

HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

COIMBATORE 641 028

B.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	
First Semester							
	Part I						
16LAT01/ 16LAH01/ 16LAM01/ 16LAF01	Tamil - I/ Hindi - I/ Malayalam I / French - I	6	3	25	75	100	3
	Part II						
16ENG01	English - I	6	3	25	75	100	3
	Part III						
16BTU01	Cell Biology and Genetics	5	3	25	75	100	4
16BTU05	Practical I - Lab in Cell Biology, Genetics and Biochemistry	5	-	-	-	-	-
16BTU02	Allied I - Chemistry (BIO)	4	3	25	75	100	4
16BTU06	Allied Practical I - Lab in Chemistry and Bioanalytical Techniques (BIO)	4	-	-	-	-	-
Second Semester							
	Part I						
16LAT02/ 16LAH02/ 16LAM02/ 16LAF02	Tamil - II/ Hindi - II/ Malayalam - II / French - II	6	3	25	75	100	3
	Part II						
16ENG02	English - II	6	3	25	75	100	3
	Part III						
16BTU03	Biochemistry	5	3	25	75	100	4

16BTU05	Practical I - Lab in Cell Biology, Genetics and Biochemistry	4	3	40	60	100	5
16BTU04	Allied II - Bioanalytical Techniques (BIO)	4	3	25	75	100	4
16BTU06	Allied Practical I - Lab in Chemistry and Bioanalytical Techniques (BIO)	3	3	40	60	100	4

	Part IV						
16GSU01	Value Education- Human Rights	2	-	100		100	2

Third Semester

	Part I						
16LAT03/ 16LAH03/ 16LAM03/ 16LAF03	Tamil III / Hindi - III/ Malayalam III / French - III	6	3	25	75	100	3
	Part II						
16ENG03	English - III	6	3	25	75	100	3
	Part III						
16BTU07	Microbiology	4	3	25	75	100	4
16BTU08	Molecular Biology	4	3	25	75	100	4
16BTU13	Practical II - Lab in Microbiology, Molecular Biology and Immunology	4	-	-	-	-	-
16BTU10	Institutional Training	-	-	100	-	100	2
16BTU09	Allied III - Biostatistics (MAT)	4	3	25	75	100	4
	Part IV						
16GSU02	Environmental Studies	2	-	100	-	100	2

Fourth Semester

	Part I						
16LAT04/ 16LAH04/ 16LAM04/ 16LAF04	Tamil IV / Hindi IV / Malayalam IV / French - IV	6	3	25	75	100	3
	Part II						
16ENG04	English - IV	6	3	25	75	100	3
	Part III						
16BTU11	Immunology	5	3	25	75	100	4

16BTU12	Allied IV - Computer Programming in C (CSC)	4	3	25	75	100	4
16BTU13	Practical II - Lab in Microbiology, Molecular Biology and Immunology	5	3	40	60	100	5
16BTU14	Allied Practical II - Programming Lab in C (CSC)	2	3	40	60	100	3
	Part IV						
16GSU03	Skill Based - Internet Security	2	-	100	-	100	2
	Part V						
16GSU04	Extension Activity	-	-	100	-	100	2
Fifth Semester							
	Part III						
16BTU15	Recombinant DNA Technology	5	3	25	75	100	4
16BTU16	Plant Biotechnology	5	3	25	75	100	4
16BTU17	Fermentation Technology	5	3	25	75	100	4
16BTU23	Practical III - Lab in Recombinant DNA Technology and Plant Biotechnology	5	-	-	-	-	-
16BTU24	Practical IV - Lab in Fermentation Technology, Animal Biotechnology and Environmental Biotechnology	5	-	-	-	-	-
16BTU18	Elective I a) Bioinformatics (OR) b) Bio Nanotechnology	5	3	25	75	100	4
	Part IV						
16GSU05	Non Major Elective General Awareness	-	-	100	-	100	2
	Part V						
16GSU06	Law of Ethics	-	-	100	-	100	2
Sixth Semester							
	Part III						
16BTU19	Animal Biotechnology	4	3	25	75	100	4
16BTU20	Environmental Biotechnology	4	3	25	75	100	4
16BTU21	Bioethics, Biosafety and IPR	4	3	25	75	100	4

16BTU23	Practical III - Lab in Recombinant DNA Technology and Plant Biotechnology	5	6	40	60	100	5
16BTU24	Practical IV - Lab in Fermentation Technology, Animal Biotechnology and Environmental Biotechnology	5	6	40	60	100	5
16BTU25	Practical V - Lab in Applied Biotechnology	4	6	40	60	100	4
16BTU22	Elective II a) Diagnostic Tools (OR) b) Cancer Biology	4	3	25	75	100	4
16BTU26	Mini Project	-	-	100	-	100	3
							140

REGULATIONS

COMPONENTS FOR EVALUATION:

1. Internal Examination Marks (For Part III theory papers)

Components	Marks
Test –I & II (Best of Two)	10
Model Exam	10
Assignment	5
Total	----- 25 =====

QUESTION PAPER PATTERN FOR I.E TEST I and II

(2 HOURS TEST)
MAXIMUM: 50 Marks

SECTION - A (20 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks

(10 x 2 = 20 marks)

Short answers 10

SECTION - B (10 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks

(2 x 5 = 10 marks)

Either or Type

SECTION - C (20 Marks)

Answer any **TWO** Questions out of **THREE** questions

ALL Questions Carry **EQUAL** Marks

(2 x 10 = 20 marks)

QUESTION PAPER PATTERN FOR IE Model Examination

(3 HOURS TEST)

MAXIMUM: 75 Marks

SECTION - A (20 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks

(10 x 2 = 20 marks)

TWO questions from each unit

SECTION - B (25 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks

(5 x 5 = 25 marks)

Either or Type.

ONE question from each unit with internal choice

SECTION - C (30 Marks)Answer any **THREE** Questions out of **FIVE** questions**ALL** Questions Carry **EQUAL** Marks

ONE question from each unit

(3 x 10 = 30 marks)

2 a) Components for Practical I.E.

Components	Marks
Test –I	20
Test - II	20
Total	----- 40 =====

2 b) Components for Practical E.E.

Components	Marks
Completion of Experiments	50
Record	5
Viva	5
Total	----- 60 =====

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

<u>Institutional /Industrial Training</u>		<u>Mini Project</u>	<u>MajorProject Work</u>	
Components	Marks	Marks	Components	Marks
I.E Work Diary	25	-	I. E a) Attendance 10 Marks b) Review / Work Diary*1 30 Marks	40
Report	50	50		
Viva –voce Examination	25	50		
Total	----- 100 =====	----- 100 =====	E.E*2 a) Final Report 40 Marks b) Viva-voce 20 Marks	60
			Total	----- 100 =====

*1 Review is for Individual Project and Work Diary is for Group Projects (group consisting of minimum 3 and maximum 5)

*2 Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

4. Components for Value Education (Part IV):

S.No.	Components	Marks
a)	Attendance 96% and above - 30 marks 91% to 95% - 25 marks 86% to 90% - 20 marks 76% to 85% - 10 marks	30 marks
b)	Participation in group activity	30 marks
c)	Assignment (2 x 10)	20 marks
d)	Test (1 hr for 20 marks) 2 out of three questions, 10 marks each	20 marks
Total		100 marks

On completion of the above components students will be remarked as follows:

Range of marks	Equivalent remarks
80 and above	Exemplary
70 – 79	Very good
60 – 69	Good
50 – 59	Fair
40 – 49	Satisfactory
Below 39	Not Satisfactory = Not completed

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters.

5. Guidelines for Environmental Studies (Part IV)

- The paper Environmental Studies is to be treated as 100% IE course which is offered in III Semester for II year UG students.
- The classes will be handled for two hours per week till the end of the Semester. At least one field trip should be arranged.
- Total Marks for the subject = 100

Components	Marks
Two Tests (2 x 30)	60
Field Visit and Report (10 + 10)	20
Two Assignments (2 x 10)	20
Total	----- 100 =====

The question paper pattern is as follows:

Test I – 2 hours [3 out of 5 essay type questions] 3 x 10 = 30 Marks

Test II – 2 hours [3 out of 5 essay type questions] 3 x 10 = 30 Marks

Total 60 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters.

6. Guidelines for Skill based subject - Internet Security (Part IV)

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

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

Total 80 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters

7. Guidelines for General Awareness (Part IV)

Components	Marks
Two Tests (2 x 50)	100

The question paper pattern is as follows:

Test I – 2 hours [50 multiple choice questions] 50 x 1 = 50Marks

Test II – 2 hours [50 multiple choice questions] 50 x 1 = 50 Marks

Total 100 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters

8. Guidelines for Law of Ethics (Part V)

Components	Marks
Two Tests (2 x 50)	100

The question paper pattern is as follows:

- c) Test I – 2 hours [5 out of 8 essay type questions] 5 x 10 = 50Marks
- d) Test II – 2 hours [5 out of 8 essay type questions] 5 x 10 = 50 Marks

Total 100 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters

9. Guidelines for Extension Activity (Part V)

- Atleast two activities should be conducted within this semester (IV) consisting of two days each.
- The activities may be Educating Rural Children, Unemployed Graduates, Self Help Group etc.

The marks may be awarded as follows

No of Activities	Marks
2 x 50 (Each Activity for two days)	100

10. QUESTION PAPER PATTERN FOR EE (Part III Theory Papers)

(3 HOURS TEST)
MAXIMUM: 75 Marks

SECTION - A (20 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks

TWO questions from each unit

(10 x 2 = 20 marks)

SECTION - B (25 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks

Either or Type.

ONE question from each unit with internal choice

(5 x 5 = 25 marks)

SECTION - C (30 Marks)

Answer any **THREE** Questions out of **FIVE** questions

ALL Questions Carry **EQUAL** Marks

ONE Question from each unit

(3 x 10 = 30 marks)

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Code No.	Subject	Semester No.
16BTU01	CELL BIOLOGY AND GENETICS	I
Objective:	To enable the students to learn the basics of Cell Biology and Genetics, that lay strong foundation in understanding the composition of cells and to know in detail the various fields of Genetics.	
Unit No.	Topics	Hours
Unit I	Cellular Organization Cell as a basic unit - Development of Cell Theory - Types of Cells - Prokaryotic and Eukaryotic cell Organization - Comparison of Microbial, Plant and Animal Cells. Cell Organelles: Structure and Function of Plasma Membrane, Chloroplast, Endoplasmic Reticulum, Golgi Apparatus, Nucleus, Mitochondria and Cell Inclusions.	12
Unit II	Cell Growth, Cell Division and Cellular Communication Cell Growth – Cell Cycle – Cell Divisions – Chromosome Structure and Function - Cell signaling and Signal Transduction Pathways Cancer Cells – Contact Inhibition – Oncogenes – Tumor Suppressor Genes – Apoptosis and Necrosis.	12
Unit III	Mendelian Genetics Law of Dominance, Independent Assortment – Back Cross, Test Cross – Multi Hybrid Cross – Complementation Test – Epistasis Non-Mendelian Genetics Extra Chromosomal Inheritance – Sex Linked Inheritance – linkage and Crossing Over.	12
Unit IV	Cytogenetics Fine structure of Gene (Codon, Cistron, Recon, Muton) both Prokaryotic and Eukaryotic – Chromosome – Genetic Code – Chemical Structure of DNA and RNA - Types of DNA and RNA. Chromosomal Mutations – Insertion - Deletion. Substitution – Spontaneous and Induced Mutations – Euploidy and Aneuploidy – Down's Syndrome – Patau Syndrome – Edwards Syndrome.	12
Unit V	Population Genetics Gene Pool and Gene Frequency- Two Models of Gene pool – Chance Mating or Panmixis - Hardy Weinberg's Law – Genetic Drift – Genetic Drift – Pedigree Analysis. Human Genetics - Blood Group and Rh Factor - Human Genome project.	12

Text Book:

I. Verma P.S and Agarwal V.K. "Genetics", S Chand and Sons, New Delhi.

Reference Books:

- David E. Sadva., "Cell Biology Organelles, Structure and Function", CBS Publishers and Distributors, New Delhi.*
- Karp G., "Cell and Molecular Biology", John Wiley & Sons, New York.*

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Code No.	Subject	Semester No.
16BTU02	ALLIED I - CHEMISTRY (BIO)	I
Objective:	To Make the Student Acquire Sound Knowledge With the Principles of Chemical Bonding, Stereoisomerism, Inter-Halogen Compounds, Chemistry of Heterocyclic Compounds, Dye Chemistry and Chemical Kinetics.	
Unit No.	Topics	Hours
Unit I	Chemical bonding Molecular Orbital Theory - MO diagram of H ₂ , He ₂ , N ₂ and O ₂ Molecules. Interhalogen Compounds – Preparation, Properties, Structure and uses of ICl, BrF ₃ . Diborane – Preparation, Properties and Structure.	9
Unit II	Hybridization and Stereoisomerism Orbital Overlap - Geometry of Organic Molecules – Methane, Ethylene and Acetylene. Inductive Effect, Electromeric Effect, Mesomeric Effect - Effects in Properties of Compounds. Stereoisomerism - Optical Isomerism, Symmetry - Elements of Symmetry. Cause of Optical Activity - Optical Activity in Lactic and Tartaric acid. Racemisation and Resolution - Geometric Isomerism exhibited by Maleic and Fumaric acid.	10
Unit III	Chemical Kinetics Introduction - Rate of a Reaction - Order and Molecularity of a Reaction – Examples. Various Order of a Reaction – Zero, First, Second Order Reactions - Pseudo First Order Reaction - Methods of Determining Order of a Reaction - Effect of Temperature on Reaction Rate - Energy of Activation.	10
Unit IV	Aromatic compounds Electrophilic substitution in benzene - Mechanism of nitration, halogenation, alkylation, acylation, sulphonation - Preparation and properties of naphthalene. Heterocyclics: Preparation and properties of furan and pyrrole.	10
Unit V	Dye chemistry Definition of Terms – Chromophore – Auxochrome - Bathochromic Shift - Hypsochromic Shift - Hyperchromic Effect - Hypsochromic Effect. Synthesis of Azo Dyes - Methyl Red, Methyl Orange, Aniline Yellow, Triphenylmethane Dyes - Preparation of Malachite Green.	9

Text Book :

1. Veeraiyan V. and Vasudevan A.N.S, "Allied Chemistry Paper I & II", High Mount Publishing House, Chennai.

Reference Books:

1. Puri B.R., Sharma L.R and Pathania M.S, "Principles of Physical Chemistry", Vishal Publishing Co., New Delhi.

2. Puri B.R and Sharma L.R, "Inorganic chemistry", Shobanlal Nagin Chand and Co., New Delhi.

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Code No.	Subject	Semester No.
16BTU03	BIOCHEMISTRY	II
Objective:	To Enable the Students to Understand the Basic Concepts in Biological Chemistry with the Emphasis on Biomolecules, its Metabolism and Function In Living System.	
Unit No.	Topics	Hours
Unit I	Structure of Atoms and Biomolecules Atomic theory – Valency - Atomic weight - Molecular weight - Molarity. Chemical Bonding – Electrostatic – Covalent - Ionic and Vander Waal's. Structure of Water Molecules - Properties and Ionization of Water. pH and Buffers.	12
Unit II	Carbohydrates and Proteins Carbohydrates: Classification, Structure and Functions - Physical and Chemical Properties. Proteins: Amino Acids and Peptides - Structure and Classification of Amino Acids - Classification and Organization of Proteins – Primary – Secondary - Tertiary and Quaternary - Biological Significance.	12
Unit III	Enzymes and Nucleic Acid IUB Classification and Nomenclature of Enzymes - Michaelis-Menten Equation - Active Sites - Activators and Inhibitors. Isoenzymes - Allosteric Enzymes. Nucleic Acids: Structure - Properties and Functions of Nucleic Acids – DNA - RNA and their Types.	12
Unit IV	Lipids and Vitamins Classification - Structure and Functions. Triglycerides – Phospholipids - Glycolipids and Lipoproteins - Structure and Function. Vitamins: Types - Structure and Functions.	12
Unit V	Metabolism Glycolysis - TCA Cycle - Glycogen Breakdown and Synthesis - Gluconeogenesis - Electron Transport Chain and Oxidative Phosphorylation – Photophosphorylation - Biosynthesis and Degradation of Nucleic Acids (Purines and Pyrimidines).	12

Text Book:

1. Sathyanarayana. U, "Biochemistry", Books and Allied (P) Ltd., Kolkatta.

Reference Books:

1. David L. Nelson and Cox M. "Lehninger's Principles of Biochemistry", Worth publication, New York.
2. Voet and Voet, "Fundamentals of Biochemistry", John Wiley and Sons inc., New York.

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Code No.	Subject	Semester No.
16BTU04	ALLIED II - BIOANALYTICAL TECHNIQUES (BIO)	II
Objective:	To make the student understand the biological phenomena using physical principles, working and its application in the field of Biotechnology.	
Unit No.	Topics	Hours
Unit I	Introduction to Basics Nature of Chemical Bonds - Intra and Intermolecular Interactions in Biological System - Energetics of a Living Body. Thermodynamics of Living Systems - Conservation of Energy in Living Systems - Concept of Enthalpy - Entropy and Life - Gibbs and Standard Free Energy - Equilibrium Constant - Coupled Reactions.	10
Unit II	Care and Maintenance of Laboratory Equipments Microscope – Balance - pH meter - Buffer of Biological Importance - Distillation Plant – Autoclave – Centrifuge - Preparative, Analytical and Ultra. Laminar Air Flow – Incubator - Automatic Dispenser and Dilutors.	10
Unit III	Colorimetry and Spectroscopy Beer - Lambert's Law - Colorimeter. Spectroscopic Techniques: Single - Double Beam - Ultraviolet and Visible - Infra red and Mass Spectroscopy - Spectro Fluorimetry - Flame Photometry.	10
Unit IV	Chromatography and Electrophoresis Techniques Paper - Thin Layer - Column and Ion Exchange Chromatography - HPLC and GC - Principles - Instrumentation and Application of AGE- Native SDS-PAGE - Isoelectric Focusing and Immunoelectrophoresis.	9
Unit V	Radioisotope Techniques Atomic Structure- Atomic Stability and Radiation – Types of Radioactivity – Radioactive Decay Energy – Rate of Radioactive Decay – Interaction of Radioactivity with Matter – Detection and Measurement of Radioactivity – Application of Radioisotopes in Biological Sciences.	9

Text Book:

1. Veerakumari. L. "Bioinstrumentation", MJP Publishers, Chennai.

Reference Books:

1. Sawhney S. K. and Randhir Singh. "Introductory to Practical Biochemistry", Narosa Publishing House, New Delhi.
2. Boyer Rodney F. "Modern Experimental Biochemistry", Benjamin Cummings Publication, Sydney.

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Code No.	Subject	Semester No.
16BTU05	PRACTICAL I - LAB IN CELL BIOLOGY, GENETICS AND BIOCHEMISTRY	I & II
Objective:	To enable the students to understand the basic techniques in Cell Biology, Genetics and Biochemistry	
Topics		
Cell Biology		
<ol style="list-style-type: none"> 1. Laboratory Rules and Regulations. 2. Microscopy – Light Microscope – Compound Microscope – Dark – Field Microscope and Bright Field Microscope. 3. Identification of Different Cell Types - Microbial, Animal and Plant cells 4. Identification of Lymphocytes. 5. Fraction of Cellular components - Chloroplast and Mitochondria. . 6. Mitotic Preparation - Onion Root Tip. 7. Cell Permeability 		
Genetics		
<ol style="list-style-type: none"> 8. Drosophila – Morphology, Section Culture and Maintenance. 9. Identification of Mutants - Physical and Chemical Methods. 10. Experiments to determine Mendel's Law. 11. Monohybrid and Dihybrid Cross Using Plants. 12. Mounting of Sex chromatin isolation from Grasshopper 13. Identification of Barr Bodies. 14. Mounting of Polytene Chromosome from Chironomous Larvae. 		
Biochemistry		
<ol style="list-style-type: none"> 15. Estimation of Protein by Lowry's method. 16. Estimation of DNA by DPA Method. 17. Estimation of RNA by Orcinol method. 18. Estimation of Sugars by Anthrone method. 19. Estimation of total free amino acids - Sulfovanicillin method. 20. Estimation of Lipids. 21. Analysis of Oils- Iodine Number - Saponification Value - Acid Number. 22. Quantification of Vitamin C. 		

Reference Books:

1. Dealtry G.B. and Rickwood D, "Cell Biology", LAB FAX. Bio Scientific Publishers, India.
2. Rajan S and Selvi Christy, " Experimental Procedures in Life sciences", Anjanaa Book House, Chennai.
3. Sadasivam S and Manickam A, "Biochemical Methods", New Age International Pvt Ltd Publishers, New Delhi.

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Code No.	Subject	Semester No.
16BTU06	ALLIED PRACTICAL I - LAB IN CHEMISTRY AND BIOANALYTICAL TECHNIQUES (BIO)	I & II
Objective:	To enable the student to understand the basics of Acid- Base Titrations and to analyze the Organic Substance systematically and to study the Concepts and Working Principle of Laboratory Equipments	
Topics		
<p>Chemistry</p> <p>Volumetric Analysis</p> <ol style="list-style-type: none"> 1. Estimation of Hydrochloric Acid- Standard Oxalic Acid. 2. Estimation of Ferrous Sulphate- Standard Mohr Salt Solution. 3. Estimation of Potassium Permanganate - Standard Sodium Hydroxide <p>Organic Analysis</p> <ol style="list-style-type: none"> 4. Detection of Elements (N, S, Halogens). To distinguish between Aliphatic and Aromatic. To distinguish between Saturated and Unsaturated. Functional group tests for Phenols, Dicarboxylic Acids, Aromatic Primary Amine, Diamide, Carbohydrate. Functional groups characterized by Confirmatory Test <p>Bioanalytical Techniques</p> <ol style="list-style-type: none"> 5. Working principle of Laboratory Equipments: Autoclave, Incubator, Laminar Air Flow, Hot Air Oven, Weighing balance. 6. Determination of pH using pH meter. 7. Determination of λ max of proteins and nucleic acids by UV-spectrophotometry. 8. Sedimentation of Emulsion of oil 9. Paper Chromatography 10. Thin Layer chromatography 		

Reference Books:

1. Venkateswaran, V. Veeraswamy R. and Kulandaivelu. A.R. "Basic Principles of Practical Chemistry", Sultan Chand and Sons, New Delhi.
2. Nigam A and Ayyagari A. "Lab Manual in Biochemistry, Immunology and Biotechnology", Tata McGraw Hill Publishing Company Private Ltd., Chennai, India.

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Code No.	Subject	Semester No.
16BTU07	MICROBIOLOGY	III
Objective:	To enable the students to understand the role of Microorganisms in the Diversity and their Participation in Day to Day Activities.	
Unit No.	Topics	Hours
Unit I	History and Scope History – Contributions of Scientist – Application of Microbiology in Different Fields – Microscopy: Discovery - Structure and Working Principles of Dark Field Microscope – Bright Field Microscope – Phase Contrast Microscope – Fluorescent Microscope - Electron Microscope: SEM and TEM.	10
Unit II	Classification of Microbes and Growth Kinetics Microbial Diversity – Four Kingdom and Five Kingdom Classification - Growth Curve – Different Phases – Effect of Different Factors on Growth rate – Types Based On Different Requirements. Microbial Interactions: Mutualism – Symbiosis – Commensalism – Parasitism – Synergism – Predation - Competition (Definition with suitable examples).	10
Unit III	Microbial Cell and Culturing Techniques Shape and Structure - Cell Wall: Structure and Composition of Gram Negative and Gram Positive Cell Wall – Flagella: Structure – Types – Function - Internal Organelles – Pure Culture Methods - Staining: Background – Principle – Types – Simple Staining, Gram’s Staining; Acid Fast Staining; Lactophenol Cotton Blue Staining and Endospore Staining – Culture Media – Types, Plating Methods – Types.	10
Unit IV	Microbial Pathogenesis Classification - Structure and Pathogenesis of HIV – HSV – TMV - Gemini Virus - <i>Bacillus tuberculosis</i> - <i>Yersinia pestis</i> - <i>Phytophthora infestans</i> - <i>Candida albicans</i> - <i>Streptococcus pneumonia</i> - <i>Clostridium tetani</i> - <i>Salmonella typhi</i> – Role of Microorganism in Biogeochemical Cycle.	9
Unit V	Applied Microbiology Various Fields of Applications – Fermented Food (Cheese and Yogurt); Biofertilisers – Nitrogen Fixation; Symbiotic and Asymbiotic – Bioremediation – <i>Pseudomonas putida</i> – Antibiotic Production (Penicillin) – Organic acid production (Citric Acid) – Microorganism as Food – SCP – Edible Mushrooms.	9

Text Book:

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

Reference Books:

1. Atlas R.M, "Principles of Microbiology", WCB McGraw Hill Publications, New Delhi.

2. Black J.G, "Microbiology: Principles and Explorations", Prentice Hall International, New Jersey.

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Code No.	Subject	Semester No.
16BTU08	MOLECULAR BIOLOGY	III
Objective:	To enable the students to understand the mechanism of Synthesis of DNA, RNA and Protein, Gene regulation and Mutation	
Unit No.	Topics	Hours
Unit I	DNA as Genetic Material Evidences for DNA as Genetic Material - Experimental proof DNA Replication in Prokaryotes – Semi-conservative Mechanism and Experimental Proof – Models of Replication. Enzymology of DNA replication, Initiation, Elongation and Termination.	10
Unit II	Transcription Prokaryotic transcription - Central dogma - RNA polymerases- Role of Eukaryotic RNA polymerases. RNA Splicing and Processing of mRNA, tRNA and rRNA, Reverse Transcription.	10
Unit III	Translation Initiation, Elongation and Termination of Protein Synthesis; Inhibitors of Protein Synthesis. Post translational Modifications of Proteins. Prokaryotic Gene Regulation - Operon Model - Lac and Trp Operon - positive and negative control - repression and attenuation.	10
Unit IV	Gene Mutations Types - Nutritional, Lethal, Conditional mutants. Missense mutation and other Point Mutations. Spontaneous Mutations, Chemical and Radiation – Induced Mutations – Ames Test, Reversion Techniques, Selection of Mutants, Auxotrophs, Replica Plating, Penicillin Cycling. Bacterial Transposons - Insertion Sequences, Mechanism of Transposition in Bacteria.	9
Unit V	Recombination in Bacteria Transformation, Transduction and Conjugation. Recombination - Mechanism; forms of Recombination, Holliday Model for Homologous Recombination.	9

Text Book:

1. David Freifelder, "Molecular Biology", Narosa Publishing House, New Delhi.

Reference Books:

1. Gardner and Simmons, "Principles of Genetics", Jones and Bartlett Publishers, Burlington.
2. Weaver, F., Robert, Hedrick, W. Philip, "Genetics", W.C. Brown Publishers, Dubuq IA, USA.

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Code No.	Subject	Semester No.
16BTU11	IMMUNOLOGY	IV
Objective:	To demonstrate the knowledge of general principles of Immunology, Immune Responses to Infections, Genetics of Transplantation and Autoimmune Disorders.	
Unit No.	Topics	Hours
Unit I	Introduction Historical Development in Immunology – Immunity: Types of Immunity – Innate and Acquired immunity. Humoral and Cell Mediated Response - Cells involved in Immune Response - Mechanisms of Defense.	12
Unit II	Antigen and Antibody Antigen - Types and Classifications, Antibody – Structure, Types, Properties and their Biological Functions. Monoclonal Antibody, Primary and Secondary Lymphoid Organs – Thymus - Bone marrow - Lymph Nodes and Spleen. Lymphocytes Traffic and Regulation - CD Molecules.	12
Unit III	Cellular Responses Hematopoiesis and Development - B Cell Development and Activation - Plasma Cells - Memory Cells. T Cell Development and Activation - MHC Molecules – Types.	12
Unit IV	Complement Complement Activation and Regulation. Cytokines: Structure - Functions and Types. Immuno Regulation - Tolerance. Autoimmunity and Hypersensitivity Reactions - Primary and Secondary Immuno Deficiency Disorders.	12
Unit V	Transplantation HLA Typing - Mechanism of Graft rejection - Tumor immunology - Immuno Surveillance - Mechanisms. Antigen – Antibody Interactions - Immunodiffusion and Immunoelectrophoresis. Principle , Applications of RID, RIA – ELISA - Fluorescent Antibody Techniques.	12

Text Book:

1. Kuby J. "Immunology", W.H Freeman and Co. New York, USA.

Reference Books:

1. Tizard., "Immunology", Saunders Publisher, Canada.

2. Ivan M. Roitt. "Essentials of Immunology", Wiley – Blackwell Publishers, UK.

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Code No.	Subject	Semester No.
16BTU13	PRACTICAL II - LAB IN MICROBIOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY	III & IV
Objective:	To enable the students to understand the basic Techniques in Microbiology, Molecular Biology and Immunology.	
Topics		
<p>Microbiology</p> <ol style="list-style-type: none"> 1. Media Preparation and Sterilization. 2. Isolation of Microbes from Soil, Water and Air using Pure Culture Techniques. 3. Enumeration of Microorganism and Pure Culture Technique. 4. Measurement of Bacterial Growth. 5. Staining Techniques – Simple Staining, Gram’s Staining, Endospore Staining, Lactophenol Cotton Blue Staining, Flagellar Staining. 6. IMVIC test. 7. Carbohydrate Fermentation Test, TSI, H₂S production test. 8. Motility Test by Hanging Drop Method. 9. Antibiotic Sensitivity Test. <p>Molecular Biology</p> <ol style="list-style-type: none"> 10. Preparation of Buffer- Borate, Phosphate, Acetate, Tris. 11. Principles and Applications of Agarose Gel Electrophoresis 12. Isolation of Genomic DNA from Bacteria. 13. Isolation of Plasmid DNA from Bacteria. 14. Isolation of RNA from Human Blood. <p>Immunology</p> <ol style="list-style-type: none"> 15. Methods of immunization and bleeding. 16. Preparation of Anti bodies. 17. Antigen-anti body reactions. 18. Single Radial Immuno diffusion. 19. Double Radial Immuno diffusion. 20. Blood grouping. 21. Preparation of serum from blood. 22. WIDAL. 23. ASO. 24. CRP. 25. ELISA- Demonstration. 		

Reference Books :

1. Kanika Sharma. "Manual of Microbiology Tools and Techniques", Ane Books, Kolkatta.
2. Nigam A and Ayyagari A, "Lab Manual in Biochemistry, Immunology and Biotechnology", Tata McGraw Publishing Company Private Ltd., Chennai, India.
3. Primrose S.B. "Principles of Gene Manipulation", Blackwell Science Ltd, Germany.

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Code No.	Subject	Semester No.
16BTU15	RECOMBINANT DNA TECHNOLOGY	V
Objective:	To make the student understand: Manipulation of Genes, Transfer Techniques, Expression Systems, Methods of Selection and Application.	
Unit No.	Topics	Hours
Unit I	Restriction and Modification System General Introduction and Application of rDNA Technology - Restriction Enzyme and Enzymes used in Cloning - DNA Polymerases, RNA Polymerase - Taq Polymerase - DNA Ligase - Methylase, Polynucleotide Kinase - Alkaline Phosphatase - Reverse Transcriptase - DNaseI - RNaseH - Terminal Deoxynucleotidyl Transferase.	12
Unit II	Organization of Vectors Types of Plasmids - Properties of Plasmid - Plasmid Compatibility and Incompatibility - Copy Number Control. Cloning Vectors: E.coli Vectors - pBR322 and pUC vectors - their derivatives - BAC. Cloning in <i>Bacillus</i> and <i>Streptomyces</i> Yeast Vector: YIP - YEP - YRP and YAC - Shuttle Vectors.	12
Unit III	Various Types of Vectors Lambda Vectors - Cosmid - Phagemid - M13 Vectors - Selectable Markers and Expression Vectors. Animal Vectors: SV40 Vectors - and Retero viral - Plant Vectors: Ti plasmid as gene vector - Caulimo viruses - Gemini viruses - Transposable elements as vectors.	12
Unit IV	Recombinant DNA Techniques Construction of cDNA and genomic DNA libraries - Probe Construction and Labeling. Hybridization Techniques: Southern - Western and Northern Blotting. Chromosome Walking and Jumping - DNA Sequencing - Microarray. Introduction of Cloned Genes into Cell: Transformation - Transduction - Particle Bombardment - Liposome Mediation - Electroporation - Selection of Clones. PCR, RFLP, AFLP, SSCP, ISSR.	12
Unit V	Applications Molecular Pharming - Production of DNA and Edible Vaccines - Antibiotics - Proteins - Enzymes - Secondary Metabolites - Recombinant Insulin and Interferon Production - Transgenic Plants: Bt Cotton.	12

Text Book:

1. Primrose S.B, "Principles of Gene Manipulation", Blackwell Science Ltd, Germany.

Reference Books:

1. Ernst L. Winnacker, "From genes to clones", Panima Publishing Corporation, NewDelhi.

Brown T.A, "Introduction to gene cloning", Stanley Thomas Publishing Ltd, London.

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Code No.	Subject	Semester No.
16BTU16	PLANT BIOTECHNOLOGY	V
Objective:	To make the student Understand: Crop development, Callus Culture and Biotechnological Applications of Plants	
Unit No.	Topics	Hours
Unit I	Plant Breeding Methods Conventional Methods of Crop Improvement - Selection – Natural Selection and Artificial Selection – Mass Selection - Pure Line Selection and Clonal Selection – Hybridization - Introduction - Acclimatization and Mutation.	12
Unit II	Micropropagation History of Plant Tissue Culture - Basic Structure of Plant (Explants) - Terms used in Plant Tissue Culture - Plant Tissue Culture Media – Types, Composition, Preparation and Sterilisation - Basic Technique of Plant Tissue Culture – Callus Culture - Cell Suspension Culture – Types. Micropropagation – Meristem and Shoot Tip Culture - Bud Culture - Factors Affecting Micropropagation.	12
Unit III	Somatic Embryogenesis and Hybridization Direct and Indirect - Somatic Embryogenesis - Embryo Culture and their Applications. Somatic Hybridization - Isolation of Protoplast - Fusion of Protoplast - Selection of Hybrid Cell and Identification of Hybrid Cell. Cybrids - Anther and Pollen culture – Somaclonal Variations.	12
Unit IV	Genetic Engineering of Plants Plant Genome Organization – Gene Expression and Regulation - Ti Plasmids – Organization - T-DNA Integration and Transfer - Ti Plasmid Derived Vector Systems – Ri Plasmids – Selectable Marker Genes - Gene Transfer Methods – Vector Mediated Gene Transfer - <i>Agrobacterium</i> , Direct or Vector less – Physical, Chemical and DNA Imbibitions - Viral Vector and their Applications.	12
Unit V	Production of GM Crops Application of Plant Tissue Culture – Cell Culture Method for Secondary Metabolite Production. Production of Pest, Insect, Virus, Bacterial and Fungal Crops – Biotic and Abiotic Stress Tolerant Crops – Engineering for Long Shelf Life of Fruits and Vegetables.	12

Text Book:

1. Sathyanarayana U, "Biotechnology", Books and Allied (P) Ltd., Kolkatta.

Reference Books:

1. Chadhuri., H.K, "Elementary Principles of Plant Breeding", Oxford and IBH Publishers, New Delhi.

2. Chawla, H.S, "Introduction to Plant Biotechnology", Oxford and IBH Publishing Co. (P) Ltd., New Delhi.

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Code No.	Subject	Semester No.
16BTU17	FERMENTATION TECHNOLOGY	V
Objective:	To make the student understand the concept of Fermentation and its Applications in Production of Microbial products, Vaccine and Antibiotics.	
Unit No.	Topics	Hours
Unit I	Introduction to Fermentation Technology History and Scope – Industrially Important Microbes - Isolation and Screening of Microbes - Preservation of Microbes- Strain Improvement - Media Formulation and Sterilization - Various Substrates for Industrial Fermentation – Types of Fermentation.	12
Unit II	Fermentor and Types Fermentor: Design, Parts and Accessories, Functions- Modes of Operation of Fermentor- Batch, Fed Batch, Continuous, Semi Continuous, Perfusion-Types of Reactors CSTR, Tower, Jet Loop, Airlift, Bubble Column and Packed Bed.	12
Unit III	Microbial Kinetics, Instrumentation and Control Microbial Growth Kinetics: Batch and Continuous Reactors- Immobilized Cell Systems- Bioreactor Instrumentation, Control and Monitoring Variables such as Temperature, Agitation, Pressure, pH, Anti-Foam - On line Measurement. On/Off Control. PID Control. Computers in Bioprocess Control Systems.	12
Unit IV	Downstream Processing Downstream processing: Filtration, Centrifugation, Cell disruption, Chromatography, Product Recovery and Purification - Flocculation and Coagulation Effluent Treatment- Sludge Process - Waste Disposal - Purification-Crystallization and Drying – Product and Packaging.	12
Unit V	Application of Fermentation Technology Ethanol, Lactic Acid Production - Citric acid, Yeast, Penicillin- Organic acid (Acetic acid)- Antibiotics (Streptomycin)- Malt Beverages- Enzymes (Amylase and Protease), Vitamins and SCP.	12

Text Book:

1. Stanbury P.F, and Whittaker A, "Principles of Fermentation Technology", Prentice Hall Publishers, New Jersey.

Reference Books:

1. Glazer A.N and Nikaido H, "Microbial Biotechnology", W H Freeman and Co., New York.
2. Preve, "Fundamentals of Biotechnology", Wiley - VCH Publications, Germany.

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Code No.	Subject	Semester No.
16BTU18	BIOINFORMATICS	V
Objective:	To enable the students to understand the application of Information Technology in Data Management, Applications in Concepts to Biological Problems and to Provide Insight into the Biological Databases.	
Unit No.	Topics	Hours
Unit I	Introduction Definitions – Objectives – Scope - Applications of Bioinformatics - History and Milestones of Bioinformatics - Human Genome Project.	12
Unit II	Basic concepts of Biomolecules and Computers Protein and Amino Acid - DNA and RNA – Sequence - Structure and Function. Basic Computer Components – Hardware – Software - Operating Systems - Computer Networks – Programming – Internet – Browsers - Search Engines – Email - Databases.	12
Unit III	Biological Databases Database – Definition – DBMS. Biological Databases – NCBI - FASTA – BLAST – Genbank - DNA Sequence Databases - Protein Databank (PDB) - Entry Formats - Carbohydrate Databases - Enzyme Databases - Pathway Databases - Relational Database Model - Theory on RDBMS - SQL.	12
Unit IV	Sequence Alignment and Molecular Docking Sequence Alignment - Pair-wise and Multiple-Sequence Alignment (Methods and Algorithms), CLUSTAL-W - Phylogenetic Analysis (Methods, algorithms).	12
Unit V	Molecular Docking Protein, Ligand Preparation, Optimization, Protein – Ligand Interaction – Protein- Protein interaction using Autodock tool, PYMOL, Discovery studio.	12

Text Book:


1. Rajaraman V, "Introduction to Information Technology", Prentice Hall of India Pvt. Ltd, New Delhi.

Reference Books:

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

2. Lesk A.M, "Introduction to Bioinformatics", Oxford University Press, London.

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Code No.	Subject	Semester No.
16BTU18	BIO NANOTECHNOLOGY	V
Objective:	To make the students to gain knowledge on basics and applications of nanotechnology; varied background about the biological/biotechnological basics and culminates into modern day applications of nanoscience in biotechnology field will be highly useful.	
Unit No	Topics	Hours
Unit I	Introduction and Properties Introduction to nanoscale dimension and paradigm - Types of nanomaterials and their classifications (1D, 2D and 3D etc.) Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well, Nanotubes and Nanowires.	12
	Characterizations Optical (UV-Vis/Fluorescence) - X-ray Diffraction Electron Microscopy, Light Scattering, Zeta Potential - Surface and Composition: ECSA, EDAX, AFM/STM – Vibrational: FT-IR and RAMAN, SERS - Magnetic, Electrical and Electrochemical.	12
Unit II	Biosynthesis and Applications of Nano-Materials in Biosystems Biosynthesis of Silver and Gold nanoparticles using Microbes and Plant Extracts. Application of Bionanoparticles in RNA, DNA and Protein Targeting - Small Molecule/ Nanomaterial - Protein Interactions Nanomaterial-Cell interactions- Manifestations of Surface Modification (Polyvalency).	12
Unit III	Nanomaterials and Diagnostics/Drug Delivery and Therapeutics MRI, Imaging - Surface Modified Nanoparticles - MEMS/NEMS based on Nanomaterials - Peptide/DNA Coupled Nanoparticles - Lipid Nanoparticles For Drug Delivery - Inorganic Nanoparticles For Drug Delivery - Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral) - Anisotropic and Magnetic Particles (Hyperthermia).	12
Unit V	Nanomaterials and Toxicity Evaluation: Cyto-Toxicity, Geno-Toxicity <i>In vivo</i> Tests/Assays etc.	12

Text Book:

1. Christof M. Niemeyer and Chad A. Mirkin, "Nanobiotechnology: Concepts, Applications and Perspectives", Wiley VCH publications, Germany.

Reference Books:

1. Chad A Mirkin and Christof M, "Nanobiotechnology More Concepts and Applications", Wein-Heim Publications, Germany.
2. Niemeyer, "Nanotechnology in Biology and Medicine: Methods, Devices, and Applications", Wein-Heim Publications, Germany.

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Code No.	Subject	Semester No.
16BTU19	ANIMAL BIOTECHNOLOGY	VI
Objective:	To make the student understand the Laboratory Safety, Animal Cell Culture and its exploitation in Biotechnology which will be useful for Human Welfare.	
Unit No.	Topics	Hours
Unit I	Animal Tissue Culture Introduction – SOP (Standard Operating Protocol) - Risk Assessment and General Safety. Animal Tissue Culture: Lab Layout - Essential Equipments: CO ₂ Incubator - Inverted Confocal Microscope.	10
Unit II	Media Types of Media - Physicochemical Properties - Balanced Salt Solutions - Complete Media – Serum - Serum-Free Media - Disadvantages of Serum supplemented Media and Advantages of Serum-Free media – Sterilization Techniques.	10
Unit III	Cell Types Specialised cells – Tumor cells. Primary Culture: Isolation of Tissue - Steps involved in Primary Cell Culture – Organ Culture – Histotypic Culture - Organotypic Culture - Cell Lines	10
Unit IV	Application of animal cell culture Vaccine Production - Tissue Engineering - Engineered Cell Culture as source of Valuable Products and Therapeutic Protein Production – 3D Culture. Stem Cells – Introduction – Types – Stem Cell Culture - Application in Biotechnology.	9
Unit V	Transgenic Animals Production Methodology - Applications of Transgenic Animals-in Therapeutic Protein Production - Live Stock Improvement - Transgenic Animals as Disease Models - <i>In Vitro</i> Fertilization and Embryo Transfer - Ethical Issues in Animal Biotechnology.	9

Text Book:

1. Freshney R.I, "Animal cell culture: A practical approach", John Wiley publication, New Jersey.

Reference Books:

1. Jennie P Mather, David Barnes, "Methods in Cell Biology: Animal cell culture methods", Academic Press, USA.
2. Primrose, "Principles of genetic manipulation", Blackwell Science Publication, Oxford.

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Code No.	Subject	Semester No.
16BTU20	ENVIRONMENTAL BIOTECHNOLOGY	VI
Objective:	To make the student understand Ecology, Ecosystem, energy flow, Uses and values of Biodiversity and Conservation of the Environment.	
Unit No.	Topics	Hours
Unit I	Ecology and Ecosystem Ecology: Definition - Scope – Branches of Ecology – Abiotic Factors – Water – Light – Biodiversity and Its Types. Ecosystem: Structure - Primary Production - Food Chain – Food Web – Energy Flow – Pyramid of Biomass – Pyramid of Energy. Biogeochemical Cycle - Nitrogen and Phosphorous.	10
Unit II	Pollution Types – Sources – Effects – Air-water – Land – Noise – Thermal – Pesticide – Radioactive – Green House Effect, Ozone and its Importance – Global Warming – Acid Rain. Environment Impact Assessment and Environmental Monitoring.	10
Unit III	Bioremediation The predominant Microorganism for Bioremediation – Recalcitrant Xenobiotics – Types of Bioremediation – Types of Reaction Bioremediation – Biodegradation of Hydrocarbon, Pesticides and Herbicides – Role of Genetic Engineering in Bioremediation.	10
Unit IV	Biofuels and Biofertiliser Renewable Energy Resources – Biomass Resources – Non –Biological And Biological Process. Algae as the source of Energy, Biodiesel as a Fuel – Production, Benefits, Emission and Facts – Biogas Production from Paper and Pulp Industry Waste. Biofertiliser – Symbiotic Nitrogen Fixers (<i>Rhizobium Spp</i>)- Algal Biofertiliser (<i>Azolla</i>), Asymbiotic Nitrogen Fixers (<i>Anabena</i>) – Mycorrhiza - Vermi Composting.	9
Unit V	Sewage Treatment System Primary – Sedimentation, Secondary – Activated Sludge Process. Trickling Filters, Rotating Biological Contactors and Tertiary Treatment – Biological Nitrogen and Phosphorus Removal - Biofilms. Industrial Waste Water Treatment System – Tannery Waste Water. Solid Waste Disposal and Solid Waste Management.	9

Text Book:

1. Sahan. T.K, "Ecology and Environmental Biology". Himalaya Publishing House, New Delhi.

Reference Books:

1. Groombridge B, "Global Biodiversity – Status of the Earth's Living Resources", Chapman and Hall, London.
2. UNEP, "Global Biodiversity Assessment", Cambridge University Press, Cambridge.

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Code No.	Subject	Semester No.
16BTU21	BIOETHICS, BIOSAFETY AND IPR	VI
Objective:	To enable the student to understand the basics of Safety, Patenting, Property Rights and Ethics involved in Biotechnology for Human Welfare.	
Unit No.	Topics	Hours
Unit I	Introduction to Bioethics in Biotechnology 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. General Agreement on Trade and Tariff (GATT) and World Trade Organizations (WTO).	10
Unit II	Biosafety and Institutional Biosafety Committees 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 - The Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).	10
Unit III	Ethics on GMO's 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.	10
Unit IV	Introduction to Intellectual Property TRIPS. Different Types of Intellectual Property Rights (IPR) – Patents - Trade Mark - Trade Secret - Copy Rights - Trademarks - Design Rights - Geographic Indications - Importance of IPR - World Intellectual Property Rights Organization (WIPO).	9
Unit V	Patent What can and what cannot be patented? - Patenting life - Legal Protection of Biotechnological Inventions - Patenting in India - Licensing - Flav'r Savr™ Tomato as a Model Case - Biopiracy and Case Studies on Patents (Basmati Rice, Turmeric, and Neem). Indian Patent Act.	9

Text Book:

1. Shaleesha A. Stanley, "Bioethics", Wisdom Educational Service, Chennai.

Reference Books:

1. Jose Cibelli., Robert P. Lanza., Keith H.S., Michael D. West, "Principles of Cloning", Academic Press, U.S.A.
2. <http://online.sfsu.edu/%7Erone/GEessays/gedanger.html>.

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Code No.	Subject	Semester No.
16BTU22	DIAGNOSTIC TOOLS	VI
Objective:	To enable the students to gain knowledge on basics and applications of different Diagnostic Techniques	
Unit No.	Topics	Hours
Unit I	Haematology Laboratory Safety and First Aid - Routine Haematological Tests – Special Haematological Tests – Blood Banking and Blood Transfusion Therapy – ImunoHaematology – RID, RIA, ELISA, WIDAL.	10
Unit II	Serology Basic Serodiagnostic tests – Agglutination Test for Serodiagnosis – Serodiagnosis for Streptococcal Infection. – Immunological Test for Pregnancy.	9
Unit III	Clinical Pathology Urine analysis – Collection – Physical, Chemical and Microscopic Examination of Urine – Laboratory evaluation of Body Fluids like CSF – Synovial Fluid – Vaginal Discharge – Gastric Juices - Semen Analysis – Stool Examination.	9
Unit IV	Diagnostic Microbiology Laboratory Procedures in Microbiology – Quality Control in Microbiology – Identification of Pathogenic Microbes – Diagnosis of Sputum Specimen – Faecal Specimen – Urine Specimen – Body Exudates – CSF – Laboratory Diagnosis of Leprosy. Fungal Diagnosis – Dermatocytosis – Subcutaneous Mycosis.	10
Unit V	Other Diagnosis and Diagnostic Equipments Parasitic Examination of Stool Specimen – Histology and Cytology – Tissue Preparation – Staining of Tissues – Identifying Characteristics of Benign and Malignant Cells. Diagnostic Equipments: ECG – EMG – EEG – CT and MRI scans – X- Ray.	10

Text Book:

1. Kanai L. Mukherjee, "Medical Laboratory Technology", Tata Mc Graw Hill publications, Chennai.

Reference Books:

1. Talib V.H. "Handbook of Medical Lab Technology". CBS publication. New Delhi.
2. Allen Gaw, Robert A.Cowan, "An Illustrated color text of Clinical Biochemistry", Churchill Living stone press, Scotland.

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Code No.	Subject	Semester No.
16BTU22	CANCER BIOLOGY	VI
Objective:	To impart basic concepts of Cancer Biology, various stages in Carcinogenesis, Molecular Cell Biology of Cancer, Cancer Metastasis, and Cancer Therapy.	
Unit No.	Topics	Hours
Unit I	Fundamentals of Cancer Biology Introduction to the Biology and history of Cancer - features of Cancer - Cancer as a Genetic Disease - Types of Cancer – Apoptosis – Necrosis – Definition - Benign Tumors vs. Malignant Tumors – Invasion – Metastasis - Cell Proliferation – Angiogenesis.	9
Unit II	Cancer Cell Metabolism Metabolism in Cancer Cells – Regulation of Cell Cycle - Tumour Suppressor Genes - Modulation of Cell Cycle-in Cancer. Cancer Risk Factors – Physical, Chemical - Metabolism of Chemical Carcinogens - DNA Adduct Formation: Biological - DNA Viruses and RNA Viruses.	10
Unit III	Cancer Classification and Screening Classification - Stage Grouping - Molecular Classification of Cancer. Screening and Evaluation – Principle - Different Kind of Screening Tests - Screening for Specific Types of Cancer - Genetic Counseling. Conventional Cancer Therapy – Chemotherapy - Types and Ways to Administer Chemotherapy.	10
Unit IV	Drugs for Cancer Anticancer Drugs - Alkylating Agents (Cisplatin) - Antimetabolites (Folic Acid Analogue) - Cytotoxic Antibiotics (Dactinomycin) - Plant Derivatives (Vinca Alkaloids); Hormone Therapy (Estrogen) - Targeting Growth Factor Receptors (Cetuximab).	9
Unit V	Advanced Technologies and Treatments Tomotherapy - Brachytherapy - Alternative Treatments for Cancer Use of Herbals and Nonconventional Therapies - Anti-Angiogenic Therapy – Radio Immunotherapy - Cancer Stem Cell Therapy - Stem Cell Transplant Autologous – Allogeneic - Syngeneic Transplant – Cryotherapy - Laser Therapy - Treatment Modalities.	10

Text Book:

1. Robin Hesketh, "Introduction to Cancer Biology", Cambridge University Press, Cambridge, England.

Reference Books:

1. Vincent T. De Vita, "Cancer: Principles and Practice of Oncology", Williams and Wilkins, Sydney.
2. Robert A. Weinberg, "The Biology of Cancer", Taylor and Francis, USA.

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Code No.	Subject	Semester No.
16BTU23	PRACTICAL III - LAB IN RECOMBINANT DNA TECHNOLOGY AND PLANT BIOTECHNOLOGY	V & VI
Objective:	To enable the students aware of various culture techniques in Plant Tissue Culture, Gene- Transfer Mechanisms and Production of Transgenic Plants and to understand the basic techniques in rDNA Technology.	
Topics		
<p>Plant Biotechnology</p> <ol style="list-style-type: none"> 1. Plant Tissue Culture Media Preparation. 2. <i>In vitro</i> Germination of Seeds. 3. Callus Induction and Differentiation. 4. Embryo Culture. 5. Somatic Embryogenesis. 6. Isolation of Protoplast. 7. Artificial Seed Production. 8. Meristem Culture. 9. Micropropagation. 10. Qualitative Analysis of Alkaloids, Flavonoids, Saponins, Tannins and Phenolics. <p>Recombinant DNA Technology</p> <ol style="list-style-type: none"> 11. Isolation of genomic DNA from Plant. 12. Isolation of genomic DNA from Animal. 13. Isolation of DNA from Human Blood. 14. Restriction Digestion. 15. Ligation. 16. Transformation. 17. SDS-PAGE. 18. Western blotting – Demo. 19. Southern blotting – Demo. 20. PCR – Demo. 		

Reference Books:

1. Robert Nicholas Trigiano and Dennis John Gray. "Plant Tissue Culture Concepts and Laboratory Exercise", CRC Press, London.
2. Sandhya Mitra, "Genetic Engineering Principles and Practice", Macmillan Publishers, India.
3. Chadhuri., H.K, "Elementary Principles of Plant Breeding", Oxford and IBH Publishers, New Delhi.

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Code No.	Subject	Semester No.
16BTU24	PRACTICAL IV - LAB IN FERMENTATION TECHNOLOGY, ANIMAL BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY	V & VI
Objective:	To enable the students to understand the Basic Techniques in Animal Tissue Culture, also to Understand the Techniques involved in Environmental Biotechnology and Fermentation Technology.	
Topics		
<p>Fermentation Technology</p> <ol style="list-style-type: none"> 1. Fermentor design and working principles – (Demo). 2. Production and assay of extra cellular enzyme –protease – submerged. 3. Wine Production. 4. Ethanol production and calculate the percentage of alcohol- SCP – Production. <p>Animal Biotechnology</p> <ol style="list-style-type: none"> 5. Media Preparation and sterilization techniques. 6. GLP and ATC instrumentation - CO₂ incubator and inverted microscope. 7. Primary Culturing of Animal Cell. 8. MTT Assay. 9. Different Modes of Immunization in Animals <p>Environmental Biotechnology</p> <ol style="list-style-type: none"> 10. Sampling Techniques. 11. Waste water analysis for Physico - Chemical Characteristics like pH, Conductivity and Hardness. 12. Total Dissolved Solids (TDS). 13. Dissolved Oxygen (DO). 14. Biochemical oxygen demand (BOD). 15. Chemical oxygen demand (COD). 16. Alkalinity. 17. Estimation of Chloride. 		

Reference Books :

1. Stanbury, P.F and Whittaker A. "Principles of Fermentation Technology", Butterworth Heinemann, USA.
2. Freshney R.I, "Animal cell culture: A practical approach", John Wiley publication, New Jersey.
3. Murugesan and Rajalakshmi, "Environmental Biotechnology", Himalaya Publishing House, New Delhi.

BOS Meeting approved:



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Code No.	Subject	Semester No.
16BTU25	PRACTICAL V - LAB IN APPLIED BIOTECHNOLOGY	VI
Objective:	To enable the students aware of various techniques related to applied fields in Biotechnology, which will help them to take up further research and can inculcate in them the production of novel compound.	
Topics		
<p>Microbial Biotechnology</p> <ol style="list-style-type: none"> 1. Isolation of Microbes from Varied Environment. 2. Pure culture and Screening of Potential Microbe. 3. Use of the isolates for Commercial Purpose. <p>Plant Biotechnology</p> <ol style="list-style-type: none"> 4. Choosing Endemic and Endangered Plants. 5. Micro propagation and Standardization Techniques. 6. Phytochemical Screening both Qualitative and Quantitative. 7. Evaluation of Potent Compounds for Various Activities. <p>Animal Biotechnology</p> <ol style="list-style-type: none"> 8. Media preparation and Sterilization. 9. Primary Cell Culture. 10. Tryphan Blue Dye Exclusion Assay. 11. MTT Assay. 		

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