

**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)**  
**COIMBATORE – 641 028**  
**M.Sc., BIOTECHNOLOGY**  
**SCHEME OF EXAMINATIONS – CBCS PATTERN**  
*(For the students admitted from the Academic year 2016-2017 and onwards)*

CODE NO.	SUBJECT	LECTURE HRS/ WEEK	EXAM DURATION (HRS)	MAX. MARKS			CREDIT POINTS
				IE	EE	TOTAL	
<b>First Semester</b>							
16BTP01	Cell and Molecular Biology	5	3	25	75	100	5
16BTP02	Microbiology	5	3	25	75	100	5
16BTP03	Biochemistry	5	3	25	75	100	5
16BTP09	Practical I - Lab in Microbiology, Biochemistry and Bioprocess Technology	5	-	-	-	-	-
16BTP10	Practical II - Lab in Cell and Molecular Biology and Genetic Engineering	5	-	-	-	-	-
16BTP04	<b>Elective I</b> a) Plant and Animal System Physiology (OR) b) Occupational Health and Industrial Safety	5	3	25	75	100	4
<b>Second Semester</b>							
16BTP05	Genetic Engineering	5	3	25	75	100	5
16BTP06	Research Methodology and Biostatistics	5	3	25	75	100	5
16BTP07	Bioprocess Technology	5	3	25	75	100	5
16BTP09	Practical I - Lab in Microbiology, Biochemistry and Bioprocess Technology	4	6	40	60	100	5
16BTP10	Practical II - Lab in Cell and Molecular Biology and Genetic Engineering	4	6	40	60	100	5
16BTP08	<b>Elective II</b> a) Genomics and Proteomics (OR) b) Bioethics, Biosafety and IPR	5	3	25	75	100	4
16GSP01	<b>Skill Based - Cyber Security</b>	2	-	100	-	100	2

<b>Third Semester</b>							
16BTP11	Immunology and Animal Biotechnology	4	3	25	75	100	4
16BTP12	Pharmaceutical Biotechnology	4	3	25	75	100	4
16BTP13	Plant Biotechnology	4	3	25	75	100	4
16BTP14	Environmental Biotechnology	4	3	25	75	100	4
16BTP18	Practical III - Lab in Immunology, Pharmaceutical and Animal Biotechnology	5	-	-	-	-	-
16BTP19	Practical IV - Lab in Plant Biotechnology and Environmental Biotechnology	5	-	-	-	-	-
16BTP15	<b>Elective III</b> a) Developmental Biology and Behavioral Studies (OR) b) Biotechniques	4	3	25	75	100	4
16BTP16	Institutional Training	-	-	100	-	100	2
<b>Fourth Semester</b>							
16BTP18	Practical III - Lab in Immunology, Pharmaceutical and Animal Biotechnology	5	6	40	60	100	5
16BTP19	Practical IV - Lab in Plant Biotechnology and Environmental Biotechnology	5	6	40	60	100	5
16BTP17	<b>Elective IV</b> a) Food Biotechnology (OR) b) Conservation Biology	5	3	25	75	100	4
16BTP20	Project Work	1	-	50	150	200	4
							<b>90</b>

## REGULATIONS

**1. Breakup Marks for IE (Theory papers)**

One Test	- 5 Marks
Model Exam	- 10 Marks
Assignments	- 5 Marks
Seminar	- 5 Marks
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Total	- 25 Marks
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**Question Paper Pattern for IE Test I**

**(for 50 Marks) (2 hours)**

**Section-A (18 Marks)**

**3 x 6=18 Marks**

Answer **ALL** Questions

**Either or Type**

**ALL questions carry EQUAL Marks**

**Section-B (32 Marks)**

**2 x 16=32 Marks**

Answer any **TWO** Questions out of three questions.

**ALL questions carry EQUAL Marks**

**Total**      **50 Marks**

**Question Paper Pattern for IE Model Exam**

**(for 75 Marks) (3**

**hours)**

**Section-A (30 Marks)**

**5 x 6=30 Marks**

Answer **ALL** Questions

One Question from each unit with **Either or Type**

**ALL questions carry EQUAL Marks**

**Section-B (45 Marks)**

**3 x 15=45 Marks**

Answer any **THREE** Questions out of five questions.

**ALL questions carry EQUAL Marks**

**Total**      **75 Marks**

**2 a) Components for Practical I. E.**

<b>Components</b>	<b>Marks</b>
Test –I	20
Test - II	20
<b>Total</b>	<b>40</b>

**2 b) Components for Practical E. E.**

<b>Components</b>	<b>Marks</b>
Completion of Experiments	50
Record	5
Viva	5
<b>Total</b>	<b>60</b>

**3. Institutional/ Industrial Training, Mini and Major Project Work**

\*<sup>1</sup>Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

<b><u>Institutional / Industrial Training</u></b>		<b><u>Mini Project</u></b>	<b><u>Project Work</u></b>	
<b>Components</b>	<b>Marks</b>		<b>Components</b>	<b>Marks</b>
<i>I.E</i> Work Diary	25	-	<i>I. E</i> a) Attendance Marks	20
Report	50	50	b) Review Marks	30
Viva –voce Examination	25	50		50
<b>Total</b>	<b>100</b>	<b>100</b>		
			<i>E.E</i> <sup>*1</sup> a) Final Report Marks	120
			b) Viva-voce Marks	30
			<b>Total</b>	<b>200</b>

**4. Components for Cyber Security Paper**

<b>Components</b>	<b>Marks</b>
Two Tests (2 x 40)	80
Two assignments (2 x 10)	20
<b>Total</b>	----- <b>100</b> =====

The question paper pattern is as follows:

- a) Test I – 2 hours [4 out of 7 essay type questions] 4 x  
10 = 40Marks
- b) Test II – 2 hours [4 out of 7 essay type questions] 4 x  
10 = 40 Marks

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**Total**  
**= 80 Marks**  
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- The passing minimum for Cyber Security is 50
- In case the candidate fails to secure 50 marks which is the passing minimum, he/she may have to reappear for the same in the subsequent semesters.

**5. Question Paper Pattern for EE Theory hours)**

**(for 75 Marks) (3**

**Section-A (30 Marks)**

**5 x 6=30 Marks**

Answer **ALL** Questions

One Question from each unit with **Either or Type**

**ALL questions carry EQUAL Marks**

**Section-B (45 Marks)**

**3 x15=45 Marks**

Answer any **THREE** Questions out of five questions.

ALL questions carry EQUAL Marks

**Total**

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**75 Marks**  
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<b>Code No.</b>	<b>Subject</b>	<b>Semester No.</b>
16BTP01	CELL AND MOLECULAR BIOLOGY	I
<b>Objective:</b>	To impart knowledge on various aspects of Cell and Molecular Biology which Supports Students to have Solid Foundation in Basic Understanding.	
<b>Unit No.</b>	<b>Topics</b>	<b>Hours</b>
<b>Unit I</b>	<b>Introduction to Different Types of Cells</b> Types of Cells - Prokaryotic and Eukaryotic Cell Structure and Intracellular Organelles – Nucleus, Mitochondria, Chloroplast, Ribosomes, Peroxisomes and Microbodies; Fractionation and Purification of Subcellular Organelles; Molecular Events of Mitosis and Meiosis.	12
<b>Unit II</b>	<b>Cellular Inclusions and Functions</b> Cytoskeleton Cell Motility and Cellular Movements – Microtubules – Microfilament. Protein Localization – Protein Targeting to Various Organelles and Secretion of Proteins by Exocytosis – Receptor Mediated Endocytosis.	12
<b>Unit III</b>	<b>Central Dogma of Cell</b> DNA Replication, RNA Transcription and Processing, Interaction of mRNA, rRNA and tRNA on Protein Synthesis. Mitochondrial Electron Transport System – Oxidative Reactions in Microbodies– Pathways of Photosynthesis – Light and Dark Reactions.	12
<b>Unit IV</b>	<b>Cell Signaling</b> Structure and Functions of Plasma Membrane – Cell Recognition, Cell to Cell Signaling, Surface Receptor and Receptor – Response Mechanisms, Cell Adhesion. Cancer – Characteristics and Causes, Oncogenes and Tumour Suppressor Genes.	12
<b>Unit V</b>	<b>Gene Expression and Development</b> Homeotic Genes in Development - Developmental Pattern of Drosophila and Arabidopsis. Spatial and Temporal Regulation of Gene Expression, Specialized Cell Structure and Function (Muscle Cell, Nerve Cell and Motile Cell).	12

**Text Book:**

1. Darnell Lodish, "Molecular Cell Biology", Baltimore Scientific Books, USA.

**Reference Books:**

1. Alberts Bruce, "Molecular Biology of Cell", Garland Science, New York.
2. Cooper G.M, "The Cell: A Molecular Approach", ASM Press, Ohio.

  
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Code No.	Subject	Semester No.
16BTP02	MICROBIOLOGY	I
<b>Objective:</b>	To provide knowledge on the Fundamentals of Microbiology and to help the students to understand the different fields of Microbiology.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Introduction and Techniques</b> History - Ultra structure of Bacterial Cell – Growth Curve and Growth Kinetics - Physical Factors Influencing Growth - Temperature, pH, Osmotic Pressure, Salt Concentration. Microbial Diversity – Classification of Bacteria, Virus and Fungi. Structure and Working Principle of Bright Field, Dark Field, Phase Contrast and Electron Microscopy. Staining Techniques, Pure culture, Sterilization and Preservation Techniques – Principle and Applications.	12
<b>Unit II</b>	<b>Food Microbiology</b> Normal Microflora in Milk, Meat, Poultry, Eggs, Fruits and Vegetables. Fresh Food - Canned Food and Stored Grains. Milk Quality Tests - Preservation of Food – High Temperature (Boiling, Pasteurization, Appertization) - Low Temperature (Freezing) – Dehydration - Osmotic Pressure. Chemical Preservations, Radiation. Microbiologically Fermented Food: Curd – Cheese – Idli – Yogurt - Acidophilic Milk - Probiotics. Microorganisms as Food – SCP ( <i>Spirulina</i> and Edible Mushrooms). Food Borne Diseases: Botulism – Salmonellosis – Shigellosis.	12
<b>Unit III</b>	<b>Industrial Microbiology</b> Primary and Secondary Screening of Industrially Important Strains - Strain Improvement through Random Mutation (Random & Rational Selection) - Genetic Recombination and Genetic Engineering - Preservation. Microbial Production of Organic Acids - Citric Acid; Antibiotics – Penicillin and Streptomycin; Enzymes - Amylase and Lipase; Vitamin - B12; Alcoholic beverage - Beer; Production of Native and Recombinant Proteins in Bacteria and Yeast - Vaccine Production in Microbes.	12
<b>Unit IV</b>	<b>Agricultural Microbiology</b> Brief account of Microbial Interactions with Plant and Soil; Biological Nitrogen Fixation - Symbiotic and Asymbiotic – Mycorrhizae – Rhizosphere. Biofertilizers: Azotobacter - Azospirillum and BGA. Biological Pest Control, Beneficial Application of <i>Agrobacterium tumefaciens</i> and <i>Agrobacterium rhizogenes</i> . Plant Disease (Brown Spot of Rice, Black Stem Rust of Wheat) - Dissemination and Control.	12
<b>Unit V</b>	<b>Environmental Microbiology</b> Role of Microbes in Biogeochemical Cycle: Carbon – Nitrogen – Phosphorus and Sulphur Cycles. Microbial Applications in Bioremediation and Biodegradation of Xenobiotics - Biofuel Production and Biomining, Waste Water Treatment – Layout - Physical; Chemical and Biological Methods.	12

**Text Book:**

1. Prescott L.M, Harley J.P and Klein D.A, "Microbiology", Tata Mc Graw Hill, New Delhi.

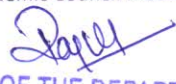
**Reference Books:**

1. Frazier W.C and West Hoff D.C, "Food Microbiology", Tata McGraw Hill Ltd, New Delhi.

2. Stanbury P.F, Whittaker A and Hall S.J, "Principles of Fermentation Technology", Butterworth-Heinemann Publishers, New York.

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Code No.	Subject	Semester No.
16BTP03	BIOCHEMISTRY	I
<b>Objective:</b>	To develop understanding and provide scientific basics of the life processes at the molecular level and to explain the structure, function and inter-relationships of biomolecules.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Atoms, Molecules and Chemical Bonds</b> Classes of Organic Compounds and Functional Groups. Covalent and Non-covalent Interactions - Vander Waal's – Electrostatic – Hydrogen Bonding and Hydrophobic Interactions; Respiration and Photosynthesis. Energy Metabolism (concept of free energy); Principles of Thermodynamics; Kinetics, Dissociation and Association Constants; Bioenergetics.	12
<b>Unit II</b>	<b>Carbohydrates</b> Structure and Classification of Mono, Di and Polysaccharides – Occurrence – Isolation – Purification – Properties and Biological Reactions. Structural Features of Homoglycans, Heteroglycans and Complex Carbohydrates. Glycolysis and TCA Cycle; Glycogen Breakdown and Synthesis; Gluconeogenesis; Interconversion of Hexoses and Pentoses.	12
<b>Unit III</b>	<b>Proteins and Lipids</b> Proteins: Classification – Primary Structure of Proteins – Structural Comparison at Secondary and Tertiary levels (Ramchandran Map) – Conformation of Proteins and Polypeptides (Secondary, Tertiary, Quaternary and Domain Structure) – Protein Folding - Biophysical and Cellular Aspects. Lipids: Structure and Classification – Properties – Oxidation of Fatty acids – Biosynthesis of Fatty acids – Triglycerides.	12
<b>Unit IV</b>	<b>Nucleic Acids</b> Classification – Structure and Properties – Biological Significance of Double Strand – Sequence Dependent Variation in the Shape of DNA. Physical Properties of Double Stranded DNA, Types of RNAs and their Biological Significance. DNA Bending – DNA Supercoiling, Secondary and Tertiary Structural Features and their Analysis. Biosynthesis of Purines and Pyrimidines, Structure of Double Stranded DNA (B, A, C, D, T and Z DNA).	12
<b>Unit V</b>	<b>Enzymes</b> Classification – Regulation of Enzymatic Activity v Enzyme Catalysis in Solution, Kinetics and Thermodynamic Analysis. Active Sites, Enzymes and Coenzymes – Coenzymes Interactions, Activators and Inhibitors – Isoenzymes – Allosteric Enzymes – Ribozyme – Hammer Head – Hair Pin and other Ribozymes – Abzyme: Structure and Drug Targets (Enzymes and Receptors).	12

**Text Book:**

1. Albert L. Lehninger, David L. Nelson and Michael M. Cox. "Lehninger Principles of Biochemistry", W.H. Freeman Publication, New York.


**Reference Books:**

1. Donald Voet and Judith G. Voet, "Biochemistry", J. Wiley & Sons, Publications, New Jersey.

2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes and Victor W. Rodwell, "Harper's Illustrated Biochemistry", Tata McGraw-Hill Publications, New Delhi.

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Code No.	Subject	Semester No.
16BTP04	PLANT AND ANIMAL SYSTEM PHYSIOLOGY	I
<b>Objective:</b>	To make the students understand Plant and Animal cells, its functions and also to provide the basics of Plant and Animal Cell Physiology.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Plant Metabolism</b> Photosynthesis - Electron Transport - CO <sub>2</sub> fixation- C <sub>3</sub> , C <sub>4</sub> and CAM pathways - Respiration and Photorespiration – Solute Translocation through Xylem and Phloem. Plant Hormones: Biosynthesis – Storage - Breakdown and Transport - Physiological Effects and Mechanisms of Action. Structure, Function and Mechanisms of action of Phytochromes - Cryptochromes and Phototropins; Stomatal Movement - Photoperiodism and Biological Clocks.	12
<b>Unit II</b>	<b>Secondary Metabolites and Stress physiology</b> Biosynthesis of Terpenoids – Steroids – Alkaloids - Flavonoids and Phenolic Compounds and their roles. Responses of Plants to Biotic (Pathogen and Insects) and Abiotic (Water, Temperature and Salt) Stresses - Mechanisms of Resistance to Biotic Stress and Tolerance to Abiotic Stress.	12
<b>Unit III</b>	<b>Muscular System:</b> Classification – Structure and Function. <b>Blood and Cardiovascular System:</b> Blood Corpuscles - Blood Groups – Haemoglobin - haemostasis. Comparative Anatomy of Heart Structure, Myogenic Heart - Specialized Tissue - Cardiac Cycle - Heart as a Pump - Blood Pressure.	12
<b>Unit IV</b>	<b>Respiratory System:</b> Anatomy and Structure of Lungs - Transport of Gases - Exchange of Gases – Waste Elimination - Neural and Chemical Regulation of Respiration. <b>Nervous System:</b> Types - Neurons – Synapse. <b>Sense organs:</b> Vision - hearing and tactile response.	12
<b>Unit V</b>	<b>Excretory System:</b> Anatomy and Structure of Urinary System – Micturition - regulation of electrolyte balance and acid-base balance. <b>Endocrinology and Reproduction:</b> Endocrine glands - basic mechanism of Hormone Action - Hormones and Diseases. Reproductive Processes - Neuroendocrine Regulation.	12

**Text Book:**

1. Frank B Salisbury and Cleon Wross, "Plant Physiology", CBS Publishers and Distributors, New Delhi.

**Reference Books**

1. Roy G. Noggle and George J. Fritz, "Introductory Plant physiology", Prentice-Hall of India Pvt.Ltd, New Delhi.

2. Neilson K.S, "Animal Physiology", Cambridge University Press, Pergamon Press, Oxford.

  
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Code No.	Subject	Semester No.
16BTP04	OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY	I
<b>Objective:</b>	The areas covered under this study helps to get knowledge on existing policies/directives for Industrial Occupational Health and Safety Management. It also gives emphasis on prevention and control methods.	
Unit No.	Topics	Hours
Unit I	<b>Parameters of safety</b> Factors affecting the conditions of occupational and Industrial safety - Concept of safety organization and Management - Safety Regulations. Definition and Role of Ergonomics in Designing Work-Place.	12
Unit II	<b>Work Environment</b> Effects of Light – Ventilation – Vibration – Noise. The Work Physiology and their Relevance to Safety - Performance Evaluation of Man - Environment systems.	12
Unit III	<b>Occupational Health and Safety</b> Occupational Health and Hazards – Physical, Chemical and Biological hazards. Occupational Diseases, their Prevention and Control. Health Protection Measures for Workers. Principles of Arthropod Control.	12
Unit IV	<b>Health Education Medical First-Aid and Management of Medical Emergencies Industrial Safety management Techniques</b> Industrial Safety Standards. Accidents-Definition, Frequency Rate, Prevention and Control. Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses.	12
Unit V	<b>Case Study</b> Principles of Functions in Safety Management - Case Study - Visit to an Industry - Preparation of report on safety measures followed in Airport/Industry.	12

**Text Book:**

1. Kolluru R.V. "Environmental Strategies-Hand Book", Mc Graw Hill Inc., New York.

**Reference Books**

1. Walsh W and Russell L, "A B C of Industrial Safety", Pitma Publishing, United Kingdom.

2. Hommedi A.H, "Environmental and Industrial Safety", I.B.B Publication, New Delhi.

  
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Code No.	Subject	Semester No.
16BTP05	GENETIC ENGINEERING	II
<b>Objective:</b>	To impart knowledge on genetic manipulation techniques and its application in producing GMO's.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Gene and Genome</b> Structure of Gene – Gene Structure in Prokaryotes – Operons, Gene Structure in Eukaryotes; Genome Organization - C - Value Paradox; Regulation of Gene Expression – Transcription and Translation in Prokaryotes and Eukaryotes.	12
<b>Unit II</b>	<b>Enzymes in Genetic Engineering</b> Restriction Endonucleases; DNA Modifying Enzymes – Nucleases, Polymerases; Enzymes that Modify Ends of DNA – Alkaline Phosphatase – Polynucleotide Kinase – Terminal Transferase – DNA ligase.	12
<b>Unit III</b>	<b>Vectors</b> Steps in Gene Cloning – Host Cell Types – Prokaryotic Hosts, Eukaryotic Hosts – Vectors - Plasmid Vectors – pBR322 – pUC vectors – Bacteriophage Vectors – Lambda and M13 vectors; Hybrid Vectors – Cosmids – Phagemids. Eukaryotic Vectors – Yeast Vectors – YAC and BAC. Plant Vectors – CaMV – TMV – <i>Agrobacterium mediated</i> Transfer; Animal Vectors – SV40 – Retrovirus – Adenovirus.	12
<b>Unit IV</b>	<b>Cloning Strategy</b> Genomic Library Construction – cDNA Library Construction – Chromosome Walking and Jumping. Methods of Gene Transfer – Transformation – Transduction – Lipofection – Electroporation. Screening of Recombinants – Genetic Methods – Chromogenic Substrate – Nucleic acid Hybridization – Immunological Screening. Blotting Techniques - PCR – RAPD – RFLP – AFLP - CRISPR Tool – NGS.	12
<b>Unit V</b>	<b>Applications of Genetic Engineering</b> Gene Therapy – Germline Gene Therapy – Somatic Cell Line Gene Therapy – <i>In vivo</i> – <i>Ex vivo</i> – Anti-Sense Gene Therapy and Embryo Gene Therapy – Genetic Counseling.	12

**Text Book:**

1. Primrose S.B. "Molecular Biotechnology", Blackwell Scientific Publishers, Oxford.

**Reference Books:**

1. Mickloss D.A and Freyar G.A, "DNA Science: A First Course in Recombinant Technology", Cold Spring Harbor Laboratory Press, New York.

2. Walker M.R and Rapley R. "Route Maps in Gene Technology", Blackwell Science Ltd, Oxford.



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Code No.	Subject	Semester No.
16BTP06	RESEARCH METHODOLOGY AND BIOSTATISTICS	II
Objective:	To enable the students to understand the basic knowledge on thesis writing and problem solving in research.	
Unit No.	Topics	Hours
Unit I	<b>Introduction to research methodology</b> What is Research? Basic and Applied Research - Essential steps in Research - Defining the Research Problem - Research/Experimental Design. Literature Collection - Literature Citation. Research Report – Components – Format of Thesis and Dissertation – Manuscript/Research Article – Review Monographs – Bibliography. Significance of Research, Teaching Learning, Evaluation and Monitoring Process.	12
Unit II	<b>Journals</b> Standard of Research Journals - Impact Factor - Citation Index. Information Retrieval - Access to Archives and Databases – Science Direct – Sciverse – Pubmed - National Informatics Center Network Services – Online Data Base Library. Search Engines – Google.	12
Unit III	<b>Biostatistics</b> Definitions - Scope of Biostatistics – Classification and Tabulation of Data – Graphical and Diagrammatic Representation – Scale Diagrams – Histograms – Frequency Polygon - Frequency Curves. <b>Measures of Central Tendency</b> – Arithmetic Mean – Median and Mode. Calculation of Mean – Median – Mode in Series of Individual Observation Discrete Series – Continuous Open End Classes.	12
Unit IV	<b>Measures of Dispersion</b> Standard deviation and Range, Chi – Square Test, Student - t Test, Regression, Correlation, One Way and Two Way ANOVA. <b>Experimentation Design:</b> Completely Randomized Design – Factorial Design – Plackett - Burman Designs – Response Surface Designs: Central Composite Designs (adapted from Montgomery) and Box-Behnken design.	12
Unit V	<b>Proportion Data and Analysis</b> Examples of Proportion data - MPM-sterility testing of medicines - animal toxicity infection and immunization studies (e.g., LD <sub>50</sub> , ED <sub>50</sub> , PD <sub>50</sub> ) – statistical treatment to proportion data. Introduction to Count data – Examples (bacterial cell count, radioactivity count, colony and plaque count, etc.). Statistical treatment to count data Poisson distribution - standard error -confidence limits of counts. Application of statistical software for biological research.	12

**Text Book:**

1. Duncary P, "Authoring a PhD, Thesis: How to Plan, Draft, Write and Finish a Doctoral Dissertation", Palgrave Macmillan, Australia.

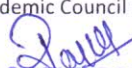
**Reference Books:**

1. Snedecor G.W and Cochran W.G, "Statistical methods", Iowa State Press.USA.

2. Matthews, "Successful Scientific writing: A step-by-step Guide for Biomedical Scientists", Cambridge University Press.

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Code No.	Subject	Semester No.
16BTP07	BIOPROCESS TECHNOLOGY	II
<b>Objective:</b>	To impart knowledge on Design and Operation of Fermentation Processes with its entire prerequisite and to endow the students with the basics of Microbial Kinetics, Metabolic Stoichiometry and Energetics.	
Unit No.	Topics	Hours
Unit I	<b>Introduction to Bioprocess Engineering</b> Fermentation – a Historical Perspective. Sources of Industrially Important Microbes for Fermented Products – Antibiotics – Vitamins – Enzymes – Organic Acids. Biotechnology and Bioprocess Engineering – Bioprocess Regulatory Constraints – Cell Construction. Substrate for Fermentation – Media Formulation - Cell Nutrients. Stoichiometry of Microbial Growth and Product Formation.	12
Unit II	<b>Bioreactor - Designs</b> Introduction to Fermentation Process – Types of Fermentation – Batch – Fed Batch – Continuous. Sterilization, Thermal Death Kinetics. Design of Continuous Sterilization Process, Fibrous Filters. Bioreactor Design, Parts and their Functions, Alternative Vessel Designs – CSTR – Tower – Airlift – Loop Jet – Bubble Column – Packed Bed. Immobilized Cells.	12
Unit III	<b>Kinetic Studies</b> Microbiology of Industrial Fermentation – Fermentation Kinetics – Rheological properties of the Medium – Theory of Mixing. Oxygen Transfer Rate – Oxygen Transfer Coefficient and Correlation. Biological Heat Transfer and Heat Transfer Coefficient – Mass Transfer.	12
Unit IV	<b>Control and Monitoring</b> Different types of Instrumentation, Common Measurement and Control Systems – Additional Sensors – Feedback Control – pH – Temperature – Agitation – Aeration – O <sub>2</sub> – Anti Foam – Baffles – Sparger and On/Off Valves - PID Control – Computers in Bioprocess Control Systems – Biosensors in Bioprocess Monitoring and Control.	12
Unit V	<b>Downstream Processing</b> Filtration – Removal of Microbial Cells – Cell Disruption: Enzymatic, Chemical and Physical Methods; Purification of Fermentation Products - Precipitation Methods, Membrane Process. Centrifugation – Ultracentrifugation; Chromatography - Ion Exchange and Gel Permeation Chromatography – HPLC. Crystallization – Drying – Lyophilisation - Packaging and Quality Assurance.	12

**Text Book:**


1. Michael L. Shuler and Fikret Karg, "Bioprocess Engineering Basic concepts", Prentice Hall International services, New Jersey.

**Reference Books:**

1. El-Mansi E.M.T and Bryce C.F.A, "Fermentation Microbiology and Biotechnology", Taylor & Francis, London.
2. Wulf Crueger and Anneliese Crueger, "Biotechnology-A Textbook of Industrial Microbiology", Panima Publishing Corporation, New Delhi.

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<b>Code No.</b>	<b>Subject</b>	<b>Semester No.</b>
16BTP08	GENOMICS AND PROTEOMICS	II
<b>Objective:</b>	To enable the students to understand the concepts of gene, protein and its applications in drug designing.	

Unit No.	Topics	Hours
<b>Unit I</b>	<b>Genome Mapping, Assembly and Comparison</b> Genome mapping - Genome sequencing - Genome sequence assembly: Base calling and assembly programs - Genome annotation: Gene ontology - Automated genome annotation - Annotation of hypothetical proteins and Genome economy. Comparative genomics: Whole genome alignment - Finding a minimal genome - Lateral gene transfer - Within-genome approach and Gene order comparison.	12
<b>Unit II</b>	<b>Functional Genomics</b> Sequence based approaches: EST - EST index construction and SAGE. Microarray based approaches: Oligonucleotide design - Data collection - Image processing - Data transformation and normalization - Statistical analysis to identify differentially expressed genes and Microarray data classification - Comparison of SAGE and DNA Microarrays.	12
<b>Unit III</b>	<b>Proteomics</b> Technology of protein expression analysis: 2D-PAGE - Mass spectrometry protein identification - protein identification through database searching - Differential in-gel electrophoresis and Protein Microarrays. Post translational modification: Prediction of disulphide bridges and Identification of posttranslational modifications in proteomics analysis - Protein sorting.	12
<b>Unit IV</b>	<b>Protein-protein interactions</b> Experimental determination of protein-protein interaction - Prediction of protein-protein interactions: prediction interactions based on domain fusion - gene neighbors - sequence homology - phylogenetic information and prediction interactions using hybrid methods.	12
<b>Unit V</b>	<b>Applications of proteomics</b> Medical proteomics - disease diagnosis: Biomarkers - Biomarker discovery using 2D GE and mass spectrometry - pattern profiling using protein chips. Pharmaceutical proteomics - drug development - The role of proteomics in target identification and target validation - Proteomics in the development of lead compounds and Proteomics in clinical development.	12


**Text Book:**

1. Xiong J, "Essential Bioinformatics", Cambridge University Press, UK.

**Reference Books:**

1. Goodman N, "Biological data becomes computer literature: New Advances in Bioinformatics", Curr. Opin. Biotechnol, India.

2. Hagen J.B, "The Origin of Bioinformatics", Nat. Rev. Genetics, USA.

  
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Code No.	Subject	Semester No.
16BTP08	BIOETHICS, BIOSAFETY AND IPR	II
<b>Objective:</b>	To make the students understand the advantages and disadvantages of biotechnological applications, ethical implications and intellectual property rights.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Bioethics</b> Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics –benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and Biowarfare.	12
<b>Unit II</b>	<b>Ethics on GMO's</b> Ethical implications of cloning: Reproductive cloning - therapeutic cloning. Ethical, legal and socioeconomic aspects of gene therapy - germ line – somatic - embryonic and adult stem cell research. GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project.	12
<b>Unit III</b>	<b>Biosafety</b> Introduction to biosafety – biosafety issues in biotechnology – risk assessment and risk Management. Safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment.	12
<b>Unit IV</b>	<b>Intellectual Property Rights</b> Introduction to intellectual property and intellectual property rights – types: patents, copy rights, Trade marks, design rights, geographical indications – importance of IPR - world intellectual Property organization (WIPO).	12
<b>Unit V</b>	<b>Patent</b> What can and what cannot be patented? – Patenting life – legal protection of biotechnological Inventions – Patenting in India: Indian patent act.	12

**Text Book:**

1. Jose Cibelli, Robert P. lanza, Keith H.S, Campbell, Michael D.West, "Principles of cloning", Academic Press, USA.

**Reference Books:**

- <http://books.cambridge.org/0521384737.html>.
- <http://online.sfsu.edu/%7Erone/GEessays/gedanger.html>.

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*Rajeev*

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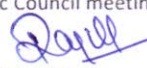
Code No.	Subject	Semester No.
16BTP09	<b>PRACTICAL I - LAB IN MICROBIOLOGY, BIOCHEMISTRY AND BIOPROCESS TECHNOLOGY</b>	<b>I &amp; II</b>
<b>Objective:</b>	To enable the students to understand the basic techniques and applications in Microbiology, Biochemistry and Bioprocess Technology.	
<b>Topics</b>		
<p><b>Microbiology</b></p> <ol style="list-style-type: none"> <li>1. Microscopy- Light, SEM, TEM, Fluorescent, Inverted Microscope.</li> <li>2. Isolation of Microbes from Soil, Contaminated Food, Industrial Waste.</li> <li>3. Staining of Bacteria: Simple, Grams, Endospore, Flagellar Staining.</li> <li>4. Staining of Fungi - Lacto Phenol Cotton Blue Method.</li> <li>5. Isolation, purification and biochemical identification of Bacteria.</li> <li>6. Antibiotic sensitivity test.</li> <li>7. Maintenance and storage of Bacterial strains.</li> <li>8. IMVIC Test.</li> </ol> <p><b>Biochemistry</b></p> <ol style="list-style-type: none"> <li>9. Estimation of Reducing Sugars by Nelson - Somogyi method.</li> <li>10. Estimation of Total Carbohydrates by Anthrone method.</li> <li>11. Estimation of Acid Value, saponification value, Iodine number of fat.</li> <li>12. Estimation of Total Free Amino Acids.</li> <li>13. Protein Estimation by Lowry's Method and Bradford method.</li> <li>14. Separation of LDH Isozymes from Serum by SDS-PAGE.</li> <li>15. Paper Chromatography - Separation of Pigments.</li> <li>16. Thin Layer Chromatography - Separation of Amino Acids.</li> <li>17. Ion Exchange Chromatography.</li> <li>18. Gel permeation Chromatography.</li> <li>19. Estimation of Ascorbic Acid and Riboflavin.</li> <li>20. Estimation of Calcium and Iron.</li> </ol> <p><b>Bioprocess Technology</b></p> <ol style="list-style-type: none"> <li>21. Fermentor – Design and Working Principle.</li> <li>22. Citric Acid Production.</li> <li>23. Amylase Production.</li> <li>24. Wine Production.</li> <li>25. Antibiotic Production.</li> </ol>		

**Reference Books:**

1. Sadasivam S and Manickam A, "Biochemical Methods", Reprint New age international (P) Ltd, New Jersey.
2. Kanika Sharma, "Manual of Microbiology Tools and Techniques", Ane Books Kolkatta.
3. Stanbury P.F, Whittaker A and Hall S.J, "Principles of Fermentation Technology", Butterworth-Heinemann Publishers, New York.

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Code No.	Subject	Semester No.
16BTP10	<b>PRACTICAL II - LAB IN CELL AND MOLECULAR BIOLOGY AND GENETIC ENGINEERING</b>	<b>I &amp; II</b>
<b>Objective:</b>	To enable the students to understand the techniques involved in cell biology and genetic material isolation and various methodology in Genetic Engineering.	
<b>Topics</b>		
<p><b>Cell and Molecular Biology</b></p> <ol style="list-style-type: none"> <li>1. Identification of Cell Types – Plant, Animal and Microbes.</li> <li>2. Fractionation of Cellular components – Nucleus, Mitochondria, Chloroplast.</li> <li>3. Mitotic Preparation - Onion Root Tip.</li> <li>4. Identification of Barr Bodies.</li> <li>5. Mounting of Polytene Chromosome from Chironomous Larvae.</li> <li>6. Cell Permeability.</li> </ol> <p><b>Genetic Engineering</b></p> <ol style="list-style-type: none"> <li>7. Isolation of Genomic DNA from Bacteria and Animal Tissue - Purification and Quantification.</li> <li>8. Agarose Gel Electrophoresis.</li> <li>9. Isolation of Plasmid DNA from Bacteria.</li> <li>10. Restriction Digestion and Ligation of Lambda phage DNA and Gel Analysis.</li> <li>11. Transformation of Plasmid DNA in <i>E.coli</i>, Expression and Selection.</li> <li>12. Polymerase Chain Reaction.</li> <li>13. Southern Hybridization using Non-Radioactive Detection.</li> <li>14. Northern Blotting.</li> <li>15. RAPD.</li> <li>16. Western Blotting.</li> </ol>		

**Reference Books:**

1. Sandhya Mitra, "Genetic Engineering Principles and Practice", Macmillan, India.
2. Joseph Sambrook, Fritsch E.F, Tom M and Chris N, "Molecular Cloning: A Laboratory Manual", Cold Spring Harbor Laboratory, New York.

  
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Code No.	Subject	Semester No.
16BTP11	IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY	III
<b>Objective:</b>	To impart knowledge on structure, functions of Immune System and Animal Tissue Culture techniques involved in Animal Biotechnology.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Antigen and Antibody</b> Antigens - Types. Antibodies: Structure and Types. Cells involved in Immune System – Primary and Secondary Lymphoid Organs - MHC Molecules - Antigen Presentation, B cell and T Cell Activation, Structure and Components of Cytokines and Complement Activation and Regulation.	9
<b>Unit II</b>	<b>Antigen – Antibody Reactions</b> ABO Blood Grouping – Hybridoma Technology – Production of Monoclonal Antibodies - Auto Immunity – Transplantation - Hypersensitivity and its Types – Immune Tolerance – Recombinant Vaccines – Peptide and DNA Vaccines – Synthetic Vaccines – <i>in vitro</i> Tests: Precipitation – Immunoelectrophoresis – RIA and ELISA.	9
<b>Unit III</b>	<b>Animal Tissue Culture</b> Tissue Culture Media – Sterilization Technique and Contamination: Sources – Types of Cell - Steps involved in Primary cell culture - Isolation of Tissue – Subculture and maintenance. Cell Line: Characterization – Morphology – Chromosome Analysis – DNA, RNA and Protein Content - Immortalization – Aberrant Growth Control – Cell counting – Plating Efficiency – Labeling Index – Generation Time of established cell line; Recent issues on research in cell lines.	10
<b>Unit IV</b>	<b>Cytotoxicity</b> Measurement of Cytotoxicity: Viability – Survival and Variable Parameters – Cell Proliferation Assays – Metabolic Cytotoxicity Assays – Microtitration Assays – Microtitration and Clonogenic Survival – Drug Interaction: Mutagenesis Assay by Sister Chromatid Exchange – Applications of Cytotoxicity Assays. Apoptosis and its determination – Necrosis; Difference between Apoptosis and Necrosis.	10
<b>Unit V</b>	<b>Application of Animal Biotechnology</b> Transgenic Animals: Production Methodology - Embryonic Stem Cell Method - Microinjection Method - Applications of Transgenic Animals - in Therapeutic Protein Production – Live Stock Improvement – Transgenic Animals as Disease Models – <i>in vitro</i> Fertilization and Embryo Transfer: Composition of IVF Media, Steps involved in IVF – Fertilization by means of Micro Insemination – PZD – ICSI – SUZI – MESA. Engineered Cell Culture as source of Valuable Products - Ethical issues in Animal Biotechnology.	10

**Text Book:**

1. Das H.K. "Textbook of Biotechnology", John Wiley publication, New Jersey.

**Reference Books:**

1. Ivan Riot, "Essentials of Immunology", Blackwell Scientific Publications, Oxford.

2. Ed. Jennie P.Mather, "Methods in cell biology: Animal cell culture methods". David Barnes, Academic press, USA.

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Code No.	Subject	Semester No.
16BTP12	PHARMACEUTICAL BIOTECHNOLOGY	III
<b>Objective:</b>	To impart basic concepts of Drug Metabolism and Pharmacokinetics. Manufacturing Principles, Product Development and its Quality.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Introduction to Pharmaceutical Biotechnology</b> History of pharmaceutical industry - Drugs discovery – Pharmacopoeia - Development phases and Drug Manufacturing Process - Drugs and Cosmetics Act and Regulatory Aspects. Generics - Definition and its advantages - Biogenerics and Biosimilars. Sources of Drugs - Animal, Plant and Microbial Origin - Drug Metabolism - Physico-Chemical Principles - Pharmacokinetic Action of Drugs in Human Bodies.	10
<b>Unit II</b>	<b>Guidelines</b> Good Microbiological and Good Laboratory Practice (GMP and GLP) - Basic Principles of Quality Control (QC) and Quality Assurance (QA) - Guidelines for QA and QC. Raw Materials – Sterilization – Media - Stock Cultures - Role of Culture Collection Centre - Public Health Laboratories and Regulatory Agencies. Biosafety Guidelines - Risk and Risk Assessment - Biosafety Levels - Laboratory Biosecurity Concepts. Toxicity Testing - Estimation of toxicity: LD <sub>50</sub> and ED <sub>50</sub> .	9
<b>Unit III</b>	<b>Advanced Pharmaceutical Biotechnology</b> Recombinant Therapeutic Proteins - Erythropoietin (EPO) - Colony stimulating Factors (CSFs) - Human Growth Hormone (hGH) – Insulin - Hepatitis B Vaccine – Factor VIII - Interferons (IFN) - Cytokines - DNA Vaccines - DNA Vaccine Construction and Immunology of DNA Vaccine - Delivery of DNA Vaccines. Peptide vaccine - Gene Pharming - Pharmacogenomics and biomarkers.	10
<b>Unit IV</b>	<b>Stability and Validation Studies of Biotech derived products</b> Basic Concept and Objectives - Effects of Various Environmental /Processing on Stability of the Formulation - Techniques for Stabilization of Product with Emphasis on Matrixing Bracketing Techniques - Climatic Zones. Biotech Process Validation: Concept - Cell Lines Culture Process Validation and Characterization - Purification Process for Viral Clearance - Validation of Recovery – Cleaning – Filtration. Issues of DNA Vaccines and Plasmid DNA Vaccines.	10
<b>Unit V</b>	<b>Drug Designing and Business Biotechnology</b> Introduction to Drug Designing and Search of Database - Information Resources for Genes and Proteins – Phylogenetics Methods - DNA Microarrays. IPR - Patents (process patent and product patent) – Marketing - Regulatory Requirements.	9

**Text Book:**

1. Daan Crommelin and Robert D. Sindelar, "Pharmaceutical Biotechnology", Taylor and Francis Publications, London.

**Reference Books:**

1. Leon Lachman, Herbert A. Lieberman, Joseph L. Kanig, "The Theory and Practice of Industrial Pharmacy", Lea & Febiger, Philadelphia, USA.
2. Allen Loyd V, "Remington: The Science and Practice of Pharmacy", Pharmaceutical Press, Great Britain.

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Code No.	Subject	Semester No.
16BTP13	PLANT BIOTECHNOLOGY	III
<b>Objective:</b>	On successful completion of the course, students will be aware of various <i>in vitro</i> culture techniques, Preservation of plant cells, Gene transferring mechanisms and Transgenesis.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Plant Tissue Culture</b> Conventional Plant Breeding methods - Selection, Hybridization, Mutation. Tissues Culture Media - Composition and Preparation; Micropropagation- Callus Culture and Suspension Culture - Somaclonal Variation - Somatic Embryogenesis - Embryo Culture.	10
<b>Unit II</b>	<b>Plant Hybrid Production</b> Protoplast isolation and Somatic Hybridization – Cybrids - Haploid Plants Artificial Seeds and Hardening. Molecular Marker Aided Breeding – RFLP - RAPD – AFLP – SCAR - CAPS and SRAPC - Marker Aided Selection. Arid and Semi Arid Technology - Green House Technology.	9
<b>Unit III</b>	<b>Plant Transformation Technology</b> Genome Organization – Mitochondria – Chloroplast - T- DNA. Gene Expression and Regulation. Ti and Ri plasmids - Binary and Co-Integrated Vector Systems - Viral Vectors and their Applications - 35S and other Promoters - Marker Genes - Reporter Genes. Gene Transfer Methods in Plants – Direct DNA Transfer methods - <i>Agrobacterium</i> Mediated. Nuclear Transformation - Chloroplast Transformation.	10
<b>Unit IV</b>	<b>Plant Recombinant Technology</b> Particle Bombardment – Electroporation – Selection of Clones. Application of Genetic Transformation techniques for Improving Productivity and Performance of Plants: Herbicide Resistance - Insect Resistance - Virus Resistance - Disease Resistance - PR Proteins - Antifungal Proteins - Abiotic Stress Tolerance - Long Shelf Life of Fruits and Flowers.	10
<b>Unit V</b>	<b>Applications</b> Extraction and Purification of Phyto-Chemicals - Phytoremediation - Industrial Phytochemical Products from Plants: Alkaloids - Therapeutic Proteins - Herbal Drugs - Bioethanol and Biodiesel.	9

**Text Book:**

1. Chawla H.S, "Introduction to Plant Biotechnology", Science Publishers, New York.

**Reference Books:**

1. Sathya Narayana U, "Text book of biotechnology", Books and Allied Ltd, Bangalore, India.

2. Mantel S.H, Mathews J.A and Mickee R.A, "Elementary of Plant Breeding: An Introduction to genetic engineering in plants", Blackwell Scientific Publishers, London.

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Code No.	Subject	Semester No.
16BTP14	ENVIRONMENTAL BIOTECHNOLOGY	IV
<b>Objective:</b>	To study the interrelationship between living organism and environment, to get an idea about the hazards of Environment and to find out the solutions to protect the environment.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Basic Concepts</b> Interactions between Environment and Biota - Limiting Factor - Energy Flow - Food Chain - Food Web and Tropic Levels - Ecological Pyramids. Biotic Community – Concept – Structure – Dominance - Fluctuation and Succession - Population Ecology.	9
<b>Unit II</b>	<b>Ecosystem Dynamics and Management</b> Stability and Complexity of Ecosystems - Speciation and Extinctions - Environmental Impact Assessment - Conservation Strategies - Sustainable Development - Global Environmental Problems: Ozone Depletion - Green House Effect and Acid Rain.	9
<b>Unit III</b>	<b>Environmental pollution</b> Types of Pollution - Methods for the Measurement of Pollution - Methodology of Environmental Management – the Problem Solving Approach, its Limitations - Air Pollution and its Control Through Biotechnology - Kind of Aquatic Habitats (fresh and marine) - Distribution and Impact of Environmental Factors on the Aquatic Biota – Productivity - Mineral Cycles and Biodegradation - different Aquatic Ecosystems.	10
<b>Unit IV</b>	<b>Xenobiotics Management</b> Ecological Considerations - Decay Behavior and Degradative Plasmids – Hydrocarbons - Substituted Hydrocarbons - Oil Pollution – Surfactants – Pesticides - Biopesticides in Integrated Pest Management - Bioremediation of Contaminated Soils and Wastelands – Bioleaching - Solid Waste: Sources and Management (Composting, Vermiculture and Methane Production).	10
<b>Unit V</b>	<b>Waste Water Management</b> Waste Water Collection - Physico-Chemical Properties of Water - Physical, Chemical and Biological Treatment Processes - Activated Sludge - Oxidation Tank - Trickling Filter – Towers - Rotating Discs - Rotating Drums - Oxidation Ponds - Anaerobic Digestion - Anaerobic Filters - Up Flow Anaerobic Sludge Blanket Reactors. Treatment Processes for Waste Waters of Dairy – Distillery – Tannery – Sugar - Antibiotic Industries.	10

**Text Book:**

1. Alan Scragg, "Environmental Biotechnology", Pearson Education Limited, England.

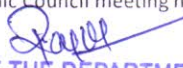
**Reference Books:**

1. Jogdand S.N, "Environmental Biotechnology", Himalaya Publishing House Pvt. Ltd, New Delhi.

2. Metcalf and Eddy, "Wastewater Engineering – Treatment, Disposal and Reuse", McGraw publications, New Delhi.

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Code No.	Subject	Semester No.
16BTP15	DEVELOPMENTAL BIOLOGY AND BEHAVIORAL STUDIES	III
<b>Objective:</b>	To impart knowledge on the steps involved in the developmental biology and also to impart knowledge on how evolutionary principles can be applied to understand human behavior.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Basic Concepts of Development</b> Potency – commitment – specification – induction – competence - determination and differentiation - morphogenetic gradients - cell fate and cell lineages - stem cells - genomic equivalence and the cytoplasmic determinants – imprinting - mutants and transgenics in analysis of development.	9
<b>Unit II</b>	<b>Gametogenesis, Fertilization and Early Development</b> Production of gametes - cell surface molecules in sperm-egg recognition in animals - embryo sac development - zygote formation – cleavage – blastulation - gastrulation and germ layers in animals. <b>Morphogenesis and Organogenesis in Plants:</b> Organization of seed germination – shoot - root and leaf development - transition to flowering and floral development in <i>Arabidopsis</i> and <i>Antirrhinum</i> .	10
<b>Unit III</b>	<b>Morphogenesis and Organogenesis in Animal</b> Axes and pattern formation in amphibia and chick. Organogenesis – eye lens induction - limb development and regeneration in vertebrates; differentiation of neurons. Post embryonic development - larval formation – metamorphosis - environmental regulation for normal development and sex determination. Mechanism of Apoptosis – Necrosis – Autophagy - Atrophic Factors - Tissue Infiltration - aging and senescence.	10
<b>Unit IV</b>	<b>Introduction to Evolution and Origin of Cells</b> Lamarck; Darwin – concepts of variation – struggle - fitness and natural selection - the evolutionary synthesis. Origin of basic biological molecules - abiotic synthesis of organic monomers and polymers - concept of Oparin and Haldane - experiment of Miller (1953) - evolution of prokaryotes - evolution of unicellular eukaryotes.	9
<b>Unit V</b>	<b>Brain, Behavior Relationship</b> Approaches and methods in study of behavior - proximate and ultimate causation - altruism and evolution - group selection, kin selection, reciprocal altruism - Social communication - social dominance - use of space and territoriality - mating systems - parental investment and reproductive success - parental care - aggressive behavior – migration - orientation and navigation.	10

**Text Book:**

1. Mohan P Arora, "Evolutionary Biology", Himalaya Publishing House, Mumbai, India.

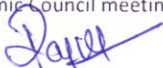
**Reference Books:**

1. GERAL P. Schatten, "Current topics in Developmental Biology", Academic Press, USA.

2. Wallace A, "The origin of animal body plans: A study in Evolutionary Developmental Biology", Cambridge University Press, Cambridge

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Code No.	Subject	Semester No.
16BTP15	BIOTECHNIQUES	III
<b>Objective:</b>	This course presents the principles and applications of Biotechnology explaining the biomolecules and applications of biophysical methods.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Histochemical and Immunotechniques</b> Antibody generation - detection of molecules using ELISA – RIA - western blot – immunoprecipitation - flow cytometry and immunofluorescence microscopy. Detection of molecules in living cells - <i>in situ</i> localization by techniques such as FISH and GISH.	9
<b>Unit II</b>	<b>Biophysical Methods</b> Analysis of biomolecules using UV/visible – fluorescence - circular dichroism - NMR and ESR spectroscopy - structure determination using X-ray diffraction and NMR; analysis using light scattering - different types of mass spectrometry and surface plasma resonance methods.	10
<b>Unit III</b>	<b>Radiolabeling Techniques</b> Properties of different types of radioisotopes normally used in biology - their detection and measurement - incorporation of radioisotopes in biological tissues and cells - molecular imaging of radioactive material - safety guidelines.	10
<b>Unit IV</b>	<b>Microscopic Techniques</b> Visualization of cells and subcellular components by light microscopy - resolving powers of different microscopes - microscopy of living cells - scanning and transmission microscopes - Different fixation and staining techniques for EM - freeze-etch and freeze-fracture methods for EM - image processing methods in microscopy.	10
<b>Unit V</b>	<b>Electrophysiological Methods</b> Single neuron recording - patch-clamp recording – ECG - Brain activity recording - lesion and stimulation of brain - pharmacological testing – PET – MRI – fMRI – CAT.	9

**Text Book:**

1. Sawhney S.K and Randhir Singh, "Introductory Practical Biochemistry", Narosa Publishing House, New Delhi.

**Reference Books:**

1. Gedder A and Balsar L.E, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, America.

2. Boyer, Rodney F. Benjamin and Cummins, "Modern Experimental Biochemistry", Addison Wesley Longman, San Francisco.



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Code No.	Subject	Semester No.
16BTP17	FOOD BIOTECHNOLOGY	IV
<b>Objective:</b>	To enable the students to understand the concepts of food preservation, production, management and packaging and its role in biotechnology.	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Food Production Technology</b> Storage - handling and Production of fruits and vegetable juices - Preparation of jam – jelly - marmalade and tomato products (sauce and ketchup), Production of pectin, vitamins from apple pomace; milk - Composition and Varieties – Pasteurization (LTLT and HTST), sterilization and UHT techniques; Processing of Milk and Milk products – Cheese, Yogurt including probiotic dairy products, Cream, butter, ghee, Ice-cream, Infant formulae, Milk powder, SCM. Non-alcoholic beverages, Processing of tea - coffee and cocoa.	12
<b>Unit II</b>	<b>Preservation Technology</b> Introduction to food preservation – Objectives and techniques - Canning - spoilage in canned foods. Dehydration and drying of food items - Low temperature preservation: cold storage - cold chain – freezing (including cryogenic freezing). Preservation by fermentation: curing and pickling. Non-thermal (e.g. high pressure processing) and minimal processing technologies - Ionization radiation. Use of preservative in foods: chemical preservative – biopreservatives.	12
<b>Unit III</b>	<b>Food Analysis Technology</b> Major ingredients present in different product - Food additives: colour - flavour, vitamins - Microbial and Chemical safety of food products (heavy metal, fungal toxins, pesticide and herbicide contamination). Hygiene and sanitation requirement in food processing and fermentation industries; Cleaning - sanitizing & pest control in food processing - storage and service areas.	12
<b>Unit IV</b>	<b>Quality control and Management</b> Definition - Quality specifications and quality attributes of different foods. Quality control programs: History and development - Total quality control and management. Quality assurance - ISO 9000 series. Food laws and regulations: PFA – FPO – MFPO - Essential Commodities Act - Sugarcane (control) Order – FSSA. Food Safety Management Systems: Pre-requisites of HACCP - ISO 22000.	12
<b>Unit V</b>	<b>Packaging</b> Functions of packaging - Type of packaging materials - Selection of packaging material for different foods - Selective properties of packaging film - Methods of packaging and equipment used - Printing of packages - Barcodes & other marking - Packaging regulations - Packaging and food preservation - Disposal of packaging materials - Rigid and semi rigid containers - Flexible containers; Sealing equipment – Labelling - Aseptic and shrink packaging.	12

**Text Book:**

1. Ralph Early, "Guide to Quality Management system for the food industry", Springer Publications, USA.

**Reference Books:**

1. Sara J. Risch and Joseph H. Hotchkiss. "Food and Packaging Interactions", American Chemical Society, Washington DC.

Desrosier W, "Technology of Food Preservation", CBS Publishers, New Delhi

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**COIMBATORE - 641 028.**

Code No.	Subject	Semester No.
16BTP17	CONSERVATION BIOLOGY	IV
<b>Objective:</b>	Helps to impart knowledge on ecological and evolutionary interactions between organisms and their environment	
Unit No.	Topics	Hours
<b>Unit I</b>	<b>Biodiversity; Species Concepts; Animal Diversity</b> What is Biodiversity - Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - Animal diversity: (Distribution, inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region).	12
<b>Unit II</b>	<b>Loss of Animal Diversity, Status of Species Extinctions</b> Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction - threats to wildlife (examples) - Habitat loss, degradation and fragmentation. Threats to animal diversity in India - Status of species: Rare - endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.	12
<b>Unit III</b>	<b>Conservation: Tools In Animal Conservation</b> What is conservation biology? - <i>In situ</i> and <i>Ex situ</i> conservation of Indian animals (Case studies) - Population management - Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) - <b>Tools in Conservation:</b> Interpretation of various data on wildlife - GIS - remote sensing - Landscape model – PVA and CAMP processes.	12
<b>Unit IV</b>	<b>Animal Laws And Policies In India; Economics of Biodiversity Conservation</b> Wildlife Protection Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity - International Trade in endangered species - Zoo policy - Laws and their applications in Zoological parks - wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.	12
<b>Unit V</b>	<b>Conservation Education and Awareness</b> Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information – Wildlife – nature - environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India - Biotechnology in conservation.	12

**Text Book:**

1. Primack R.B. "Essentials of Conservation Biology", Sinauer Associates, USA.


**Reference Books:**

1. Meffe G.K and Carroll C.R. "Principles of Conservation Biology", Sinauer Associates, USA.

2. Groom Bridge B. "Global Biodiversity: Status of the Earth's Living Resources", Chapman and Hall, London.

BOS Meeting approved:

Approved in First Academic Council meeting held on 09-07-2016

  
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Code No.	Subject	Semester No.
16BTP18	PRACTICAL III - LAB IN IMMUNOLOGY, PHARMACEUTICAL AND ANIMAL BIOTECHNOLOGY	III & IV
<b>Objective:</b>	To give laboratory training in different Immunotechniques, Pharmaceutical techniques and also to provide the fundamentals of Animal Cell Culture.	
<b>Topics</b>		
<b>Immunology</b>		
<ol style="list-style-type: none"> <li>1. Demonstration of animal handling for experimental purposes, cervical dislocation, dissection of mice, cardiac puncture, blood sample preparation and its handling.</li> <li>2. Immunization and generation of antiserum in animals against antigen.</li> <li>3. Separation of IgG using affinity chromatography.</li> <li>4. Blood grouping and counting of blood cells.</li> <li>5. Antigen-Antibody Interactions: Radial Immunodiffusion, Ouchterlony Double Diffusion Precipitin Ring Test.</li> <li>6. Immunoelectrophoresis and Rocket Immunoelectrophoresis.</li> <li>7. Antibody titre by ELISA.</li> <li>8. SDS-PAGE and Immunoblotting.</li> <li>9. Separation of mononuclear cells from Human peripheral blood.</li> </ol>		
<b>Pharmaceutical Biotechnology</b>		
<ol style="list-style-type: none"> <li>10. Various modes of administration of drugs: Intravenous, Intramuscular, Intraperitoneal, Intradermal.</li> <li>11. Acute toxicity testing of drugs.</li> <li>12. Determination of analgesic and anti-inflammatory activity of a compound.</li> <li>13. Spectrophotometric determination of Allantoin and Griseofulvin.</li> <li>14. Microbial analysis of Pharamaceuticals (syrops).</li> <li>15. DPPH and SOD - Antioxidant Assay.</li> </ol>		
<b>Animal Biotechnology</b>		
<ol style="list-style-type: none"> <li>16. Sterilization techniques</li> <li>17. Preparation of culture media and sera.</li> <li>18. Preparation of primary cell culture.</li> <li>19. Trypsinizing and subculturing cells from a monolayer.</li> <li>20. Passaging cells in suspension culture.</li> <li>21. Determining cell umber and viability with a hemocytometer and Trypan blue staining.</li> <li>22. Preservation of cells.</li> </ol>		

**Reference Books:**

1. Leslie Hudson and Hay F.C. "Practical Immunology", Blackwell Scientific Publications, London.
2. Gary Walsh. "Biopharmaceuticals", John Wiley & Sons Inc, London.
3. Ian Freshney R, "Animal Cell Culture: A Practical Approach", IRL Press, USA.

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Code No.	Subject	Semester No.
16BTP19	PRACTICAL IV - LAB IN PLANT BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY	III & IV
<b>Objective:</b>	After successful completion of the course, students will be aware of various culture techniques in PTC; Production of transgenic plants. Environmental lab helps to impart knowledge on various tests involved in waste water treatment.	
<b>Topics</b>		
<p><b>Plant Biotechnology</b></p> <ol style="list-style-type: none"> <li>1. PTC Laboratory Organization.</li> <li>2. Preparation of PTC Medium.</li> <li>3. Callus Induction and Differentiation.</li> <li>4. <i>In Vitro</i> Germination of Seeds.</li> <li>5. Embryo culture.</li> <li>6. Somatic embryogenesis.</li> <li>7. Protoplast isolation and protoplast fusion.</li> <li>8. Artificial seeds production.</li> <li>9. Meristem culture.</li> <li>10. Isolation of genomic DNA from plant tissue.</li> <li>11. Isolation of RNA from plant tissue.</li> <li>12. Multiple Shoot Induction.</li> <li>13. Secondary Metabolite Production through Cell Suspension Culture and Quantification.</li> </ol> <p><b>Environmental Biotechnology</b></p> <ol style="list-style-type: none"> <li>14. Sampling techniques: Waste water analysis for physico - chemical characteristics such as pH, conductivity, TDS, DO, BOD, COD, CO<sub>2</sub>, alkalinity, nutrients, chlorides, hardness, settle ability of solids.</li> <li>15. Isolation of microorganisms (Bacteria and Fungi) from polluted environment.</li> <li>16. Microbial degradation of hydrocarbons.</li> <li>17. Removal of Heavy metals from industrial effluent.</li> </ol>		

**Reference Books:**

1. Robert Nicholas T and Dennis John G, "Plant Tissue Culture Concepts and Laboratory Exercise", CRC Press, Florida.

Trivedy K, "Advances in Waste Water Treatment Technologies (Volumes I and II)", Global Science publications, India.



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