi, Balrampur
4. Dr. Shubhada Rahalkar - Member -
   Professor, Govt. Bilasa Girls P. G. College, Bilaspur
5. Dr. Anil Kumar Shrivastava - Member -
   Professor, Govt. V. Y. T. P. G. Autonomous College, Durg
6. Dr. R. K. Tamboli - Member -
   Assistant Professor, Kirodimal Govt. Arts & Science College, Raigarh
7. Dr. Parmita Dubey - Member -
   Assistant Professor, Govt. J. Y. Chhattisgarh College, Raipur
8. Dr. Shashi Gupta - Member -
   Assistant Professor, Govt. Nagarjuna P. G. College of Science, Raipur
9. Dr. L. P. Miri - Member -
   Assistant Professor, Govt. J.P. Verma P. G. Arts & Commerce College, Bilaspur
10. Dr. Rajesh Kumar Rai - Member -
    Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur
11. Dr. Hema Kulkarni - Member -
    Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon R. Dist -Durg

Date : 13.06.2022.

| Part A:Introduction | | | | |
|---|---|---|---|---|
| Program: **Certificate Course** | | Class: **B.Sc. II Year** | Year: **2023** | Session:**2023- 2024** |
| 1 | Course Code | **ZOOL- 4T** | | |
| 2 | Course Title | **Biochemistry and Molecular Biology** | | |
| 3 | Course Type | **Theory** | | |
| 4 | Pre-requisite (if any) | No | | |
| 5 | **Course Learning Outcomes (CLO)** | At the end of this course, the students will be able<br>• Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.<br>• Understand the concept of enzyme, its mechanism of action and regulation.<br>• Learn the preparation of models of peptides and nucleotides.<br>• Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.<br>• Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.<br>• Understand the process of DNA replication, transcription and translation. | | |
| 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 Peroid |
| I | **Biomolecules:**<br>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 monosacharides- Hexoses and pentoses. Disacharides-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. | 12 |
| II | **Enzymes and Metabolic Pathways:**<br>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 & glycogenesis (Glycogen synthesis) . Lipid Metabolism- Mobilization of triglycerides, metabolism of glycerol, β-oxidation of fatty acids, Ketogenesis and significance. | 12 |

13.6.2022

| | | |
|---|---|---|
| III | **Structure of chromosomes, Nucleic acids and DNA replication:** 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 | **Central dogma, RNA transcription, RNA processing:** Central Dogma of Molecular Biology. Trancription (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 | **Ribosomes and Translation (Protein Synthesis):** 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 *Prokaryote and its comparison with* eukaryote., 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 |
| **Keywords:** 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, 2nd 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, 4th edition. New York: Garland Science.
9. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger,

Freeman(2003) Molecular Cell Biology, 5th edition. W. H. & Company.

**Online resources (Try to include similar course available on SWAYAM/NPTEL/CEC etc.)**

https://onlinecourses.nptel.ac.in/noc20_cy10/preview
https://www.classcentral.com/course/swayam-biochemistry-iitm-22920
https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
https://www.classcentral.com/course/swayam-molecular-biology-19952

| **Part** D: **Assessment and Evaluation** |
|---|
| University Exam (UE) : Maximum Marks: 50 |

## DECLARATION

This is to certify that the syllabus is framed by the central board of study (Zoology) as per the guidelines of the department of higher education, Chhattisgarh government.

1. Dr. K. R. Sahu - Chairman -
   Assistant Professor, Govt. Pandit Madhav Rao Sapre College, Pendra Road
2. Dr. Ajit Hundet - Member -
   Professor, Govt. D. B. Girls College, Raipur
3. Dr. Prem Prakash Singh - Member -
   Professor, Govt. College, Kusmi, Balrampur
4. Dr. Shubhada Rahalkar - Member -
   Professor, Govt. Bilasa Girls P. G. College, Bilaspur
5. Dr. Anil Kumar Shrivastava - Member -
   Professor, Govt. V. Y. T. P. G. Autonomous College, Durg
6. Dr. R. K. Tamboli - Member -
   Assistant Professor, Kirodimal Govt. Arts & Science College, Raigarh
7. Dr. Parmita Dubey - Member -
   Assistant Professor, Govt. J. Y. Chhattisgarh College, Raipur
8. Dr. Shashi Gupta - Member -
   Assistant Professor, Govt. Nagarjuna P. G. College of Science, Raipur
9. Dr. L. P. Miri - Member -
   Assistant Professor, Govt. J.P. Verma P. G. Arts & Commerce College, Bilaspur
10. Dr. Rajesh Kumar Rai - Member -
    Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur
11. Dr. Hema Kulkarni - Member -
    Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon R. Dist -Durg

Date : 13.06.2022.

| 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 :<br>• Able to understand and explain Mendel's Law of Inheritance<br>• Capable to analyze inheritance of gene by pedigree analysis.<br>• Able to know laboratory culture of Drosophila.<br>• Able to understand cytological, histological and osteological configuration for animal life.<br>• Capable to understand Human keryotype and Numerical alteration in chromosomes<br>• Capable to explain Evolution and evidences<br>• Capable of performing tests for identification of biological macromolecules<br>• Able to estimate nucleic acids and Isolation of DNA | | |
| 6 | Credit Value | 2 | | |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks : 17 | |

13.6.2023

**Part B**

Total No. of Lecturer (one hour per week)

Total Periods: 30

| | Contents | No. of period |
|---|---|---|
| | **Tentative list of practical/exercise:**<br>1. Application of probability in the law of segregation with coin tossing.<br>2. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.<br>3. Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.<br>4. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).<br>5. Types of eggs based on quantity and distribution of yolk: sea urchin, insect, frog, Chick.<br>6. Comparative study of cleavage patterns in Frog and Amphioxus models.<br>7. How do cells move, change shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick<br>8. Study of development of chick embryo through incubated chick eggs up to 96 h.<br>9. Extra embryonic membranes of chick through permanent slides.<br>10. Some videos to develop understanding on the process of development.<br>11. Study of adaptive radiations in feet of birds and mouth parts of insects.<br>12. Understanding embryological evidence of evolution (through charts and videos).<br>13. Study of types of fossils.<br>14. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit).<br>15. Preparation of models of amino acids and dipeptides.<br>16. Ninhydrin test for α-amino acids.<br>17. Determination of pK and pI values of glycine.<br>18. Benedict's test for reducing sugars.<br>19. Iodine test for starch.<br>20. Determination of acid value of oil<br>21. Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs).<br>22. Estimation of DNA by DPA method.<br>23. Estimation of RNA by Orcinol method.<br>24. Isolation of genomic DNA by ethanol precipitation method. | 30 |

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

| Part C - **Learning Resource** |
|---|
| Text Books, Reference Books, Other Resources |

**Suggested Readings:**

**Text Books:**

1. Practical Hand Book of Genetics: Vikas Pali Kalyani Publication
3. Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology, A Laboratory Manual Debarati Das, Academic Publishers.
4. Cytogenetics:Mohan P Arora, Himalayan Publishing House
5. Modern Experimental Biochemistry by Rodney F. Boyer
6. Molecular Cloning: A Laboratory Manual by Joe Sambrook
7. Practical Manual for Biochemistry : By GG Kaushik, CBS Publication

**E-Resources:**

1. https://onlinecourses.nptel.ac.in/noc22_cy32/preview
2. https://www.classcentral.com/course/swayam-experimental-biochemistry-12909
3. https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20-%20Biochemistry.pdf
4. Fundamentals of Genetics.pdf (jru.edu.in)

| **Part** D: **Assessment and Evaluation** |
|---|
| Practical Exam(UE): Maximum Marks: 50 Marks |

## DECLARATION

This is to certify that the syllabus is framed by the central board of study (Zoology) as per the guidelines of the department of higher education, Chhattisgarh government.

1. Dr. K. R. Sahu - Chairman -
   Assistant Professor, Govt. Pandit Madhav Rao Sapre Collfge, Pendra Road
2. Dr. Ajit Hundet - Member -
   Professor, Govt. D. B. Girls College, Raipur
3. Dr. Prem Prakash Singh - Member - Prem Prakash Singh 13/06/2022
   Professor, Govt. College, Kusmi, Balrampur
4. Dr. Shubhada Rahalkar - Member - S Rahalkar 13.6.2022
   Professor, Govt. Bilasa Girls P. G. College, Bilaspur
5. Dr. Anil Kumar Shrivastava - Member -
   Professor, Govt. V. Y. T. P. G. Autonomous College, Durg

6. Dr. R. K. Tamboli - Member -
Assistant Professor, Kirodimal Govt. Arts & Science College, Raigarh

7. Dr. Parmita Dubey - Member -
Assistant Professor, Govt. J. Y. Chhattisgarh College, Raipur

8. Dr. Shashi Gupta - Member -
Assistant Professor, Govt. Nagarjuna P. G. College of Science, Raipur

9. Dr. L. P. Miri - Member -
Assistant Professor, Govt. J.P. Verma P. G. Arts & Commerce College, Bilaspur

10. Dr. Rajesh Kumar Rai - Member -
Assistant Professor, Govt. Mahamaya College, Ratanpur, Bilaspur

11. Dr. Hema Kulkarni - Member -
Assistant Professor, Shahid Domeshwar Sahu Govt. College, Jamgaon (R), Durg

Date: 13.06.2022.