



B.Sc. 2 Year (Semester 3) Zoology Core **Paper 1**

Molecular Biology, Bioinstrumentation & Biotechniques
(Theory+ Practical)

Programme/Class: Diploma	Year: 2	Semester: 3
Subject: Zoology		
Course Code: B050301T	Course Title: Molecular Biology, Bioinstrumentation & Biotechniques	
Course outcomes: The student at the completion of the course will be able to have: <ul style="list-style-type: none">• A detailed and conceptual understanding of molecular processes viz. DNA to trait.• A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level.• Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms.• Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.• How genes are regulated differently at different time and place in prokaryotes and eukaryotes.		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks: 33 %	
Total No. of Lectures-60		
Units	Topic	No of Lectures 60
I	Process of Transcription <ul style="list-style-type: none">• Fine structure of gene• RNA polymerases• Transcription factors and machinery• Formation of initiation complex• Initiation, elongation and termination of transcription in prokaryotes and eukaryotes	07
II	Process of Translation <ul style="list-style-type: none">• The Genetic code• Ribosome• Factors involved in translation• Aminoacylation of tRNA, tRNA-identity, aminoacyltRNAsynthetase• Initiation, elongation and termination of translation in prokaryotes and eukaryotes	07
III	Regulation of Gene Expression I <ul style="list-style-type: none">• Regulation of gene expression in prokaryotes: lac and trpoperons in <i>E. coli</i>• Regulation of gene expression in eukaryotes: Role of chromatin in gene expression• Regulation at transcriptional level, Post-transcriptional	08



	modifications: Capping, Splicing, Polyadenylation • RNA editing.	
IV	Regulation of Gene Expression II • Regulation of gene expression in eukaryotes: • Regulation at translational level, Post- translational modifications: protein folding etc. • Intracellular protein degradation • Gene silencing, RNA interference (RNAi)	08
V	Principle and Types of Microscopes • Principle of Microscopy and Applications • Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, • Fluorescence microscopy, confocal microscopy, electron microscopy	06
VI	Centrifugation and Chromatography • Principle of Centrifugation • Types of Centrifuges: high speed and ultracentrifuge • Types of rotors: Vertical, Swing-out, Fixed-angle etc. Principle and Types of Chromatography: paper, ion-exchange, gel filtration, HPLC, affinity	08
VII	Spectrophotometry and Biochemical Techniques • Biochemical techniques: Measurement of pH, Preparation of buffers and solutions • Principle of Colorimetry/Spectrophotometry: Beer-Lambert law • Measurement, applications and safety measures of radio-tracer techniques	08
VIII	Molecular Techniques • Detection of nucleic acid by gel electrophoresis • DNA sequencing DNA fingerprinting, RFLP • Polymerase Chain Reaction (PCR) • Detection of proteins, PAGE, ELISA, Western blotting	08

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002).
5. Watson et al. Molecular Biology of the Gene. Pearson (2004).
6. Lewin. Genes VIII. Pearson (2004).
7. Pierce B. Genetics. Freeman (2004).
8. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).
9. Primrose. Molecular Biotechnology. Panima (2001).
10. Clark & Switzer. Experimental Biochemistry. Freeman (2000)

Course Books published in Hindi may be prescribed by the Universities and Colleges



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This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Further Suggestions:

It widens the scope for students to join Government and Non-Government organization up skillingthe people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:

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B.Sc. 2 Year (Semester 3) Zoology Paper 1
Bioinstrumentation & Molecular Biology Lab (Practical)

Programme/Class: Diploma	Year: 2	Semester: 3
Subject: Zoology		
Course Code: B050301P	Course Title: Course Title: Bioinstrumentation & Molecular Biology Lab	
Course outcomes: The student at the completion of the course will be able to <ul style="list-style-type: none">• Understand the basic principles of microscopy, working of different types of microscopes• Understand the basic techniques of centrifugation and chromatography for studying cells and separation of biomolecules• Understand the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer and use them in Biochemistry.• Learn about some of the commonly used advance DNA testing methods.		
Credits: 2	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks: 40	
Total No. of Lab Periods/Practical= 30 (60 hours)		
Units	Topic	No of Lab Periods
I	<ul style="list-style-type: none">• To study the working principle and Simple, Compound and Binocular microscopes.• To study the working principle of various lab equipments such as pH Meter, Electronic balance, use of glass and micropipettes, Laminar flow, Incubator, Waterbath, Centrifuge, Chromatography apparatus, etc.	08
II	<ul style="list-style-type: none">• To prepare solutions and buffers.• To measure absorbance in Colorimeter or Spectrophotometer.• Demonstration of differential centrifugation to fractionate different components in a mixture.	10
III	<ul style="list-style-type: none">• To prepare dilutions of Riboflavin and verify the principle of spectrophotometry.• To identify different amino acids in a mixture using paper chromatography.• Demonstration of DNA extraction from blood or tissue samples.• To estimate amount of DNA using spectrophotometer.	17
IV	Virtual Labs (Suggestive sites) www.labinapp.com www.uwlax.edu www.labster.com www.onlinelabs.in	04



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	www.powershow.in https://vlab.amrita.edu info@premiereducationaltechnologyies.com https://li.wsu.edu	
Suggested Readings: <ul style="list-style-type: none">• Sambrook et al .Molecular Cloning Vols I, II, III. CSHL (2001).• Primrose. Molecular Biotechnology. Panima (2001).• Clark & Switzer. Experimental Biochemistry. Freeman (2000). Suggestive digital platforms web links- ePG- Pathshala, infibnet,IGNOU & UPRTOUonline study material. Svayam Portal, http://heecontent.upsdc.gov.in/Home.aspx		
Suggested Continuous Evaluation Methods: <ul style="list-style-type: none">• Assessment of observation report.• Preparation of questionnaire.• Visits Records.Attendance.		
<p>This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 from Science</p>		
Further Suggestions: It widens the scope for students to join Government and Non-Government organization up skillingthe people at different levels as per their socio-economic structure.		
At the End of the whole syllabus any remarks/ suggestions		



B.Sc. 2 Year (Semester 4) Zoology Paper 1

Gene Technology, Immunology and Computational Biology (Theory)

Programme/Class: Diploma	Year: 2	Semester: 4
Subject: Zoology		
Course Code: B050401T	Course Title: Gene Technology, Immunology and Computational Biology	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none">• Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it.• Know the applications of biotechnology in various fields like agriculture, industry and human health.• To have an in depth understanding about Immune System & its mechanisms.• Get introduced to DNA testing and utility of genetic engineering in forensic sciences.• Get introduced to computers and use of bioinformatics tools.• Enable students to get employment in pathology/Hospital.• Take up research in biological sciences.		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:33	
Total No. of Lectures-60		
Units	Topic	No of Lectures
I	Principles of Gene Manipulation <ul style="list-style-type: none">• Recombinant DNA Technology• Selection and identification of recombinant cells• Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation• Gene transfer techniques, Gene therapy	10
II	Applications of Genetic Engineering <ul style="list-style-type: none">• Single cell proteins• Biosensors, Biochips• Crop and livestock improvement, development of transgenics• Development of DNA drugs and vaccines	08
III	DNA Diagnostics <ul style="list-style-type: none">• Genetic analysis of human diseases, detection of known and unknown mutations• Concept of pharmacogenomics and pharmacogenetics	04



IV	Immune System and its Components <ul style="list-style-type: none">• Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system• Structure and functions of different classes of immunoglobulins, Hypersensitivity• Humoral immunity and cell mediated immunity• HLA complex: organization, class I and II HLA molecules	10
V	Biostatistics I <ul style="list-style-type: none">• Calculations of mean, median, mode, variance, standard deviation• Concepts of coefficient of variation, Skewness, Kurtosis• Elementary idea of probability and application	07
VI	Biostatistics II <ul style="list-style-type: none">• Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram• Tests of significance: one and two sample tests, t-test and Chi-square test	07
VII	Basics of Computers <ul style="list-style-type: none">• Basics (CPU, I/O units) and operating systems• Concept of homepages and websites, World Wide Web, URLs, using search engines	06
VIII	Bioinformatics <ul style="list-style-type: none">• Databases: nucleic acids, genomes, protein sequences and structures, Bibliography• Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW• Phylogenetic analysis	08

Suggested Readings:

- Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
- Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
- Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).
- Primrose. Molecular Biotechnology. Panima (2001).
- Clark & Switzer. Experimental Biochemistry. Freeman (2000)
- Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
- Wilson. Clinical Genetics-A Short Course, Wiley (2000).
- Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).
- Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
- Statistical Methods (Eighth Edition) by G. W. Snedecor and W. G. Cochran, Willey Blackwell
- Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
- Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
- Westhead et al Bioinformatics: Instant Notes. Viva Books (2003).

This course can be opted as an elective by the students of following subjects: I
The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Preparation of Audio-visual aids.



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- Attendance

At the End of the whole syllabus any remarks/ suggestions:

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B.Sc. 2 Year (Semester 4) Zoology Paper 2
Genetic Engineering and Counseling Lab (Practical)

Programme/Class: Diploma	Year: 2	Semester: 4
Subject: Zoology		
Course Code: B050401P	Course Title: Genetic Engineering and Counseling Lab	
Course outcomes: The student at the completion of the course will be able to:		
<ul style="list-style-type: none">• Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19.• Get introduced to DNA testing and utility of genetic engineering in forensic sciences.• Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.• Use bioinformatics tools to find out evolutionary/phylogenetic relationship of organisms using gene sequences.• Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders.• Enable students to take up research in biological sciences.		
Credits: 2	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:40	
Total No. of Lab Periods/ Practical-30 (60 hours)		
Units	Topic	No of Lab Periods
I	<ul style="list-style-type: none">• Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc.• Measure the height and weight of all students in the class and apply statistical measures.	08
II	<ul style="list-style-type: none">• Determination of ABO Blood group• To perform bacterial culture and calculate generation time of bacteria.• To study Restriction enzyme digestion using teaching kits.• To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits.• Demonstration of agarose gel electrophoresis for detection of DNA.• Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. To calculate molecular weight of unknown DNA and protein fragments from gel pictures.	08
III	<ul style="list-style-type: none">• To learn the basics of computer applications• To learn sequence analysis using BLAST• To learn Multiple sequence alignment using CLUSTALW	07



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	<ul style="list-style-type: none"> To learn about Phylogenetic analysis using the programme PHYLIP. To learn how to perform Primer designing for PCR using available softwares etc. 	
IV	<p>Virtual Labs (Suggestive sites)</p> <ul style="list-style-type: none"> Gel Documentation System https://youtu.be/WPpt3-FanNE Colorimeter- https://youtu.be/v4aK6G0bGuU PCR Part 1- https://youtu.be/CpGX1UFSI4A PCR Part 2- https://youtu.be/6IcHAYPTAEw DNA isolation Part 1 https://youtu.be/QE7UI0JnY9A DNA isolation part 2- https://youtu.be/-efr_HFeHxM DNA curve- https://youtu.be/ubL8QxTeuG4 Spectrophotometer https://youtu.be/ubL8QxTeuG4 Agarose Part 1- https://youtu.be/7gvHPFww--g Agarose part 2- https://youtu.be/j_bOZCHNsSg Use softwares like Primer3, NEB cutter NCBI, BLAST, CLUSTAL W, PHYLIP 	07

Suggested Readings:

- Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
- Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
- Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).
- Primrose. Molecular Biotechnology. Panima (2001).

This course can be opted as an elective by the students of following subjects: Open for all

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class 12th.
 The eligibility for this paper is 10+2 with any subject

Further Suggestions:

At the End of the whole syllabus any remarks/ suggestions: