

M. Sc. Zoology

Semester : II

Name of the Course: Biostatistics, Computer Applications and Bioinformatics

Course code : PZ1721

Teaching Plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Unit I(18 hrs)					
	1	Population and sample, variables and sampling methods.	2	Classifies variables and constants.	Lecture, PPT, Seminar, Discussion	Short test, MCQ, Seminar, Online Assignment Formative assessment I (1,2,3,4,5,6) Quiz I
	2	Types of biological data.	2	Compares primary and secondary data.	Lecture, PPT, Discussion, Jigsaw	
	3	Measurement scales - ratio scale, interval scale, ordinal scale, nominal scale - parameters and statistics. Accuracy and precision.	4	Recognize different kinds of scales.	Lecture, PPT, Jigsaw, Flip class	
	4	Data collection and presentation – Tabulation.	3	Recognize different methods of Classification and Tabulation.	Lecture, PPT, Brainstorming, Q&A method	
	5	Data collection and presentation – graphs and diagrams.	3	Creates different types of diagrams and graphs.	Lecture, problem faced learning, Practical	
	6	Measures of central tendency: types of mean, median, mode.	4	Distinguish measures of central tendency.	Lecture, Problem solving, Project	
II	Unit II(18 hrs)					
	1	Measures of dispersion: range – quartile and percentile.	2	Assess and construct Quartiles and Percentiles.	Lecture, Chalk and talk, Problem solving	MCQ Mind map Seminar, Online Assignment Formative assessment I
	2	Mean deviation - standard deviation - coefficient of variation.	2	Differentiates absolute and relative measures of dispersion.	Lecture, Problem solving	
	3	Skewness and kurtosis -	2	Evaluates and	Lecture	

		standard error.		interprets the Skewness and kurtosis.	PPT, Problem solving, Discussion	(1) Quiz I
	4	Distribution: Binomial, Poisson and Normal.	2	Apply probability distributions to solve problems.	Lecture, PPT, Problem solving, video clipping	Formative assessment II (2,3,4, 5,6,7) Quiz II
	5	Parametric and non parametric tests.	2	Apply parametric and non-parametric analysis.	Lecture, Chalk and talk, PPT	
	6	Hypothesis testing – single and two populations mean - types of error (Type I and Type II).	4	Relate Type I and Type II error and statistical significance.	Lecture, Problem solving, Chalk and talk, PPT	
	7	Chi-square analysis – test for goodness of fit and homogeneity.	4	Elucidate goodness of fit using chi-square test.	Lecture, Problem solving, Discussion	
III	Unit III(18 hrs)					
	1	Student's <i>t</i> -distribution.	2	Perform t-tests to verify the level of significance.	Lecture, Problem solving	Mind map, Short test,
	2	Analysis of variance (ANOVA) one way classification and two way classification (Factorial design).	3	Perform analysis of variance.	Lecture, Problem solving	Seminar, Online Assignment
	3	Probability: Addition theorem, multiplication theorem and conditional theorem.	1	Solves problems on probabilities.	Lecture, Exercise	Formative assessment III (1,2,3,4,5,6, 7)
	4	Permutation and combination.	2	Identifies the concept of permutation and combinations.	Lecture, Problem solving, Video	
	5	Correlation – types, methods of study and testing the significance.	3	Test the significance of different statistics.	Lecture, Problem solving, Practical	
	6	Regression: equations – regression lines – simple linear regression and testing its	4	Estimate regression and find the significance of the slope.	Lecture, brainstorming, solve problems	

		significance.				
	7	Mathematical modeling in biology: types and applications	3	Examine problems using the appropriate mathematical models.	Lecture, PPT, Video	
IV	Unit IV(18 hrs)					
	1	Computer applications. Computer memory and storage devices (Hard disc, floppy disc, CD-ROM, DVD, Pen drive).	3	Recall the storage devices of computer.	Lecture, PPT, Models,	MCQ Seminar, Online Assignment Formative assessment I - (1,2) Short test Formative assessment II (3, 4) Formative assessment III (5,6,7)
	2	Microsoft office - M.S. Power point	2	Create document in Microsoft word programs to create documents.	Lecture, PPT, Project	
	3	MS Excel and statistical function	3	Generate charts and graphs and perform statistical analysis.	Lecture, Solve problems using Excel	
	4	Descriptive statistics – <i>t</i> –test, ANOVA, correlation, regression, Chi-square test.	4	Perform descriptive statistics.	Demonstrations, Solve problems using Excel, Project	
	5	Table and charts	2	Creates charts and figures using MS Excel.	Demonstration, Exercises to solve problems, Project	
	6	Internet and E-Mail - viruses and worms.	2	Browse internet, sent emails and address viruses and worms.	Lecture and demonstration, Discussion	
	7	SPSS Package - usage and application.	2	Perform statistical calculations using SPSS.	Lecture, Demonstration, Discussion	
V	Unit V(18 hrs)					
	1	Bioinformatics: Scope.	1	Realizes the scope of bioinformatics.	Lecture, mind storming.	Listing out important terms, Slip test, Seminar, Online Assignment
	2	Biological databases – Database retrieval tools (Locus link, ENTREZ, PubMed and SRS) – Nucleotide sequence database (NCBI, EMBL) - Protein	4	Distinguish Biological databases and their uses.	Lecture, Demonstration using softwares.	

	database (SWISS-PROT).				Formative assessment I - (1,2) Quiz I
3	Database similarity research tools.	3	Choose appropriate bioinformatics tools.	Lecture, Video	Formative assessment II (3, 4) Quiz II
4	Biological sequence analysis (BLAST, FASTA Biological sequence analysis: sequence alignment, pairwise alignment and multiple sequence alignment (CLUSTALW).	5	Perform pairwise and multiple sequence alignment using software.	PPT, Mind storming Jigsaw	Formative assessment III (5,6)
5	Protein structure visualizing tools (RasMol, Swiss PDB Viewer).	3	Analyze structure of proteins.	Lecture, Chart, video	
6	Applications of bioinformatics tools.	2	Recall the applications of bioinformatics tools.	Discussion, Project	

Course instructor
Dr. F. Brisca Renuga

Head of the Department
Dr. S. Mary Mettilda Bai

Semester : II
Name of the Course : Genetics and Evolution
Course code : PZ1722

Teaching Plan

Unit	Modules	Topics	Hou rs	Learning outcome	Pedagogy	Assessment
I	Mendelian Genetics (18 hrs)					
	1	Mendelian principles Dominance, segregation Independent assortment.	3	Demonstrate Mendelian principles.	Lecture, Demonstration	MCQ, Short test, Seminar, Online Assignment, Formative Assessment I (1,2,3,4,5), Quiz I
	2	Allelic interactions Non-allelic interactions Penetrance, expressivity and Pleiotropism.	4	Discuss the interaction of genes.	Lecture Blended classroom	
	3	Linkage and crossing over – types – mechanism – theories.	3	Describe Linkage and crossing over.	Lecture, PPT	
	4	Chromosome mapping Linkage maps, tetrad analysis Mapping with molecular markers, mapping by using somatic cell hybrids.	4	Explain Chromosome mapping	Lecture, PPT	
5	LOD score linkage test Polygenic inheritance Heritability and its measurements QTL mapping.	4	Analyse LOD score and construct QTL mapping.	Lecture, PPT		
II	Molecular and Human Genetics (18 hrs)					
	1	Gene concept, Mutation - types and effects of gene mutation Mutagens -- insertional mutagens.	2	Explain the concept of gene and gene mutation.	Lecture, Chalk and talk	Short test, mind map Objective test, Seminar, Online Assignment, Formative Assessment I (1,2,3), Quiz I Formative Assessment
	2	DNA damage and repair, Inter and Intra chromosomal aberrations. Ploidy - kinds – mechanism – significance.	4	Identify DNA damage and repair, chromosomal aberrations and ploidy.	Lecture, PPT Team teaching	
3	Human chromosomes, Karyotyping, Chromosomal banding and painting Pedigree analysis.	4	Construct Karyotype and Pedigree analysis.	Lecture, Discussion suggestope dia		

	4	Inborn errors of metabolism: Disorders of amino acid metabolism (Phenylketonuria, Alkaptonuria, albinism), Disorders of nucleic acid metabolism (Gout, ADA deficiency).	4	Explain the disorders of amino acid and nucleic acid metabolism.	Lecture, Video Quiz method	II (4,5)
	5	Disorders of carbohydrate metabolism (Pompe's, G ₆ PD deficiency), Disorders of lipid metabolism (Tay Sach's disease, Gaucher's disease), Hemoglobin disorders (sickle cell anemia, thalassemia).	4	Identify metabolic disorders.	Lecture, Discussion Quiz method	
III	Population Genetics and Evolution (18 hrs)					
	1	Mendelian populations Gene pool and gene frequencies Hardy Weinberg law and genetic equilibrium.	3	Explain Mendelian populations and Hardy Weinberg law and genetic equilibrium.	Lecture, Chalk and talk, Problem solving	Short test, MCQ, Objective test, Seminar Online Assignment Formative Assessment II (1,2,3,4,5) Quiz II
	2	Calculation of gene frequencies: Autosomal dominant and recessive alleles, Codominant alleles, Multiple alleles.	4	Calculate gene frequencies.	Lecture, Problem solving	
	3	Sex-linked genes. Factors affecting Hardy Weinberg equilibrium: Selection, heterozygous advantage, Mutation.	4	Discuss the factors affecting Hardy Weinberg equilibrium.	Lecture, PPT	
	4	Migration, Random genetic drift, Founder's effect.	3	Discuss speciation.	Lecture, Chalk and talk	
	5	Genetic load and death Neutralist hypothesis Genetic polymorphism.	4	Describe Neutralist hypothesis and Genetic polymorphism.	Lecture, Discussion	
IV	Molecular evolution (18 hrs)					
	1	Principle - methods of molecular evolution. Nucleotide substitution (types and rates). Interpretation of variation in DNA sequence. Molecular clock.	4	Analyse the principles of molecular evolution.	Lecture, Chalk and talk	MCQ Seminar, Online Assignment Formative Assessment II (1) Formative
	2	Origin of new gene functions – evolution of novel genes and proteins. Molecular phylogeny, Phylogenetic tree.	3	Assess molecular phylogeny.	Lecture, PPT	

	3	Reconstruction of phylogenetic relationship. Distance Matrix approach and Parsimony based approach. Kinds of molecular phylogenies.	4	Adopt different methods of molecular phylogeny.	Lecture, PPT	Assessment III (2,3,4,5)
	4	Universal Tree of Life. Phylogenetic and biological concept of species.	3	Relate Phylogenetic and biological concept of species.	Lecture, PPT	
	5	Adaptive radiation Isolating mechanisms Modes of speciation (allopatry and sympatry).	4	Discuss different modes of speciation.	Lecture, Discussion	
V	Origin of higher categories (18 hrs)					
	1	Major trends in the origin of higher categories Microevolution, macroevolution Mega-evolution and co-evolution.	4	Recall the origin of higher categories.	Lecture, PPT Group discussion	MCQ Seminar, Online Assignment Formative Assessment III
	2	Evolution rates Phyletic gradualism Punctuated equilibrium.	3	Differentiate rates of evolution.	Lecture, PPT	
	3	Origin and Evolution of Primates. Evolution of Anthropoid Primates The First hominids.	4	Trace the evolution of Primates.	Lecture, PPT, Quiz method	
	4	Origin of modern man Bipedalism Communication.	3	Describe the origin of modern man.	Lecture, PPT	
	5	Speech – language Altruism and morality Evolution of culture.	4	Explain the cultural evolution of man.	Lecture, Discussion Narrative method	

Course instructor
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Semester : II
 Name of the Course : Research Methodology
 Course code : PZ1723

Teaching Plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Microscope (18 hrs)					
	1	Principle – Instrumentation Types– bright field and dark field. Types- phase contrast.	4	Differentiate bright field, dark field and Phase contrast microscope.	Lecture, observation of microscopes and hands on learning	MCQ Short test Seminar, Online Assignme nt, Formative Assessme nt I (1,2,3,4) Quiz I
	2	Types- interference and fluorescence, polarization, confocal and Electron microscopes- Scanning tunneling microscope.	6	Explain the working principle of different types of microscope.	Lecture, PPT	
	3	Atomic force microscope, Near field scanning optical microscope and Magnetic force microscope.	4	Compare the atomic force, near field scanning optical and magnetic force microscope and its applications.	Lecture, Demonstration	
	4	Photography – light – film, Camera types and Photomicrography.	4	Explain photography and its applications.	Lecture, Demonstration	
II	Centrifugation (18 hrs)					
	1	Centrifugation: Principle, Centrifugation: Factors affecting sedimentation rate. Types and applications of centrifuges.	4	Demonstrate centrifugation and centrifuges.	Lecture, PPT	MCQ, Seminar, Online Assignme nt Formative Assessme nt I (1,2,3,4) Quiz I Formative Assessme nt II (5,6) Quiz II
	2	PH meter: principle, electrodes and applications.	2	Demonstrate pH meter.	Lecture, Demonstration	
	3	Cryotechniques – cryopreservation, Whole mounts.	3	Apply cryotechnique in histology. Prepare whole mount.	Lecture, Demonstration	
	4	Microtome: Rotary and Freezing microtome.	3	Permanent mount of specimens/tissues.	Lecture, PPT, Demonstration	
	5	Microtomy: Fixation, Dehydration and Clearing.	3			
6	Microtomy: Embedding and Sectioning, Staining and Mounting.	3				

III	Chromatography (18 hrs)					
	1	Chromatography: Principle.	1	Discuss principle of chromatography.	Lecture	MCQ, Short test, Mind map, Seminar, Online assignment, Formative Assessment II (1,2,3,4,5) Quiz II
	2	Types- paper chromatography and Thin layer and Column Chromatography.	2	Demonstrate paper, thin layer and column chromatography.	Lecture, hands on learning	
	3	Gas and Liquid chromatography High Performance Liquid Chromatography Ion exchange chromatography Affinity chromatography.	6	Explain the principle and applications of different types of chromatography.	Lecture/ Demo	
	4	Electrophoresis: Principles and types – Paper- Gel, Polyacrylamide gel, Agarose gel Isoelectric focusing and Immunoelectrophoresis.	5	Apply the principles of different types of electrophoresis.	Demonstrate, Lecture, Seminar	
	5	Protein sequencing methods.	4	Explain protein sequencing methods.	Lecture	
IV	Spectrophotometer (18 hrs)					
	1	Spectrophotometer: principle, design and applications. Spectroscopy: principle- design.	3	Demonstrate spectrophotometer and spectroscopy.	Lecture, Hands on learning	Short test, Seminar, Online Assignment, Formative Assessment II (1,2) Quiz II Formative Assessment III (3,4,5, 6)
	2	Types- Atomic Absorption Spectroscopy, Flame photometer,	3	Discuss atomic absorption spectroscopy and flame photometer.	Lecture, Demo	
	3	Chemiluminometer	1	Describe chemiluminometer.	Lecture	
	4	Nuclear Magnetic Resonance spectroscopy. FTIR spectrometry and Electron Spin Resonance.	5	Explain nuclear magnetic resonance spectroscopy, FTIR spectrometry and Electrons spin resonance.	Lecture, Demo	
	5	Magnetic Resonance Imaging and applications.	3	Discuss magnetic resonance imaging and applications.	Lecture, Video.	
	6	Radioactivity counters.	3	Differentiate the types of radioactivity counters and its applications.	Lecture, PPT	
V	Experimental design and Report writing (18 hrs.)					
	1	Essential steps in research Literature collection and Review of literature.	3	Apply literature collection and review of literature.	Lecture,	Seminar Short test Seminar, Online Assignment Analysis of
	2	Research and discriminative reading, Bibliography.	3	Comprehend literature through research and discriminative reading, bibliography.	Lecture,	

	3	Index card, Literature citation, Plagiarism, Alphabet number system. Research report: Tables and Figures, Formatting and typing.	6	Identify plagiarism and prepare good Research report.	Lecture, Demo on plagiarism check	a paper and report writing Formative Assessment III (1,2,3,4,5)
	4	Online literature collection, Open access journals, Impact factor and Copyright.	4	Analyse articles through online and access journals.	Lecture/Searching on the net	
	5	Laboratory safety.	2	Apply safety rules in the laboratory.	Lecture/Discussion	

Course instructor

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Semester : II
Name of the Course : Developmental Biology
Course code : PZ1724

Teaching Plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Unit I (18 hrs)					
	1	Historical perspectives and theories of embryology.	2	Explain the theories of embryology	Lecture, Group Discussion	MCQ, Formative assessment I Quiz 1, Seminar, Online Assignment
	2	Male reproductive system of a mammal. Spermatogenesis.	3	Describe the male reproductive system. Explain the formation of sperm.	Lecture, PPT, video	
	3	Structure and function of sperm, Factors influencing spermatogenesis, Semen and seminal fluid.	5	Explain the structure of sperm and its function. Comprehend the factors influencing spermatogenesis. Describe semen and seminal fluid.	Lecture, Chalk and talk, PPT	
	4	Female reproductive system of a mammal, Female gonad, Oogenesis.	4	Describe the female reproductive system and oogenesis.	Lecture, PPT, Flipped Classroom	
	5	Ovulation, Regulation of ovulation. Vitellogenesis, types of eggs.	4	Explain the ovulation and vitellogenesis. Differentiate the types of eggs.	Lecture, PPT, video	
II	Unit II (18 hrs)					
	1	Mechanism of fertilization, Theories of fertilization and Post fertilization changes.	4	Explain the mechanism of fertilization.	Lecture, PPT, Chalk and talk	Short test, Formative assessment I (1,2,3), Quiz 1, Formative assessment II (4) Quiz 1I Seminar, Online
	2	Laws of cleavage, planes – patterns – chemical changes during cleavage	3	Define the types of cleavage.	Lecture and observation of slides	
	3	Cleavage and blastulation in chick and mammal.	5	Identify the different stages of cleavage in chick and mammal.	Lecture and observation of slides	
	4	Cell lineage, Fate map of chick and Mammal. Gradient theory. Morphogenetic pattern and fields.	6	Discuss the fate map and morphogenetic pattern.	Lecture, Chalk and talk, PPT	

						Assignment
III	Unit III (18 hrs)					
	1	Morphogenetic movements. Gastrulation in chick and mammal. Germinal layers and their derivatives in vertebrates.	5	Explain the formation of germinal layers and their derivatives.	Lecture, PPT, Group Discussion	Quiz, Mind map Formative assessment II (1,2,3,4) Seminar, Online Assignment,
	2	Neurogenesis, Notogenesis, Development of mesoderm and coelom.	5	Differentiate the dermal derivatives. Comprehend the development of mesoderm and coelom.	Lecture, PPT, YouTube	
	3	Development of Central nervous system, Eye.	3	Explain the formation of eye and CNS	Lecture, PPT, Video	
	4	Development of Skin and its derivatives, Heart, Kidney, Limbs, Alimentary canal and its derivatives.	5	Explain the development of the vital organs.	Lecture, PPT, Group Discussion	
IV	Unit IV (18 hrs)					
	1	Development and differentiation of testis.	3	Comprehend the development of male reproductive organ.	Lecture, PPT, YouTube	MCQ, Short test, Seminar, Online Assignment, Formative assessment II (1,2) Quiz II Formative assessment III (3,4, 5)
	2	Development of male genital ducts and accessory glands.	3	Differentiate the development of testis and accessory glands.	Lecture, Chalk and talk, PPT	
	3	Development and differentiation of ovary, Development of female genital ducts and accessory glands.	5	Differentiate the development of ovary and accessory glands.	Lecture, PPT, video	
	4	Infertility – causes and treatment. Assisted Reproductive Technology (ART), Family planning.	4	Analyse the different causes of infertility and methods to solve. Discuss the methods of family planning.	Lecture, PPT, Group Discussion	
	5	Development of extra embryonic membranes. Placentation in mammals.	3	Compare the placenta of mammals	Lecture, models, PPT	
V	Unit V (18 hrs)					
	1	Embryonic induction in vertebrates – Types – exogenous and endogenous. Theories of organizer or inductor, Competence.	5	Explain the process of induction and competence.	Lecture, Chalk and talk, PPT	Short test Online Assignment

	2	Differentiation - characteristics and types, Selective action of genes in differentiation. Teratogenesis and teratogens.	5	Explain the role of genes in differentiation. Explain the effect of teratogens.	Lecture, PPT	Formative assessment III Seminar
	3	Metamorphosis in insects and amphibians. Neoteny.	3	Explain the process of metamorphosis and neoteny.	Lecture, field observation	
	4	Regeneration - Regenerative ability in animals and mechanism. Asexual reproduction, Parthenogenesis and types.	5	Discuss the types of asexual reproduction and parthenogenesis Analyse the regenerative ability of animals.	Lecture, PPT, Group discussion	

Course instructor

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Semester : II

Name of the Course: Practical II - Biostatistics, Computer applications and Bioinformatics, Genetics and Evolution & Research Methodology

Course code : PZ17P2

Teaching Plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Biostatistics, Computer applications and Bioinformatics					
	1	Collection of data - insect population in the campus.	4	Perform data collection.	Field visit and direct application	Pre-assessment.
	2	Graphical representation of collected data.	2	Analyse the data collected and apply graphical representation.	Practical	Performance-based Assessment
	3	Diagrammatic representation of collected of data.	2	Analyse the data collected and apply diagrammatic representation.	Practical	
	4	Measures of central tendency: mean, median and mode.	4	Recalls and Differentiate.	Practical	Model examination
	5	Measures of dispersion- Standard deviation and standard error.	2	Recalls and apply the distribution.	Practical	Self-assessment
	6	Correlation coefficient – height - weight relationship, length and width of molluscan shells.	2	Recalls and analyse the relation between two variables.	Practical	
	7	Study of probability using coin tossing with 2 and 3 coins and chi square test.	2	Recalls and apply the theory.	Practical	
	8	Regression Analysis.	2	Apply the theory and analyse the relation between two variables.	Practical	
	9	Test of significance (student's <i>t</i> -test).	2	Recalls and apply the theory.	Practical	
	10	Preparation of graph using M.S. Excel.	4	Apply the theory and Perform the same.	Practical	
11	Charts/ Models NCBI, SWISS-PROT and PubMed.	4	Distinguish Biological databases and their uses.	Practical		
II	Genetics and Evolution					
1.	Demonstration of monohybrid and dihybrid cross using beads.	3	Illustrate monohybrid and dihybrid cross using beads.	Practical	Performance based assessment	

	2.	Identification of sex and mutant forms of <i>Drosophila</i> .	3	Identifying sex and mutants in <i>Drosophila</i> .	Practical	Internal assessment Model examination
	3.	Calculation of gene frequencies using Hardy-Weinberg equilibrium - ABO blood group.	3	Application of Hardy-Weinberg equilibrium – in ABO blood group.	Practical	
	4.	Demonstration of natural selection using beads.	3	Illustration of natural selection.	Practical	
	5.	Demonstration of genetic drift using beads.	3	Illustration of genetic drift.	Practical	
	6.	Analysis of variation in fingerprint patterns.	3	Distinguish the variation in fingerprint patterns.	Practical	
	7.	Study of homologous organs (forelimbs and hind limbs of vertebrates).	3	Distinguish homology in the limbs of vertebrates.	Practical	
	8.	Study of analogous organs (wings of animals).	3	Distinguish analogy in the wings of vertebrates.	Practical	
	9.	Adaptive radiation - beaks in Birds.	3	Explain Adaptive radiation by comparing beaks in Birds.	Practical	
	10	Specimens / Charts / Models / Photographs: Karyotype of syndromes, Pedigree chart, Fossils (Ammonite, Trilobite, Nautiloid fossil), Living fossil (<i>Limulus</i> , <i>Peripatus</i>), Connecting link (<i>Archaeopteryx</i>), leaf insect, stick insect.	3	Observes the spotters and identify them	Observation	
III	Research Methodology					
	1	Whole mount preparation of five specimens.	4	Recall the sectioning of animal tissues.	Practical	Performance based assessment Internal assessment Model examination
	2	Separation of amino acids using thin layer chromatography.	4	Explain the technique of separation of amino acids.	Practical	
	3	Sectioning and staining of a tissue.	9	Recall the sectioning and staining of animal tissues.	Practical	
	4	Separation of pigments by column chromatography using plant extracts (Demonstration).	5	Explain the technique of separation of pigments and proteins.	Practical	
	5	Gel electrophoresis (Demonstration).	4		Practical	
	6	Phase contrast microscope, fluorescent microscope and	2	Discuss the method of operation of instruments.	Instrument s/ Charts/	

		pH meter			Models	
7		Centrifuge, spectrophotometer, Flame photometer, microtome	1			
8		Chromatography column Electrophoretic apparatus and Index card.	1	Recall and apply chromatographic and electrophoretic technique. Recall the use of index card in research article writing.		

Course instructors

Dr. F. Brisca Renuga,
Dr. P.T. Arokya Glory,
Dr. J. Vinoliya Josephine Mary

Head of the Department

Dr. S. Mary Mettilda Bai

Semester : IV
Name of the Course : Microbiology
Course code : PZ1741

Teaching plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Introduction, Classification of microorganisms (18 hrs)					
	1.	History and Scope of Microbiology. Classification of microorganisms - Whittaker's five kingdom classification. Three domain classification.	4	Recall the history and scope of Microbiology, Classify and identify the microorganisms	Lecture, Discussion, PPT	MCQ Seminar Online Assignment
	2.	Viruses - General properties. Structure of viruses. Viral taxonomy.	3	Identify the taxonomical status of a virus.	Lecture, PPT, YouTube learning	
	3.	Bacteriophages: Reproduction of DNA and RNA phages. Temperate bacteriophages and lysogeny.	4	Describe the bacteriophage reproduction	Lecture, PPT, Video - animation	Formative Assessment I (1,2,3,4,5,6)
	4.	Cytocidal infections and cell damage, persistent, latent and slow virus infections.	3	Explain the viral infections	Lecture, PPT, video	
	5.	Cultivation of viruses and purification assays.	2	Cultivate the virus and purify the virus using different assays.	Lecture, Mind map	
	6.	Viruses and cancer. Viroids and Prions	2	Explain the relationship of cancer and virus.	Lecture and PPT, Xenography.	
II	Bacteria (18 hrs)					
	1.	Classification, Bergey's system of bacterial classification	2	Classify the microorganism	Lecture, PPT, Quiz	MCQ Seminar Online Assignment
	2.	Bacterial morphology and fine structure of <i>Escherichia coli</i> .	2	Recite the structure of <i>E. coli</i> .	Lecture PPT, Reflective	
	3.	Bacterial nutrition - Common nutrient requirements. Nutritional classes. Uptake of nutrients.	3	Apply the types of nutrient to culture bacteria	Lecture, PPT, Project-based	Formative Assessment I (1,2,3,4,5) Quiz I
	4.	Bacterial growth and measurement of growth. Influence of environmental factors on growth. Synchronous growth.	3	Culture the bacteria and assess their growth.	Lecture, PPT Experiment	
	5.	Continuous culture – Chemostat and turbidostat.	2	Culture bacteria using chemostat and turbidostat.	Lecture, Problem-based	
	6.	Types of culture media.	3	Select the	PPT,	Formative Assessment

				appropriate culture media.	Experiment	nt II (6,7) Quiz II	
	7.	Pure culture and methods of isolating pure cultures (streak plate technique and Pour-plate technique).	3	Culture the bacteria and isolate using different methods.	PPT Video Experiment		
III	Industrial Microbiology (18 hrs)						
	1.	Fermentation and microbes - fermenter and types of fermenters (air-lift fermenter and stirred tank fermenter).	3	Explain the types of fermenters	Lecture, Self learning	MCQ Short test Seminar	
	2.	Production of microbial products: alcohol (ethanol), antibiotics (penicillin), vitamin B ₂ and Vitamin B ₁₂ .	4	Make microbial products	Lecture, Demonstration, Team teaching	Online Assignment	
	3.	Biofertilizers - steps for preparing bacterial biofertilizers.	2	Prepare biofertilizers.	Lecture, Video, Project-based	Formative Assessment II (1,2,3,4, 5,6,) Quiz II	
	4.	Mass cultivation of Cyanobacteria and <i>Azolla</i> . Production of mycorrhizal fungi and VAM fungi.	4	Train and cultivate Cyanobacteria and <i>Azolla</i> , mycorrhizal and VAM fungi	Lecture, Virtual, Experiment		
	5.	Bacterial insecticides – <i>Pseudomonas</i> species and <i>Bacillus</i> species	3	Develop bacterial insecticides	Lecture, PPT, Problem-based		
	6.	Food spoilage and food preservation.	2	Preserve food	Lecture, PPT, Problem-based		
IV	Environmental Microbiology(18 hrs)						
	1.	Drinking water and microbiological analysis of water purity - Coliform test.	4	Analyze the purity of the drinking water	Lecture, Demonstration, Project-based	MCQ Seminar	
	2.	Most Probable Number (MPN) test, Membrane Filter (MF) test, Purification of water	2	Analyze the water using MPN and MF test	Lecture, PPT, Problem-based	Online Assignment	
	3.	Sewage treatment – small scale, Large scale (primary, secondary , and tertiary) treatment	2	Explain sewage treatment	Lecture, Video, Project-based	Formative Assessment II (1,2) Quiz II	
	4.	Biogas production – solubilization, acetogenesis and methanogenesis.	3	Discuss the use and method of production of biogas	Lecture, Video, Quiz		
	5.	Microbial leaching – copper and Uranium leaching.	3	Explain copper and uranium leaching using microbes	Lecture, PPT, Technology-based	Formative Assessment III (3,4,5,6)	
	6.	Biodegradation of petroleum and Xenobiotics.	4	Narrate the biodegradation of petroleum and xenobiotics	Video, PPT, Technology-based		

V Antimicrobial agents, Microbes and diseases (18 hrs)						
1.	Classification, Drug administration.	2	Classify microbial agents and drug usage.	Lecture, Chalk and talk	MCQ Seminar Online Assignment Formative Assessment - III (1,2,3,4, 5,6,7)	
2.	Determining of antimicrobial activity, Mechanism of antimicrobial agent, effectiveness of antimicrobial drugs, Drug resistance, drug dosage.	3	Narrate the mechanism of effectiveness of antimicrobial drugs.	Lecture, Mind map, Problem-based		
3.	Antibacterial drug (penicillin), antifungal drug (nystatin), antiviral drug (amantadine), Current problems of antibiotic resistance in man.	3	Explain the antimicrobial drugs and their resistance.	Lecture, PPT, Project-based, team teaching		
4.	Microbes and diseases- Gnotobiotic animals, distribution of normal microbiota of the human body.	1	Discuss the Gnotobiotic and micro biota of the human body.	Lecture, Group discussion		
5.	Mechanism of microbial pathogenesis, Nosocomial infections.	1	Explicate the mechanism microbial pathogenesis.	Lecture, PPT, Project-based		
6.	Protozoan diseases: Malaria and Amoebiasis, Fungal diseases: Mycotoxicosis and Aspergillosis, Bacterial diseases: Airborne diseases – Meningitis and Streptococcal pneumonia, Food and water borne diseases: Cholera and Typhoid. Soil borne diseases: Tetanus and Anthrax.	5	Elucidate the microbial diseases.	Lecture, PPT, Card method.		
7.	Sexually transmitted and contact diseases – Gonorrhoea and Syphilis, Viral diseases: Ebola, Hepatitis-B, Rabies and AIDS.	3	Give awareness on STD.	Lecture, Video, Case study		

Course instructor
Dr. A. Shyla Suganthi

Head of the Department
Dr. S. Mary Mettilda Bai

Semester : IV
Name of the Course : Ecobiology
Course code : PZ1742

Teaching Plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	I (18 Hrs)					
	1	Introduction: Scope of Ecobiology and need for public awareness.	3	Explain the advantages of being aware of ecobiology concepts.	Lecture, Chalk and talk	Short test, MCQ, Mind map Seminar, Online assignment, Formative assessment I (1,2,3,4,5) Quiz I
	2	Ecosystem: Concepts of ecosystem – structure and functions.	3	Summarize ecosystem and its functions.	Video classes, Lecture.	
	3	Energy flows – single channel energy model, Y - shaped energy flow models.	3	Differentiate between the various models of energy flow.	Lecture, Chalk and talk	
	4	Productivity - Primary production, secondary production, measurement of primary productivity.	4	Summarize productivity and its types.	Lecture, Chalk and talk	
	5	Habitat ecology: freshwater, marine, estuarine, mangrove and terrestrial.	5	Differentiate between the various ecological habitats.	Lecture, Blended learning.	
II	II (18 Hrs)					
	1	Population: Structure and regulation, growth form, population fluctuations, population processes.	4	Summarize the concept of population and various processes associated with it.	Lecture, Chalk and talk	MCQ , Seminar, Online assignment, Formative assessment I (1,2,3) Quiz I Online assignment, Seminar Formative assessment II (4,5) Quiz II
	2	Life table - diagrammatic and conventional life tables, Life history strategies.	3	Explain life table and life history strategies.	Lecture, Chalk and talk	
	3	Community: Concept, basic terms, community structure, composition and stratification.	4	Describe community concept, structure etc.	Lecture. Flipped learning	
	4	Ecological niche, Ecotone and Edge effect, Ecotype.	3	Explain ecological niche and ecotype.	Lecture, Flipped learning	

	5	Ecological succession: types, general process, Concept of climax.	4	Summarize ecological succession.	Lecture, PPT	
III	III (18 Hrs)					
	1	Environment in action: Climatic factors (climate, precipitation, temperature, light, oxygen, carbon dioxide and pH), topographic factors, edaphic factors (soil formation, soil profile, soil organisms).	6	Summarize the various environmental factors	Lecture , Chalk and talk	Short test, MCQ, Mind map Online assignment, Seminar Formative assessment II (1,2,3,4) Quiz II
	2	Biotic factors (symbiosis, commensalism, parasitism and competition).	4	Compare various biotic factors.	Lecture, Flipped learning.	
	3	Biological clock: biological rhythms and mechanism of biological clock.	3	Explain biological clock.	Lecture, PPT	
	4	Natural resource ecology: Concept and classification of resource, mineral resource, land resource, forest resource, water resource, energy resource (conventional and non-conventional).	5	Describe, differentiate and classify natural resources.	Lecture, Chalk and talk	
IV	IV (18 Hrs)					
	1	Biogeochemical cycles: water cycle, carbon cycle, nitrogen cycle, sulphur cycle and phosphorus cycle.	6	Summaries biogeochemical cycles and differentiate them.	Lecture, PPT	Short test, MCQ, Mind map Online assignment, Seminar Formative assessment II (1) Quiz II Formative assessment III (2,3,4,5)
	2	Biogeography: patterns of distribution (continuous, discontinuous, endemic), descriptive zoogeography, zoogeographical regions of the world. Dynamic biogeography (dispersal dynamics, dispersal pathways, migration, ecesis).	5	Explain the patterns of distribution and zoogeography.	Lecture, Flipped learning, Group discussion	
	3	Natural Disasters: Floods, earthquakes, cyclones, landslides, Tsunami, Mitigation and Disaster Management.	5	Evaluating the causes, effects and mitigation strategies for natural disasters.	Lecture, Interactive session.	

	4	Urbanization: Possible advantages of urbanization – problems, solutions.	1	Summarize the advantages, problems and solutions for urbanization.	Lecture, PPT	
	5	Remote sensing and its applications.	1	Describe the applications of remote sensing.	Lecture, Chalk and talk	
V	V (18 Hrs)					
	1	Pollution ecology: Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution, nuclear hazards.	7	Describe the causes, effects and control of pollution	Lecture, Chalk and talk	MCQ, Short test , Online assignment, Seminar Formative assessment III (1,2,3,4)
	2	Greenhouse Gas emission and climate change.	3	Evaluating climate change and possible intervention strategies.	Lecture, Interactive discussion.	
	3	Waste management: solid, liquid and gaseous wastes. E-wastes.	3	Describe the management of wastes.	Lecture, Chalk and talk	
	4	Toxicology: Biomagnification and bioaccumulation, toxicants, classification, toxicity (LC ₅₀ and LD ₅₀), mode of action.	5	Identify toxicants, classify them and describe their mode of action.	Lecture, Chalk and talk	

Course instructor
Dr. Jeni Chandar Padua

Head of the Department
Dr. S. Mary Metilda Bai

Semester : IV
Name of the Course : Biotechnology & Nanobiology
Course code : PZ1743

Teaching Plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Gene cloning (18 hrs)					
	1	Basic steps of gene cloning, restriction and modifying enzymes, linkers and adaptors.	4	Explain gene cloning, restriction and modifying enzymes.	Lecture, Video class	MCQ, Short test,
	2	Cloning and expression vectors, construction of chimeric DNA	4	Analyse construction of chimeric DNA.	Lecture PPT	Seminar, Online Assignment,
	3	Nucleic acid probes, DNA libraries.	3	Gain knowledge on DNA libraries.	Lecture	Formative Assessment I (1,2,3,4,5)
	4	Polymerase chain reaction, molecular markers.	3	Discuss the Polymerase chain reaction and molecular markers.	Lecture, Video class	Quiz I
	5	DNA sequencing, synthesis of oligonucleotides. Human Genome Project.	4	Appreciate human genome project.	Lecture	
II	Animal Biotechnology (18 hrs)					
	1	Primary culture and cell lines; pluripotent stem cell lines; tissue engineering.	4	Appreciate the advances in tissue engineering.	Lecture, Video class	Short test, Mind map, Objective test,
	2	<i>In vitro</i> fertilization and embryo transfer in animals; gene transfer methods.	4	Apply gene transfer methods in producing transgenic species.	Lecture, Video class	Formative Assessment I (1,2,3)
	3	Primary explantation techniques – organ and embryo culture.	3	Explain organ and embryo culture.	Lecture, Group discussion	Quiz I
	4	Transgenic animals and the knockouts.	3	Discuss transgenic animals.	Lecture, video	Formative Assessment II (4, 5)
	5	Biotechnology and aquaculture: ploidy induction, gynogenesis and androgenesis.	4	Describe ploidy induction, gynogenesis and androgenesis.	Lecture, PPT	Quiz II
III	Medical Biotechnology (18 hrs)					
	1	Hybridoma technology and Monoclonal antibodies.	4	Prepare monoclonal antibodies.	Lecture, Video class	Short test, MCQ,

	2	Applications of biotechnology in medicine, Vaccines, diagnostics and forensics.	4	Apply biotechnology in medicine, Vaccines, diagnostics and forensics.	Lecture, Video class	Objective test, Seminar, Online Assignment, Formative Assessment II (1,2,3,4,5), Quiz II	
	3	Enzyme biotechnology: Isolation and purification of enzymes, uses of enzymes in industries, immobilization of enzymes and their uses.	5	Demonstrate immobilization of enzymes and their uses.	Lecture, PPT		
	4	Biosensors. Terminator and traitor technology.	3	Describe the types and applications of biosensors.	Lecture		
	5	Intellectual Property Rights.	2	Gain knowledge on Intellectual Property Rights.	Lecture		
IV	Industrial and Environmental Biotechnology (18 hrs)						
	1	Production of metabolites - Downstream processing and <i>in situ</i> recovery of products.	4	Demonstrate downstream processing.	Lecture, Video class	MCQ, Formative Assessment II (1,2) Quiz II Formative Assessment III (3,4,5)	
	2	Microbial biotransformation, microbial biomass production (SCP).	3	Discuss microbial biotransformation, microbial biomass production.	Lecture, PPT		
	3	Bioremediation and Phytoremediation.	3	Explain the process of bioremediation.	Lecture, Video class		
	4	Genetically engineered microorganisms (GEMs) - treating oil spills, detection of pesticide in soil and their degradation, sequestering heavy metals.	5	Summarizes the importance of GEMs	Lecture, PPT		
	5	Biomining and Biofuels.	3	Explain the production of biomining and biofuels.	Lecture, seminar		
V	Nanomaterials(18hrs)						Short test,
	1	Types and properties, DNA and protein nanoarrays	3	Explain the basics of nanotechnology	Lecture, PPT	Seminar,	
	2	Biosystems (microbes) as nanofactories.	3	Summarize biosystems as nanofactories.	Lecture, Video class	Online Assignment,	

	3	Application of nanotechnology - medical diagnostics, imaging and drug delivery, agro-practices and food related nanoproducts, cosmetics, contact lenses and dental implants.	5	Discuss the applications of nanotechnology.	Lecture, Video class	Formative Assessment III
	4	Nanotechnological approaches for environmental remediation, prevention of contamination, environment maintenance and quality enhancement.	4	Illustrate Nanotechnological approaches for environmental remediation.	Lecture, PPT	
	5	Risks and threats of nanoparticles in environment.	3	Describe Risks and threats of nanoparticles in environment.	Lecture, Group discussion	

Course instructor

Dr. A. Punitha

Head of the Department

Dr. S. Mary Mettilda Bai

Semester : IV
Name of the Course : Medical Entomology
Course code : PZ1745

Teaching plan

Unit	Modules	Topics	Hours	Learning outcome	Pedagogy	Assessment
I	Introduction, Insects of medical importance (18 Hrs)					
	1	Fundamentals and scope of medical entomology.	3	Explain the meaning of terms of entomology.	Lecture, Chalk and talk	Short test, MCQ, Online Assignment, Seminar, Formative Assessment I (1,2,3,4,5), Quiz I
	2	Insects of medical importance: filth breeding insects.	3	Identify the filth breeding insects.	Lecture, PPT, Project.	
	3	Insects of medical importance: venomous insects.	4	Recall venomous insects.	Lecture, PPT, Quiz	
	4	Insects of medical importance: blood sucking insects.	4	Discuss on the blood sucking insects.	Lecture, PPT, You tube learning	
	5	Insects affecting physiology.	4	Explain the mechanism of insect physiology.	Lecture, PPT, Xenography	
II	Life cycle of human parasitic insects (18 Hrs)					
	1	Lice, fleas, mosquitoes, house flies and tsetse fly.	5	Describe the life cycle of human parasitic insects.	Lecture, PPT,	MCQ, Memory matrix, Online assignment, Seminar, Formative Assessment I (1,2,3), Quiz I, Formative Assessment II (4), Quiz II
	2	Immunity to human parasites.	5	Explain the mechanism of immunity to human parasites.	Lecture, PPT, Team teaching	
	3	Host-parasitic relationships.	3	Discuss the host-parasite relationship.	Lecture, PPT	
	4	Ecological adaptive features among human parasites.	5	Discuss different adaptive mechanism of human parasites.	Lecture, PPT, Chalk and talk, Virtual learning	
III						
Vector Entomology (18 Hrs)						
1	Scope of vector entomology	4	Recall vector borne diseases.	Lecture, Self learning	MCQ Short test, Online assignment, Seminar, Formative Assessment II	
2	Vector borne diseases.	3	Explain the transmission of vector borne diseases.	Lecture, Reflective, PPT, Web based		
3	Mechanism of transmission in human beings-mechanical.	5	Differentiate the	Lecture,		

		in human beings- biological, myiasis.		biological and mechanical mode of transmission.	PPT, Andragogy	(1,2,3,4,5) Quiz II
	4	Common vector insects and their identification: mosquitoes, sand flies, black flies, house fly, tsetse fly, human flea and human louse.	6	Recall the common vector insects.	Lecture, PPT, Project	Memory matrix
IV	Medical importance and management (18 Hrs)					
	1	Lice- body, head and pubic louse.	3	Differentiate different louse of human	Lecture, PPT, Project, Discussion	MCQ, Short test, Online assignment, Seminar, Formative Assessment II (1,2) Quiz II, Formative Assessment III (3,4,5)
	2	Fleas- flea nuisance, plague, flea-borne endemic typhus.	3	Discuss flea related diseases	Lecture, PPT, Virtual	
	3	Mosquitoes- nuisance, malaria, filariasis, yellow fever, dengue	4	Recall different mosquito related diseases	Lecture, PPT, Discussion	
	4	House flies- common and greater house fly- typhoid, dysentery, diarrhea, cholera, amoebiasis, gastroenteritis.	4	Differentiate dysentery, diarrhea, cholera and amoebiasis.	Lecture, PPT, Jigsaw	
	5	Tsetse fly- Gambian and Rhodesian sleeping sickness.	4	Discuss the symptoms and treatment for sleeping sickness.	Lecture, PPT	
V	Vector control (18 Hrs)					
	1	Insecticides - use and consequences.	4	Discuss different insecticides.	Lecture, PPT, Discussion	MCQ Short test, Online assignment, Seminar, Formative Assessment III (1,2,3,4,5)
	2	Use of bio-control agents and bio-pesticides.	4	Differentiate bio-pesticides and insecticides.	Lecture, PPT	
	3	Use of bio-control agents - bacillus and predatory fishes.	3	Identify predatory fishes.	Lecture, PPT, Project, Problem	
	4	National programmes related to vector borne diseases- malaria- N.M.E.P., N.M.C.P.	3	Explain different National programmes related to vector borne diseases.	Lecture, PPT, Discussion	
	5	National programmes related to vector borne diseases- filarial- N.F.C.P., N.F.E.P.	4	Explain different National programmes related to vector borne diseases.	Lecture, PPT, Discussion	

Course instructor
Dr. C. Josephine Priyadarshini

Head of the Department
Dr. S. Mary Mettilda Bai

Semester : IV
Name of the Course : Practical IV - Microbiology, Ecobiology & Biotechnology and Nanobiology
Course Code : PZ17P4

Teaching plan

Unit	Modules	Topic	Hours	Learning outcome	Pedagogy	Assessment	
I	Microbiology(30 Hrs)						
	1	Sterilization of glassware.	2	Recall the importance of sterilization of glassware.	Demonstration and practical	Pre-assessment.	
	2	Preparation of culture media.	2	Prepare and select the appropriate culture media.	Demonstration, Practical		Performance-based Assessment.
	3	Isolation of bacteria from soil, air and water.	2	Isolate the bacteria from different samples.	Practical		
	4	Serial dilution – pure culture of bacteria.	4	Culture different bacteria.	Practical	Self-assessment	
	5	Observation of bacterial motility – hanging drop method.	2	Recognize the motility of bacteria.	Demonstration, Practical		
	6	Simple staining of bacteria.	2	Identify bacteria by simple staining.	Demonstration, Practical		
	7	Gram staining of bacteria.	2	Categorize bacteria.	Practical		
	8	Negative staining of bacteria.	2	Spot the bacteria.	Practical		
	9	Methylene blue reductase test for testing the quality of milk.	4	Test the quality of milk.	Demonstration, Practical		
	10	Test for antibiotic sensitivity.	4	Analyze the resistance and sensitivity of the bacteria.	Demonstration, Practical		
11	Charts/ Models <i>Streptococcus, Salmonella, Corynebacterium, Clostridium, Influenza virus, Rabies virus, Hepatitis –B, HIV, Entamoeba, Aspergillus,</i>	4	Discriminate different micro-organism and explain the apparatus used for microbiological studies.	Practical			

		root nodules, <i>Azolla</i> , ocular and stage micrometer, Autoclave, Laminar flow				
II	Ecobiology(30 Hrs)					
	1	Measurement of primary productivity (O ₂ measurement method).	2	Recall primary productivity and its measurement	Practical	Self- assessm ent
	2	Sampling of animal population using quadrat method.	2	Identify various animal population of an area.	Practical	
	3	Observation of life table in an insect.	4	Recognise the stages in the life table of an insect.	Practical	
	4	Collection and identification of freshwater planktons.	4	Identify the different freshwater planktons of an area.	Practical	Perform ance- based Assessm ent.
	5	Measurement of turbidity using Secchi disc.	2	Spot the turbidity of any water body.	Practical	
	6	Determination of LC ₅₀ of a pesticide.	4	Test the LC ₅₀ of a pesticide.	Demonstrati on Practical	
	7	Estimation of H ₂ S in water sample.	2	Identify the H ₂ S content in any water sample.	Practical	
	8	Estimation of salinity in water sample.	2	Test the salinity of a water sample.	Practical	
	9	Estimation of CO ₂ in water sample.	2	Identify the amount of CO ₂ in water sample.	Practical	
	10	Study report of a pond ecosystem.	2	Document on a pond ecosystem that has been visited.	Practical	Model examina tion
	11	Commensalisms (Shark and <i>Echeneis</i>), Mutualism (Sea anemone and Hermit crab).	2	Discriminate between commensalism and mutualism.	Spotters	
12	Food chain, Food web, Conventional energy source (coal) and non-conventional energy source (wind mill).	2	Identify between conventional and non-conventional energy source.	Spotters		
III	Biotechnology and Nanobiology(30 Hrs)					
	1	Extraction of genomic DNA.	4	Isolate the genomic DNA from animal tissue.	Practical	Self- assessm ent
	2	Estimation of DNA (DPA method).	3	Estimate the DNA.		
	3	Agarose gel electrophoresis in	2	Separation of DNA by Agarose gel		

	separation of DNA.		electrophoresis. Agarose gel electrophoresis.		
4	Polymerase Chain reaction.	2	Demonstrate PCR	Demonstration	Performance-based Assessment. Model examination
5	Bacterial culture and antibiotic selection media.	4	Analyze the resistance and sensitivity of the bacteria.	Practical	
6	Immobilization of yeast cells.	2	Prepare Immobilization of yeast cells.		
7	Preparation of wine.	2	Prepare wine from grape fruits.		
8	Estimation of ethanol content in wine.	2	Estimate ethanol.		
9	Production of amylase by bacteria.	4	Isolate bacteria from soil and produce amylase enzyme.		
10	Flow charts/ Instruments/ Figures Plasmid DNA isolation, Insulin production by rDNA Technology, Hybridoma production, Synthesis of DNA nanoarray, Southern blotting, Biosensor (glucometer), Air-lift bioreactor, Buckyballs, Dendrimers.	5	Discriminate molecular technology and bioreactors.	Flow charts, instruments, Figures	

Course instructor

Dr. A. Shyla Suganthi
 Dr. Jeni Chandar Padua
 Dr. A. Punitha

Head of the Department

Dr. S. Mary Mettilda Bai