JECRC UNIVERSITY

School of Sciences
Course Structure and Syllabus
B. Sc. Biotechnology
2020-2023

School of Sciences
Syllabi and Course Structure
B.Sc. (Biotechnology)
Academic Programmes
Batch (2020-2023)

Total credit for Batch 2020-2023: 153 Credits

Details of B.Sc various subjects and their credits with contact hours are given below:

Semester I

S. No.	Subject Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits	
						L	P		
	BBI019A	Cell Biology	4	-		4		4	C
	BBI020A	Practical of Cytology			2		1	1	C
	BBI021A	Biological Macromolecules	4	-		4		4	F
	BBI022A	Qualitative estimation of biological molecules			2		1	1	F
	BBI023A	Microbiology	4	-		4		4	ID
	BBI024A	Practical's of Microbiology			2		1	1	ID
	BBI062A	Basic of Chemistry	4		2	4		4	ID
	BBI058A	Practicals of Chemistry			2		1	1	ID
	BMC001A	Fundamental of computers	2	-				2	

	BMC002 A	**Fundamental of computer lab**			**-**	**2**		**1**	
	BMC051 A	**Environmental studies**	**3**		**1**	**2**		**4**	
								27	

Semester II

S. No.	**Subject Code**	**Subject**	**Lecture (Hr.)**	**Tutorials (Hrs.)**	**Practical (Hrs.)**	**Credits**		**Total Credits**	
						L	**P**		
1.	**BBI026A**	**Metabolic Pathway**	**4**	**-**		**4**		**4**	**F**
2.	**BBI027A**	**Quantitative estimation of Biological molecules**			**2**			**1**	**F**
3.	**BBI028A**	**Genetics**	**4**	**-**		**4**		**4**	**S**
4.	**BBI029A**	**Practical's of Genetics**			**2**			**1**	**S**
5.	**BBI030A**	**Analytical Techniques**	**4**	**-**		**4**		**4**	**F**
6.	**BBI031A**	**Practical's of Biotechniques**			**2**			**1**	**F**
7	**BBI063A**	**Ecology and Environment Management**	**4**			**4**		**4**	**ID**
8	**BBI064A**	**Practicals of Ecology and Environment**	1		**2**			**1**	**ID**
9.	**BMC003 A**	**Computer Application – II(Advanced MS-Excel)**	**3**	**-**				**1**	**G**
10.	**BMC102 A**	**Communication skills I**	**3**		**-**	**3**		**3**	**F**
								24	

Semester III

S. No.	**Subject Code**	**Subject**	**Lecture (Hr.)**	**Tutorials (Hrs.)**	**Practical (Hrs.)**	**Credits**		**Total Credits**	
						L	**P**		
1.	**BBI033**	**Introductory**	**4**	**-**		**4**		**4**	**C**

	A	**Immunology**							
2.	**BBI034A**	**Practical's of Immunological techniques**			**2**			**1**	**C**
3.	**BBI035A**	**r-DNA technology**	**4**	**-**		**4**		**4**	**S**
4.	**BBI036A**	**Practical's of Genetic Engineering**			**2**			**1**	**S**
5.	**BBI037A**	**Medical Biotechnology**	**4**	**-**		**4**		**4**	**S**
6.	**BBI038A**	**Practical's of Medical Biotechnology**			**2**			**1**	**S**
7.	**BBI065A**	**Biostatistics**	**4**			4		**4**	**ID**
8.	**BBI066A**	**Problem Based on Biostatistics**	**2**		**2**		**1**	**1**	**ID**
9.	**BMC004A**	**Computer Application – III(Advanced MS-Projects)**		**-**	2			**1**	**G**
10.	**BMC105A**	**Communication skills II**	**3**		**-**	**3**		**3**	**F**
								24	

Semester IV

S. No.	**Subject Code**	**Subject**	**Lecture (Hr.)**	**Tutorials (Hrs.)**	**Practical (Hrs.)**	**Credits**	**Total Credits**		
						L	**P**		
1.	**BBI040A**	**Molecular Biology**	**4**	**-**		**4**		**4**	**C**
2.	**BBI041A**	**Practical's of Molecular Biology**			**2**			**1**	**C**
3.	**BBI042A**	**Plant Biotechnology**	**4**	**-**		**4**		**4**	**S**
4.	**BBI043A**	**Practical's of Plant Tissue Culture**			**2**			**1**	**S**
5.	**BBI044A**	**Bioprocess Engineering and Technology**	**4**	**-**		**4**		**4**	**C**
6.	**BBI045A**	**Practical's of Fermentation**			**2**			**1**	**C**

		Technology							
7	**BBI067A**	**Microbial Physiology**	**4**			**4**		**4**	**ID**
8	**BBI068A**	**Practicals of Microbial Physiology**			**2**	1		**1**	**ID**
7.	**BMC005A**	**Computer Application – IV(Web Designing)**	**2**	**-**		**2**		**2**	**S**
8.	**BMC006A**	**Computer Application – IV(Web Designing) Lab**			**2**			**1**	**S**
9.	**BMC111A**	**Communication Skill IV**	**3**			**3**		**3**	**F**
								26	

Semester V

S. No.	**Subject Code**	**Subject**	**Lecture (Hr.)**	**Tutorials (Hrs.)**	**Practical (Hrs.)**	**Credits**		**Total Credits**	
						L	**P**		
1.	**BBI047A**	**Proteomics and Genomics**	**4**	**-**		**4**		**4**	**C**
2.	**BBI048A**	**Practical Exercises of Bioinformatics**			**2**			**1**	**C**
3.	**BBI069A**	**Animal Tissue culture**	**4**	**-**		**4**		**4**	**S**
4.	**BBI050A**	**Practical of Animal Biotechnology**			**2**			**1**	**S**
5.	**BBI070A**	**Environmental Biotechnology**	**4**	**-**		**4**		**4**	**C**
6.	**BBI052A**	**Practical's of Environmental Biotechnology**			**2**			**1**	**C**
7.	**BMC113A**	**Communication Skills V**	**3**	**-**		**3**		**3**	**F**
8.	**BMC109A**	**Value Education Human rights and Legislative Procedures**	**3**			**3**		**3**	**G**
10.	**BBI071A**	**Project**			6			**6**	
								27	

Semester VI

S. No.	Subject Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits	
						L	P		
1.	BBI072A	IPR, Biosafety, Bioeathics Entrepreneurship Development	4			4		4	ID
2	BBI073A	Exercise Based on IPR, Entrepreneurship				2		1	ID
3	BBI074A	Basics of Forensic Science	4			4		4	C
4	BBI075A	Practicals on Forensic Science				2		1	C
5	BBI076A	Biotechnology and Human Welfare	4			4		4	C
6	BBI077A	Practical Based on Biotechnology and Human Welfare	2			2		1	C
7	BBI078A	Molecular Diagnostics	4			4		4	S
8	BBI079A	Practical of Molecular Techniques				2		1	S
9	BBI080A	Industrial Fermentations	4			4		4	C
10	BBI081A	Practicals of Fermentation				2		1	C
								25	

Total Credits

Credits	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	Total
	27	24	24	26	27	25	153

Semester I

Subject Code	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI019A	Cell Biology	4	-	2	4	1	5
BBI021A	Biological Macromolecules	4	-	2	4	1	5
BBI023A	Microbiology	4	-	2	4	1	5
BBI062A	Basics of Chemistry	4		2	4	1	5
BMC001A	Fundamental of Computers	2	-				2
BMC002A	Fundamental of Computers lab			2			2
BMC051A	Environment Studies	3	-	-	3		3
							27

JECRC University
Department of Biotechnology,
B.Sc. Semester – I
Course – Cell Biology
Course Code – BBI019A
Lectures: 4 Hrs/week

UNIT 1	Cell
UNIT 2	Cell division
UNIT 3	Transport across membrane
UNIT 4	Structure of cilia and flagella
UNIT 5	Centrioles and basal bodies

PROGRAM OUTCOME

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies.

(Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able understand the structure and function of cell and cell organelles. Describe the structure and function of membranes, especially the phospholipid bilayer.

CO-2 Students will be able to understand the types and mechanism of cell division and able to identify the different stages of cell division

CO-3 Students will be able to explain distinguish between passive and active transport; explain how substances are directly transported across a membrane. Describe the primary mechanisms by which cells import and export macromolecules and protein folding.

CO-4 Students will be able to understand the organization of flagella. Explain the assembly of microtubules and microfilaments.

CO-5 Students will be able to explain structure and chemical composition of centrioles and basal bodies

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	H	L	H	L	L	L	L
CO3	M	M	M	L	M	M	M
CO4	M	M	L	L	L	L	M
CO5	H	H	M	M	H	M	M

L-LOW, M-MEDIUM, H-HIGH

BBI019A: CELL BIOLOGY **Credit(s): 4**

Unit-I

Cell: Shapes, Morphology, difference between plant cell and Animal cell, Prokaryotes and Eukaryotes, Structure, Function, Relationship including organelles and their Biogenesis (e.g., Endoplasmic reticulum, Golgi body, nucleus, Lysosomes, vacuoles); Cell theory; Membrane structure, cell wall.

Unit-II

Cell divisions: Cell cycles, Amitosis, Mitosis phases, structure and functions of spindle apparatus; anaphasic chromosome movement; Meiosis: phases, synaptonemal complex formation of chiasmata. Significance of mitosis and meiosis

Unit-III

Transport across membrane: Active, Passive, Facilitated; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.

Chromosome organization: eukaryotic and prokaryotic, Chromosomes morphology: Centromere, Telomere; Specialized types of chromosomes: Sex chromosomes, Lampbrush chromosome, polytene chromosomes, Nucleosomes, Solanoid and Super solenoid modal

Unit-IV

Structure of cilia and flagella, microtubule and microfilament microtubule assembly, functions of filament and microtubules, Structure of Plastids and the light reaction and

dark reaction, Centrioles and basal bodies: structure, chemical composition, duplication of centrioles, function of centrioles and basal bodies,

Unit-V

Structure of Mitochondria, Ribosomes Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

Text / Reference Books

1. Strickberger "Genetics" (Macmillan)

2. Garreld Karp "cell biology"

3. C.B.Pawar "Cell biology"

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

BBI020A: Practical of Cytology **Credit(S): 1**

1. To analyze prepared slides of mitosis
2. To perform and identify different stages of mitosis in onion root tip
3. To analyze prepared slides of meiosis
4. To perform and identify different stages of mitosis in onion flower bud
5. To prepare the slide of Giant chromosome
6. To analyze slides of different cell organelles
7. Introduction to microtomy and apparatus handling
8. To localize lipid Histochemically
9. To localize starch Histochemically
10. To localize proteins Histochemically
11. To perform paper chromatography for dyes
12. To perform chromosomal banding using dyes
13. Demonstration of dialysis
14. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes

B.Sc. Semester- I
Course-Biological Macromolecules
Course Code-BBI020A
Lectures: 4 Hrs/week

UNIT 1	**Molecular Interaction and vitamins**
UNIT 2	**Carbohydrates**
UNIT 3	**Lipids**
UNIT 4	**Amino acids and Proteins**
UNIT 5	**Nucleic acids**

PROGRAM OUTCOME

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PO5. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to classify different types of molecular interactions, understand basic chemical reactions, categorize molecules according to their functional group and demonstrate familiarity with the pH scale

CO-2 Students will be able to define, classify and summarize the roles that carbohydrates play in biological systems. Predict the products of chemical reactions of carbohydrates (acetal/hemiacetal formation or oxidation).

CO-3 Students will be able to illustrate different types of lipids and relate their structure to their role in biological systems. Describe/recognize lipids found in cell membranes and their transport across membranes.

CO-4 Students will be able to describe/recognize amino acid structures, describe their physical and chemical properties, and predict how their ionic charges change with pH. Define primary, secondary, tertiary and quaternary structure and function of proteins and identify the types of interactions important in each case.

CO-5 Students will be able to describe/recognize nucleic acids, DNA and RNA. Explain the role that nucleic acids play in DNA and RNA.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2		M	L	L		L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L			L	
CO5		H	H	M	M	H	M

L-LOW, M-MEDIUM, H-HIGH

BBI021A: BIOLOGICAL MACROMOLECULES Credit(s):4

Unit-I

Molecular interactions: The concept of pH, dissociation and ionization of acids and bases, Lewis acid and base, buffers and their role in biology, buffering mechanism, Henderson-Hasselbalch equation, biological buffer and Their Importance

Vitamins: Structure and biochemical properties of water soluble and fat soluble vitamins and their coenzyme activity.

Unit-II

Carbohydrates: Introduction, biological importance. Definition, Classification, Monosaccharides other than glucose, glycosidic, bond, disaccharides, polysaccharides (starch, glycogen, peptidoglycan) Hetero polysaccharides, Mutarotation, osazone formation, Inversion of Sucrose

Unit-III

Lipids: Introduction Structure, distribution and biological importance of fats and fatty acids; Chemical properties and characterization of Fats, Waxes, Cerebrosides, gangliosides, phospholipids and their types and proteolipids; Steroids and Prostaglandins

Unit-IV

Amino acids: Definition, Classification, Structure and types; Proteins: Classification, structure and properties, biologically active peptides, classification and properties of proteins, structure of proteins-primary, secondary, tertiary and quaternary structure of proteins.

Unit-V

Nucleic acids: Structure of purines, pyrimidines, nucleosides and nucleotides; Structure, types and biological role of RNA and DNA

Text / Reference Books

1. Outlines of Biochemistry: Conn and Stumpf
2. Principles of Biochemistry: Jeffory Zubey
3. Biochemistry: Stryer

BBI022A: Qualitative estimation of biological molecules **Credit(s): 1**

1. To prepare the solutions of given normality and its standardization.

2. To Calibrate the pH meter by using different buffer solutions
3. To Prepare the buffer solutions
4. To determine the pKa value and hence the Dissociation constant of a given acid by using pH meter.
5. To prepare buffer solutions in the pH range of 2.2 to 8.0
6. To perform Qualitative estimation of carbohydrates
7. To perform Qualitative estimation of proteins
8. To perform Qualitative estimation of lipids
9. To perform the Titrimetric estimation of molar and mass concentration of sulfuric acid
10. To Determine the acid value of oil
11. To verify Lambert and beer law's
12. To calibrate spectrophotometer using $K_2Cr_2O_7$ solution
13. To study activity of any enzyme under optimum conditions.
14. To study the effect of pH, temperature on the activity of salivary amylase enzyme
15. To study relation between absorbance and % transmission

JECRC University
Department of Biotechnology
B.Sc. Semester- I
Course- Microbiology
Course Code: BBI023A
Lectures: 4 Hrs/week

UNIT 1	**History and Introduction to Microbiology**
UNIT 2	**Morphology and subcellular structures**
UNIT 3	**Microbial nutrition**
UNIT 4	**Bacterial Growth**
UNIT 5	**Control of Growth of Microbes**

PROGRAM OUTCOME

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Course outcome

CO-1 Students will be able to describe how field of microbiology and other branches have evolved; microorganisms are classified and cite examples of the vital role of microorganisms in biotechnology, fermentation, medicine, and other industries important to human well being and explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats.

CO-2 Students will be able to explain morphology and subcellular structures of prokaryotic cell. Explain the role of different structures in the prokaryotic cell.

CO-3 Students will be able to describe classification of microbes on the basis of mode of nutrition.

CO-4 Students will be able to able to characterization different types of bacterial culture. Identify various phases of bacterial growth.

CO-5 Students will be able to analyze the role of various methods in controlling the growth of microbes.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	H	L	M	M	L	M	M
CO2	M	M	L	M	H	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	M	L	L	H
CO5	H	H	M	M	H	M	L

L – LOW, M- MEDIUM, H-HIGH

BBI023A: MICROBIOLOGY **Credit(s): 4**

Unit-I

Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms Eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses, Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

Unit-II

Morphology and subcellular structures: Bacterial morphology,Plasmids and episomes, nuclear material, Bacterial cell wall structure, Structure of viruses, Virus Replication Cycles, Mechanisms of Viral Entry and Spread of Infection, HIV Hepatitis New and Reemerging Viruses Prions and Viroids Plant Viruses Bacteriophages, Poliovirus Influenza, Rabies, Poxviruses, Plant Virsus, TMV

Unit-III

Microbial Nutrition: Nutritional types (definition and example) - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (ammonia, nitrite, sulfur, hydrogen, iron oxidizing bacteria); Chemoorganotrophs, Effect of oxygen on growth - classification on the basis of oxygen requirement and tolerance

Unit-IV

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria**.**

Unit-V

Control of growth of Microbes: Sterilization, disinfection, antiseptic, sanitizer, germicide, antimicrobial agent (definition, application & examples); physical method of disinfection and sterilization - dry heat, moist heat, filtration, radiation (mode of action, applications); Chemical control, Assessment of chemical disinfectant; phenol coefficient-definition and method of determination

Text / Reference Books

1. Stanier, RY., et al., General Microbiology, 5th ed., 2000, Tata-McGraw Hill
2. Atlas, RM., Principles of Microbiology, 2nd ed., 1997, McGraw-Hill

BBI024A: Practicals of Microbiology **Credit(s): 1**

1. To perform the Simple staining
2. To perform the Gram staining
3. To perform the Endospore staining
4. To perform the Acid fast staining
5. To prepare the different types of media
6. To Prepare Nutrient Agar media for bacterial culture
7. To Prepare the Potato Dextrose Agar media for fungal culture
8. To Prepare Nutrient and SDA Broth for fungal culture
9. To isolate microflora from soil
10. To isolate microflora from air
11. To isolate identify bacteria on the basis of their shapes
12. To Culture microflora from water by spreading and serial dilution method
13. Determination of bacterial cell size by micrometry. . Enumeration of microorganism - total & viable count.

JECRC University
Department of Biotechnology
B.Sc. Semester-I
Course – Basics of Chemistry

Course Code – BBI062A
Lectures: 4 Hrs/week

UNIT 1	**Structure of Atom**
UNIT 2	**Bonding in organic compounds, Various Bonds involved in Chemistry**
UNIT 3	**Molecular orbital theory**
UNIT 4	**Reaction Mechanism, Enzymes, Acid Base**
UNIT 5	**Thermodynamics**

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Course outcome

CO-1 Students will be able to understand the basic of atomic structure, the various principals.

CO-2 Students will be able to describe the various bond involved in chemistry, the propertiesof bonds etc.

CO-3 Students will be able to describe molecular orbital theory and how it is different from VBT
CO-4 Explain the various reaction mechanisms found in organic chemistry.

CO-5 Students will be able to demonstrate familiarity with the first and second laws of thermodynamics; classify different types of atomic bonds; understand basic chemical reactions and demonstrate an understanding of the metabolic pathways - the energy-yielding and energy-requiring reactions in life

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	M	M	L	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	L	L	M	M
CO4	M	L	L	L	M	L	H
CO5	H	H	M	H	H	M	M

L – LOW , M- MEDIUM , H-HIGH

Paper-BBI062A -Basic of Chemistry **Credit(s): 4**

Unit I

Structure of Atom- Discovery of electron, proton and neutron; atomic number, isotopes and isobars Thompson's model and its limitations, Rutherford's model and its limitations, Bohr's model and its limitations, concept of shells and sub shells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals -

Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals.

Unit II

Bonding in organic compounds: Classification, trivial names and IUPAC system of nomenclature of organic compounds, Nature of covalent bond and its orbital representation, Hybridization, bond energy, polarity of bond & dipole moment of molecules, inductive effect, hydrogen bond, Hemolytic & heterolytic fission of bonds electrophile & nucleophile, carbonation, carbon ions and radicals- there stability, geometry & generation.

Various Bonds involved in Chemistry

Ionic Bond, Coordination Bond, Vander walls force, Di sulphide bond, Nature of covalent bond and its orbital representation, Hybridization, Covalent bond Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridisation and shapes of inorganic molecules and ions- BeF2, SnCl2,

XeF_4, BF_3, NH3, H_2O, ClF_3, ICl_2, PF_6, SF_6 and IF_7

Unit III

Molecular orbital theory Homo nuclear (elements and ions of Ist and 2nd row) and heteronuclear (BO, CN, CO+, NO, CO, CN-), bond energy, polarity of bond & dipole moment of molecules, inductive effect, hydrogen bond, conjugation, resonance. Electrophile & nucleophile, carbonation, carbon ions and radicals- there stability, Concept of oxidation and reduction, redox reactions, oxidation number,

Unit IV

Reaction Mechanism: SN1 & SN2 reaction, E1&E2 reaction (elementary treatment) of aliphatic hydrocarbon.. Nucleophilic and electrophilic aromatic substitution with examples

Acid and Bases Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases. Buffer, Handerson equation, significance of Buffers, concept of pH., Hydrolysis of salts (elementary idea), , buffer solutions, Henderson equation.

Enzymes- Nomenclature, Classification, Properties, Their Kinetics, Inhibition of Enzymes, Reversible and Irreversible Inhibition, Feedback inhibition, Abzymes, Ribozymes, mode of action, lock and key model

Unit V

Thermodynamics Entropy, First law and Second Law of thermodynamics, High energy compounds and their classifications, ATP-ADP cycle, Chemosmotic theory for ATP production, structure of ATP, Redox Reactions, Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers , applications of redox reactions.

Text / Reference Books

1. Peter Sykes A Guidebook to Mechanism in Organic Chemistry
2. M.S Chauhan version of Solomon Fryhle
3. Problems in chemistry by M.S Chauhan (Buy Solution book too :P) {Balaji}
4. Modern Approach To Chemical Calculations (By R.C Mukherjee) {Bharti Bhavan}

BBI058A: Practicals of Chemistry **Credit(s): 1**

1. To prepare the solutions of different Normality, Molaritty, and Percentage
2. To calibrate PH meter/colorimeter
3. To Titrate Strong Acid against strong Base using indicator
4. To verify Lambert beer law
5. General safety measures with special reference to safe handling of chemicals
6. To Prepare dilute solutions of known concentration of sulphuric acid, hydrochloric acid and nitric acid.
7. To Study pH change by common-ion effect in case of weak acids and weak bases by above method (specific examples of CH_3COOH and CH_3COONa and NH4OH and NH4Cl may be taken
8. To Separate coloured substances by paper chromatography, and comparison of their Rf values. (a) a mixture of red and blue ink or a black ink. (b) juice of a flower or grass.
9. Study of solubility of solid substances in water at different temperatures and plotting of a solubility curve.
10. Acquaintance with chemistry laboratory and basic laboratory techniques (cutting, bending and boring of glass tubes, sealing of apparatus, filtration, distillation, crystallization, preparation calibration, cleaning of glass apparatus and use of burner etc.)

SEMESTER-II

Subject Code	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI026A	Metabolic Pathways)	4	-	2	4	2	5
BBI028A	Genetics	4	-	2	4	2	5
BBI030A	Analytical Techniques	4	-	2	4	2	5
BBI063A	Ecology and Environment Management	4		2	4	1	5
BMC003A BMC004A	Computer Applications	3	-				3
BMC102A	Communication Skills	3	-	-	3		3
							26

JECRC University
Department of Biotechnology
B.Sc. Semester-II
Course – Metabolic Pathways
Course Code – BBI026A
Lectures: 4 Hrs/week

UNIT 1	Bioenergetics; General Concepts of Thermodynamics
UNIT 2	Carbohydrate Metabolism
UNIT 3	Lipid Metabolism
UNIT 4	Amino Acid Metabolism
UNIT 5	Nucleotide Metabolism

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context sociotechnological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to demonstrate familiarity with the first and second laws of thermodynamics; classify different types of atomic bonds; understand basic chemical reactions and demonstrate an understanding of the metabolic pathways - the energy-yielding and energy-requiring reactions in life

CO-2 Students will be able to describe what happens during carbohydrate digestion, glycolysis, glycogenesis, and glycogenolysis. Illustrate the basic components and steps of fermentation. Describe what happens in the citric acid cycle, oxidative phosphorylation & ETS. Explain the role of each process in energy production. Identify the basic components and steps photosynthesis. Calculate the energy outcome from both carbohydrates and fats.

CO-3 Students will be able to describe what happens in fatty acid oxidation and synthesis as well as in ketogenesis.
CO-4 Explain what happens during digestion of proteins, catabolism of amino acids and the urea cycle.

CO-5 Students will learn the different ways of anabolism and catabolism of nucleic acids. They will be able to describe various types of genetic mutation and inborn errors of metabolism. Describe the methods for detecting and correcting inborn errors of metabolism. Understand the relation between biochemical defects and metabolic disorders. Understand the metabolic basis of cancer, diabetes and other diseases.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	L	M	L	H
CO5	H	H	M	M	H	M	M

L – LOW , M- MEDIUM , H-HIGH

BBI026A: Metabolic Pathways **Credit(s): 4**

Unit-I

Bioenergetics; General concepts of Thermodynamics: Laws of Thermodynamics, Enthalpy, Entropy, Free energy & Chemical Equilibria, High Energy Bonds & Compounds, ATP-ADP Cycle, Oxidation-reduction Reactions and Redox potential, chemosmotic theory for ATP Production, Metabolism: Introduction (Anabolism & catabolism),

Unit-II

Carbohydrate metabolism: Glycolysis, Fermentation, Citric acid cycle, Oxidative Phosphorylation and ETS, Gluconeogenesis, Glycogenesis and Glycogenolysis, HMP shunt, Glyoxylate pathway.

Unit-III

Lipid metabolism: Fatty acid degradation (beta, alpha, and omega degradation), degradation of odd chain fatty acids, Fatty acid synthesis, Regulation of fatty acid metabolism. Cholestrol Biosynthesis, Ketone Bodies formation and degradation

Unit-IV

Amino acid metabolism: Transamination, deamination, oxidative deamination, Amino acid degradation & Biosynthesis, Urea cycle and its regulation.

Unit-V

Nucleotide metabolism: Synthesis of purines & pyrimidines nucleotides, salvage pathway, nucleotide degradation, associated metabolic disorders. Leasch Nayan Syndrome, SCID

Text / Reference Books

1. Outlines of Biochemistry: Conn & Stumpf
2. Principles of Biochemistry: Voet & Voet
3. Principles of Biochemistry: Jeffory Zubey
4. Clinical Biochemistry: D.C Deb
5. Biochemistry: Stryer
6. Lehninger's Principles of Biochemistry: Nelson & Cox

BBI027A: Quantitative estimation of Biological molecules **Credit(s): 1**

1. To perform Quantitative estimation of carbohydrates by anthrone method
2. To perform acid value for given oil
3. To perform Quantitative estimation of RNA using Orcinol method
4. To perform Quantitative estimation of DNA using DPA method
5. To perform the Chlorophyll estimation Arnon' method
6. To Separate the dyes using radial paper chromatography
7. To separate Amino acid using paper chromatography
8. To separate Amino acid using thin layer chromatography
9. To Determine saponification value of oil
10. To perform Quantitative estimation of Protein by Biuret method
11. To perform Quantitative estimation of Protein by Barford method
12. To perform Quantitative estimation of reducing sugar
13. To perform Quantitative estimation of glycogen

JECRC University
Department of Biotechnology
B.Sc. Semester-II
Course-Genetics

Course Code-BBI028A
Lectures: 4 Hrs/week

UNIT 1	**Mendelian Principles**
UNIT 2	**Sex determination, linkage and crossing over, Sex linked inheritance**
UNIT 3	**Principles of linkage**
UNIT 4	**Mutations**
UNIT 5	**Population Genetics**

PROGRAM OUTCOME

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Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to identify the impact of Gregor Mendel on the field of genetics and apply Mendel's laws of inheritance. Apply the principles of extensions to Mendelian inheritance, including multiple allelism, lethal alleles and gene interactions. Describe non-Mendelian inheritance.

CO-2 Students will be able to describe the chromosomal basis of inheritance. Discuss the role environment plays on phenotypes. Explain sex determination and sex linked inheritance.

CO-3 Students will be able to explain linkage, recombination, and the mapping of genes on chromosomes. Deduce the relationship between genetic, physical, and cytogenetic maps. Discuss the role environment plays on phenotypes.

CO-4 Students will be able to describe the structure and function of a gene. Describe normal chromosome number, structure, and behavior in human cells, and understand the cause and effect of alterations in chromosome number and/or structure. Understand how to identify and classify mutations in DNA. Describe examples of human genetic disorders caused by gene mutations and chromosomal rearrangements. Describe extra chromosomal inheritance and cite examples of extra chromosomal inheritance.

CO-5 Students will be able to examine karyotypes and identify the effects of significant changes in chromosome number. Explain the conventions of a family pedigree and predict whether a disease will be passed through a family in one of three modes, the key concepts in population, evolutionary and quantitative genetics including: the basis of genetic variation; heritability; Hardy-Weinberg Equilibrium; roles of migration, mutation. Apply the Hardy-Weinberg Law in analyzing population genetics for gene frequency, sex linkage, equilibrium, and heterozygote frequency.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	M	L	L	M
CO5	H	H	M	M	H	M	H

L – LOW, M- MEDIUM, H-HIGH

BBI028A: Genetics **Credit(s): 4**

Unit-I

Mendelian principles: Principle of segregation, monoclonal crosses, dominance, co dominance, lethal genes. Principle of independent assortment: dihybrid gene interactions, epistasis, multiple alleles.

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Unit-II

Sex determination, linkage and crossing over, Sex linked inheritance- Mechanism of sex determination: Simple mechanisms, One or a few genes, identification of sex chromosomes, XX-XY mechanism, Y chromosome and sex determination in mammals, Balanced concept of sex determination in Drosophila, plant, Environmental factors in sex determination, Sex linked inheritance.

Unit-III

Principles of linkage: Crossing over, cytological basis of crossing over, chromosome mapping by two factor crosses, interference, Molecular concept of the gene and gene mapping.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA. Genetic organization of prokaryotic and viral genome. Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

Unit-IV

Mutations: induced mutations in plants, animal and microbes for economic benefit of man spontaneous and induced, Frame shift mutation,

Extra-chromosomal inheritance: Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

Unit-V

Population Genetics: Behavioral genetics, Hardy-Weinberg frequencies, inbreeding, calculating F from pedigrees. Human Genetics: chromosomal banding, turner syndrome, klinfiter syndrome, Down syndrome, patau syndrome, Edward syndrome, cat cry syndrome, barr body.

Text / Reference Books

1. Strickberger "Genetics" (Macmillan)
2. Freifelder "Genetics"

BBI029A: Practicals of Genetics **Credit(s): 1**

1. To study the Mendel's law of inheritance
2. To analyze various chromosomal abnormalities
3. To perform the Karyotyping of normal human cells
4. To perform the Karyotyping of abnormal human cells
5. To perform the Pedigree analysis
6. To determine the Problems related to pedigree analysis (2)
7. To study the Linkage in Drosophila.
8. To determine the Problems related to linkage
9. To analyze Barr body using methylene blue
10. To analyze different stages of Mitosis and Meiosis
11. Differential staining of WBC
12. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
13. Karyotyping with the help of photographs

JECRC University
Department of Biotechnology
B.Sc. Semester-II
Course-Analytical Techniques
Course Code-BBI030A
Lectures: 4 Hrs/week

UNIT 1	**Instruments, basic principle and usage**
UNIT 2	**Microscopy**
UNIT 3	**Basic principles of electrophoresis**
UNIT 4	**Chromatography**
UNIT 5	**Spectroscopic Techniques**

PROGRAM OUTCOME

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Program Specific Outcome

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Course outcome

CO-1 Students will be able to explain the basic principle of pH and detection systems involved in measurement.

CO-2 Students will be able to understand why and how the light microscope and electron microscope are used in biology. Understand the principle and technique of sedimentation

CO-3 Students will be able to explain principles of electrophoresis techniques and discuss how these techniques can be used for various purposes. Explain the basic principles of analyses and detection systems involved in radio isotopic techniques. Describe hazards related with radiations and related safety measures.

CO-4 Students will be able to explain basic principles for chromatographic separation techniques and typical applications of chromatographic techniques.

CO-5 Students will be able to describe Beer Lambert's Law. Explain the theoretical principles of selected instrumental methods within spectrometric/spectrophotometric methods, and main components in such analytical instruments.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M	L	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	H	M	L	L
CO5	H	H	M	M	H	M	L

L – LOW, M- MEDIUM, H-HIGH

BBI030A: Analytical Techniques **Credit(s): 4**

Unit-I

Instruments, basic principle and usage: pH meter, Measurement of pH: Principles of glass and reference electrodes, types of electrodes, calibration of pH meter, Handerson equation, biological buffer.

Unit-II

Microscopy: Simple microscopy, Phase contrast microscopy and electron microscopy (TEM and SEM). Sedimentation- Sedimentation velocity, preparative and analytical ultracentrifugation techniques

Unit-III

Basic principles of electrophoresis: AGE and SDS-PAGE and their importance, Radioisotopic Techniques: Types of radioisotopes used in Biochemistry, units of radioactivity measurements, isotopes commonly used in biochemical studies – 32P, 35S, 14C and 3H), application of isotopes, Autoradiography: Biological hazards of radiation and safety measures in handling radioisotopes; Biological applications

Unit-V

Chromatography: General principles and applications of – Adsorption chromatography, Ion-exchange chromatography, Thin-layer chromatography, Hydrophobic chromatography, Gas-liquid chromatography, HPLC, Affinity chromatography, Paper chromatography.

Unit-V

Spectroscopic Techniques: Beer-Lambert law, light absorption and its transmittance, determination and application of extinction coefficient, application of visible and UV spectroscopic, and its application, IR spectroscopy and their applications

Text / Reference Books

1. Textbook of optics and atomic physics – P.P. Khandelwal (Himalaya Publishing House
2. Nuclear physics an introduction – S.B. Patel (New Age International) Biophysics – Pattabhi and Gautham (Narosa Publishing House)
3. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
4. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
5. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
6. Introduction to atomic spectra – H.E. White (Mc Graw Hill)
7. Molecular cell biology – Ladish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell (W.H. Freeman and Co.)

8. Biophysics - Cotrell (Eastern Economy Edition)

9. Clinical Biophysics –Principles and Techniques- P. Narayanan (Bhalani Pub., Mumbai

BBI031A: Practicals of Biotechniques **Credit(s): 1**

1. To Calibrate the spectrophotometer
2. To perform Verification of Beer-Lambert Law
3. To calibrate pH meter without buffer solution
4. To prepare a solution of different Normality, molarity
5. To prepare primary and secondary standard solution
6. To convert secondary standard solution into primary standard solution
7. To determine the λ_{max} for DNA
8. To separate various molecule on the basis of their sedimentation coefficient
9. To separate Amino acid using paper chromatography
10. To separate Amino acid using thin layer chromatography
11. To separate the aliphatic and aromatic fraction of oil by column chromatography
12. To separate the DNA using agarose gel electrophoresis

JECRC University
Department of Biotechnology
B.Sc. Semester-II
Course- Ecology and Environment Management
Course Code-BBI063A
Lectures: 4 Hrs/week

UNIT 1	**Our Environment**
UNIT 2	**Energy transfer in an Ecosystem**
UNIT 3	**Environmental Management Plan**
UNIT 4	**Environmental biotechnologies**
UNIT 5	**Hazardous Waste Management and Treatment-**

PROGRAM OUTCOME

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Program Specific Outcome

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PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain the basic the basic knowledge of ecology and environment.

CO-2 Students will be able to understand Detail knowledge about the ecosystem

CO-3 Students will be able to Pollution and waste management

CO-4 Students will be able to explain basic Biotechnological approach of environmental management.

CO-5 Students will be able to describe Hazardous Waste Management and Treatment- **Mapping of PO/CO**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	L	L	M	M
CO2	M	L	L	M	L	M	L
CO3	H	M	M	L	M	M	M
CO4	M	L	M	H	M	L	L
CO5	H	H	M	L	H	M	L

L – LOW, M- MEDIUM, H-HIGH

Paper Code BBI063A Ecology and Environment Management

Credit(s): 4

Unit-I

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem, Types of ecosystem including habitats, Cybernetics & Homeostasis. Biological control of chemical environment

Unit II

Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids, 10% law, Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N,C,P cycles). Bio-monitoring, active and passive monitoring, concept of bioaccumulation, bio-indicator parameters, bio-air conditioning and bio-purifiers

Unit-III

Environmental Management Plan - Monitoring of Environmental Quality Training, Rainwater Harvesting Statutory requirements and Implementation Green Belt Plantation, Documentation Social Responsibility, Environmental Management Cell,

Unit-IV

Environmental biotechnologies- Biotechnologies in protection and preservation of environment, Bioremediation, Brief account of important viral, bacterial and fungal diseases of plants and their ecosystem level effects. Elementary information of gene transfer, brief account of cloning vehicles and recombinant DNA technology and its applications. Selection for nutritional quality, disease resistance, salt and drought tolerance, Involvement of microbial communities in bio-degradation, Microbiological management of hazardous waste and waste lands

Hazardous Waste Management and Treatment- Hazardous Waste: Identification and Classification, Hazardous Waste Management, Hazardous Waste Treatment, Physical and chemical treatment, Biological treatment and Thermal Treatment, Hazardous Waste Management in India

Unit V

Principles of Enviroemtn Management- Introducing Environmental Management, (EM) Definition and scope, Goals of EM, Need for EM, Need for sustainable development, EM tools

Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS), scope and types of environmental audit, cost benefit analysis, environmental management plan (EMP), international organization for standardization (ISO), standards and certification,

Text / Reference Books

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge University Press.

2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.

3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House

4. Joseph, B., Environmental studies, Tata Mc Graw Hill.

5. Michael Allabay, Basics of environmental science, Routledge Press.

6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5thedition) Books/Cole, Thompson Learning, Inc.

7. Mohapatra Textbook of environmental biotechnology IK publication.

8. Rana SVS, Environmental pollution – health and toxicology, Narosa Publication

9. Sinha, S. 2010. Handbook on Wildlife Law Enforsement in India. TRAFFIC, India.

10. Thakur, I S, Environmental Biotechnology, I K Publication.

BBI064A: Practicals of Ecology and Environment Credit(s): 1

1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.
2. Determination of population density in a terrestrial community or hypothetical community by quad rate method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community.
3. Principle of GPS (Global Positioning System).
4. Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.
5. Study of the types of soil, their texture by sieve method and rapid tests for –pH, chlorides, nitrates, carbonates and organic carbon
6. Study any five endangered/ threatened species- one from each class.

SEMESTER-III

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI033A	Introductory Immunology	4	-	2	4	1	5
BBI035A	r-DNA Technology	4	-	2	4	1	5
BBI037A	Medical Biotechnology	4	-	2	4	1	5
BBI065A	Biostatistics	4		2	4	1	5
BMC005A BMC006A	Computer Applications	3	-				3
BMC104A	Communication skills	3	-	-	3		3
							26

JECRC University
Department of Biotechnology
B.Sc. Semester- III
Course-Introductory Immunology
Course Code-BBI033A
Lectures: 4 Hrs/week

UNIT 1	**Overview of Immune System**
UNIT 2	**Antigen and Antibody**
UNIT 3	**Antigen-Antibody Interaction and MHC**
UNIT 4	**Major Histocompatibility complex**
UNIT 5	**Vaccines**

PROGRAM OUTCOME

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Course outcome

CO-1 Students will understand the general properties of immune response both innate and adaptive. Cells and tissues involved in the immune response.

CO-2 Students will be able to describe immunogens, properties of immunogens and biological system involved. Explain basic structure of antibody, different types of antibodies and their role in biological system.

CO-3 Students will be able to explain the concept of affinity and avidity, emphasize on the antigen-antibody interaction. Explain employment of antigen-antibody interaction to conduct different immunological and serological test in laboratory.

CO-4 Students will be able to describe structure of MHC molecules, types. Explain the processing and presentation of exogenous and endogenous antigens. Interpret the complement system, components, their roles, activation pathway and their biological roles. Describe immunity in defense and disease with respect to microbes.

CO-5 Students will be able to explain the principle of immunization-vaccination and its role in protection against disease. Describe production, advantages and disadvantages of various types of vaccines.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	H	H	L	L
CO5	H	H	M	M	H	M	M

L – LOW, M- MEDIUM, H-HIGH

BBI033A: Introductory Immunology **Credit(s): 4**

Unit-I

Overviews of immune system: Historical perspectives. Types of immunity: Innate and acquired. Features of immune response: Memory, Specificity and recognition of self and non-self, Clonal nature of immune response; Hematopoiesis and differentiation; Cells and organs of the immune system

Unit-II

Antigen: Immunogenicity v/s antigenicity, factors affecting immunogenicity, nature of immunogen, biological system, epitopes, haptens and antigenicity; Immunoglobulins: Structure of antibody, antibody mediated effector functions, antibody classes and biological activities; Monoclonal antibodies: Production and applications

Unit-III

Antigen-Antibody interactions: types: precipitation and agglutination reaction, radioimmunoassay, ELISA, chemiluminescence, ELISPOT assay, western blot, immune precipitation, immune fluorescence, flow cytometry and fluorescence.

Unit-IV

Major histocompatibility complex: General organization, MHC molecules: structure & genes, their mode of antigen presentation and interaction, cellular distribution of MHC, regulation of MHC expression and disease susceptibility. Complement system: Function, components, activation, regulation and deficiencies of complement. Immune response to infectious diseases: Bacteria, viruses and intracellular parasites.

Unit-V

Vaccines: Active and Passive Immunization Types of Vaccines – Inactivate Attenuated, Purified macromolecules and Recombinant-vector, DNA, Multivalent subunit Vaccines.

Text / Reference Books

1. Roitt I.M, Brostoff, J., Male D.K. (2001). Immunology (Illustrated Publisher, Mosby)

2. T. J. Kindt, R.A. G. B. A. Osborne, J. Kuby (2006). Immunology (W.H. Freeman and Company, New York)

3. Austyn, J.M., Wood, K.J. (1993). Principles of cellular and molecular immunology (Oxford University Press Inc. New York)

4. Paul, W.E. (2008). Fundamental immunology (Lippincott Williams & Wilkins).

5. Birch J.R., Lennox E.S. (1995). Monoclonal antibodies: Principles and applications (Wiley-Liss).

6. T.G. Parslow, D.P. Stites, A.I. Terr (1997). Medical immunology (Lange Medical Books/McGraw-Hill)

7. Ian Freshncy (4th Edition) Buttler.

9. Elements of Biotechnology –P.K. Gupta (1st Edition-200) Rastogi Publications.

BBI034A: Practicals of Immunological Techniques **Credit(s): 1**

1. To perform the Differential leucocytes count
2. To perform total counting of leucocytes
3. To perform the Total RBC count
4. To perform Haemagglutination assay
5. To separate the serum from blood
6. To perform Double immunodiffusion test using specific antibody and antigen.
7. To perform Dot ELISA.
8. To determine the Blood group
9. To perform Oucterlouny Double diffusion (ODD)
10. To perform Rocket Immuno-electrophoresis
11. To perform sandwich ELISA
12. To perform RID
13. To perform IEP

JECRC University
Department of Biotechnology
B.Sc. Semester-III
Course-r-DNA Technology
Course Code-BBI035A
Lectures: 4 Hrs/week

UNIT 1	**Expression of genes in prokaryotic and eukaryotic systems**
UNIT 2	**Tools used in r-DNA technique**
UNIT 3	**DNA sequencing**

UNIT 4	**Polymerase Chain Reaction**
UNIT 5	**Application of r-DNA Technology**

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to whichthese assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context sociotechnological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies.

(Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to define the term regulation as it applies to genes. Discuss different components of prokaryotic and eukaryotic gene regulation. Discuss different components and types of gene regulation

CO-2 Students will be able to explain technical know-how on versatile tools and techniques in recombinant DNA technology. Describe the events involved in generating recombinant DNA molecules, to include cDNA generation, expression vectors and the choice of host cell

CO-3 Students will be able to explain principle and technique of DNA sequencing.

CO-4 Students will be able to explain principle of PCR and site directed mutagenesis.

CO-5 Students will be able to understand application of genetic engineering techniques in basic and applied experimental biology.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	M	L	L	H
CO5	H	H	M	M	H	M	L

L – LOW, M- MEDIUM, H-HIGH

BBI035A: r-DNA Technology **Credit(s): 4**

Unit-I

Expression of genes in prokaryotic and eukaryotic systems: Gene structure in prokaryotic and eukaryotic cells. Gene expression – concept of operon and related elements in the unit, regulatory and structural gene, post translational processing of mRNA, extra chromosomal DNA and its functions. Restriction endonuclease, Ribonucleases, taq DNA, SI nuclease, Alkaline phosphates, klenow enzyme, methyl transferase, restriction modification system

Unit-II

Preparation of desired gene by genomic DNA, from reverse transcriptase and by gene machine; Vectors: bacteriophages, cosmids, Triplasmids, yeast artificial chromosome, shuttle and binary vectors, DNA labeling radioactive and non-radioactive methods

Unit-III

DNA sequencing, Southern and Northern blotting in situ, DNA fingerprinting, Ligation method for gene transfer, Gene transfer technology cDNA and genomic DNA library, gene isolation and cloning, Selection of recombinants

Unit-IV

Polymerase chain reaction and site directed mutagenesis- Expression of cloned gene in recombinant cells, production of biochemicals with examples.

Unit-V

Application of rDNA technology Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

Text / Reference Books

1. D.M. Glover, Genetic Engineering, Cloning DNA, Chapman and Hall, New York, 1980

2. S. Mahesh and A.B. Vedamurthy, Biotechnology-4 (rDNA Technology, Environmental biotechnology, Animal cell culture), New Age publisher.

3. T. A. Brown

4. Primrose

BBI036A: Practicals of Genetic Engineering **Credit(s): 1**

1. To Isolate the genomic DNA from bacteria
2. To perform Isolation of plasmid from bacteria
3. To perform Agarose gel electrophoresis for DNA separation
4. To perform Restriction Digestion DNA/plasmid
5. To perform DNA isolation from plant by CTAB method
6. To perform Ligation
7. To estimate DNA by DPA method

8. To determine the molecular weight of DNA
9. To estimate the amount of RNA by Orcinol method
10. To isolate DNA from Onion cell

JECRC University
Department of Biotechnology
B.Sc. Semester-III
Course-Medical Biotechnology
Course Code-BBI037A
Lectures: 4 Hrs/week

UNIT 1	**Gene therapy**
UNIT 2	**Stem cell culture technology**
UNIT 3	**Xenotransplantation**
UNIT 4	**Use of Genetic engineering**
UNIT 5	**Disease diagnosis techniques**

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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PO5. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain basic concepts of gene therapy. Describe the expression of cloned proteins in animal cells. Explain methods and various types of gene delivery models.

CO-2 Students will be able to explain the concept of stem cell culture technology and tissue engineering. Describe application of stem cell culture in modern medical science.

CO-3 Students will be able to explain xenotransplantation technique and production.

CO-4 Students will be able to describe uses of genetic engineering technique in production of various products. Describe various types of vaccines.

CO-5 Students will be able to techniques used in testing and analysis of serological tests.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L	M	L	L	L
CO5	H	H	M	M	H	M	L

L – LOW, M- MEDIUM, H-HIGH

BBI037A: Medical Biotechnology **Credit(s): 4**

Unit-I

Gene therapy- background, types of gene therapy (*ex vivo* & *in vivo*), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. Gene Delivery methods-Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery,

Unit-II

Stem cell culture technology- introduction to stem cell types of stem cells, application of stem cells in modern medical science. Tissue Engineering – Skin, Liver, Pancreas, therapeutic Ribozymes, synthetic drugs.

Unit-III

Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues; Production of artificial tissues or organs; Cell Adhesion-based therapy- integrins, inflammation, cancer & metastasis;

Drug designing, Drug delivery and targeting: conventional & new approaches to drug delivery.

Unit-IV

Use of genetic engineering- in production of human insulin, growth hormones, factor VIII, plasminogen active protein, interferon, vaccine production, modification of monoclonal antibody in cancer treatment.

Unit-V

Disease diagnosis technique; ELISA, RIA, RIEP, ODD, RID, FISH, GISH, IMMUNO FLUORESCENCE

Text / Reference Book

1. Text Box of Microbiology R. Ananthanarayanan and C. K. Jayaram Paniker, Orient Longman, 1997.
2. Medical Microbiology, Vol 1; Microbial infection : Mackie and MaCartny, Churchil Livingstone, 1996
3. Bailey and Scott's Diagnostic Microbiology: Baron EJ, Peterson LR and Finegold SM Mosby, 1990.

4. Essential immunology (1995) - Roitt, I. M. Blackwell Scientific Publications Oxford.
5. Fundamental immunology: W.E. Paul 1984, Raven Press, New York.
6. Fundamentals of immunology: R.M. Coleman, M.F. Lombord and R.E. Sicarc (1992), 2nd ed, C. Brown publishers.
7. Immunology: D.M. Weir and J Steward, 7thEd, (1993).
8. Broude A.I. (1981): Medical " Microbiology" ; and Infectious Diseases, W.B. Saunders & Co. Philadelphia.
9. An Introduction to Immunology: Ian R. Tizzard.

BBI038A: Practicals of Medical Biotechnology **Credit(s): 1**

1. To determine Differential leucocytes count.
2. To analyze Total leucocytes.
3. To determine Total RBC count.
4. To Separate serum from blood.
5. To perform Direct and indirect ELISA.
6. To determine Blood groups
7. To determine Oucterlouny Double diffusion (ODD)
8. To perform Rocket Immuno-electrophoresis

JECRC University
Department of Biotechnology,
B.Sc. Semester – III
Course – Biostatistics
Course Code – BBI065A
Lectures: 4 Hrs/week

UNIT 1	**Data collection, tabulation; diagrammatic and graphic presentation**
UNIT 2	**Measures of central tendency, hypothesis testing**
UNIT 3	**Correlation and Regression**
UNIT 4	**Skewness, moments and kurtosis**
UNIT 5	**Probability and expected value; theoretical distributions**

PROGRAM OUTCOME

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies.

(Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to discuss and explain what biostatistics is and how it is used in the field of public health, data collection and data management, learn the common statistical

techniques and terminology, numeric and graphical techniques to display, interpret and summarize medical and health related data.

CO-2 Students will be able to be able to understand measures of central tendency. Test the hypothesis that the value of a population parameter equals a certain value; interpretation of data and how to perform basic tests to evaluate them. Translate research objectives into clear, testable statistical hypotheses. Hypothesis testing, type I and type II errors, and confidence bounds.

CO-3 Students will be able to carry out correlation and regression analyses, able to analyze the relationship between outcome (dependent variable) and explanatory variables (independent variables). Describe and discuss different types of regression analyses.

CO-4 Students will understand the moments, Karl Pearson's coefficient, Skewness, Kurtosis

CO-5 Students will be able to understand and explain the basic principles of probability and how they relate to biostatistics; familiar with the common probability distributions that are used in statistical inference; the probability and theoretical distributions and problems based on it.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	H	M	M	M	M
CO2	M	L	L	L	L	L	L
CO3	H	L	M	L	M	M	M
CO4	M	L	L	L	L	L	M
CO5	H	H	M	L	H	M	M

L-LOW, M-MEDIUM, H-HIGH

BBI065A- Biostatistics **Credit(s): 4**

Unit I

Statistical methods- An introduction, types of data, collection, classification and tabulation of the Primary data, Secondary data, Discrete data and continuous data, diagrammatic and graphical representation of grouped data, frequency distribution {univariate and bivariate}, cumulative frequency distribution and their graphical representation, histogram frequency polygon and ogives.

Unit II

Measures of central tendency. Measures of dispersion; skewness, kurtosis, Elementary Probability and basic laws. Discrete and Continuous Random variable, Mathematical

Expectation, Mean and Variance of Binomial, Poisson and Normal distribution. Sample mean and Sampling variance. Hypothesis testing using standard normal variate. Curve Fitting.

Unit III

Correlation and Regression- Emphasis on examples from Biological Sciences, Probability and their theories with examples

Unit IV

Moments (Single and double variables) and their relationships, Karl Pearson's, Beta & Gamma coefficients, Charlier's checks and Sheppard's correction for moments for grouped data (without derivation), skewness & kurtosis and their measures.

Unit V

Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions

Text / Reference Books

1. Le CT (2003) introductory biostatistics, 1st edition, John Wiley, USA
2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley andSons Inc.

BBI066A **Problem Based on Biostatistics** **Credit(s): 1**

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square

SEMESTER-IV

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI040A	Molecular Biology	4	-	2	4	1	5
BBI042A	Plant Biotechnology	4	-	2	4	1	5

BBI044A	**Bioprocess Engineering and Technology**	**4**	**-**	**2**	**4**	**1**	**5**
BBI067A	**Microbial Physiology**	**4**	**-**	**2**	**4**	**1**	**5**
BMC007A BMC008A	**Computer Applications**	**4**	**-**				**4**
BMC111A	**Communication skill**	**3**	**-**	**-**	**3**		**3**
							27

Department of Biotechnology,
JECRC University
B.Sc. Semester- IV
Subject- Molecular Biology
BBI040A
Lectures: 4Hrs/week

UNIT 1	**Nucleic Acids**
UNIT 2	**Transcription in prokaryotes and eukaryotes**
UNIT 3	**Translation in prokaryotes and eukaryotes**
UNIT 4	**Regulation of gene expression in prokaryotes**
UNIT 5	**Mutation**

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain about nucleic acid as genetic material and unit of heredity

CO-2 Students will be able to learn the transcription in prokaryotes and eukaryotes

CO-3 Students will be able to explains the translational steps, mechanisms and regulation involved for prokaryotes and eukaryotes

CO-4 Students will be able to analyze the regulation of gene expression in prokaryotes

CO-5 Students will be able to understand the role of mutation and its different types

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	M	L	L			L	L
CO3	H	M	M	L	M	M	M

CO4	M	L	L			L	
CO5	H	H	M	M	H	M	

L – LOW , M- MEDIUM , H-HIGH

BBI040A: Molecular Biology **Credit(s): 4**

Unit-I

Nucleic Acids: as the genetic material, structure and aggregation of DNA and RNA, DNA double helix, different conformations of double helix, DNA super coiling, Denaturation and renaturation of DNA, C-value paradox, Cot value, chemical complexity; DNA replication: Mechanism, Enzymes and accessory proteins involved, DNA damage, DNA mutagenesis and DNA repair (SOS and excision repair); Homologous recombination, site specific recombination and transposons.

Unit-II

Transcription in prokaryotes and eukaryotes: General and specific transcription factors, Regulatory elements and mechanism of transcription regulation, Modifications of RNA; Genetic code: deciphering the genetic code, nature of the code.

Unit-III

Translation in prokaryotes and eukaryotes: machinery- tRNA, Ribosomes, mRNA, aminoacyl-tRNA synthases and aminoacylation of tRNA; Mechanisms of initiation, elongation and termination, Regulation of translation, post translational modifications of proteins, protein localization, protein degradation.

Unit-IV

Regulation of gene expression in prokaryotes: lac, arabinose and trp operons - induction, repression and attenuation mechanism.

Unit-V

Mutation: Induced mutation, spontaneous mutation, frame shift mutation, point mutation, non sense mutations, site directed mutagenesis

Text / Reference Books

1. Glick, B.T and Pastermak J.J (1998) Molecular Biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press.

2. Howe.C. (1995) Gene Cloning and Manipulations, Cambridge University Press, USA

3. Lewin, B., Gene VI New York, Oxford University Press.

4. Rigby, P.W.J. (1987) Genetic Engineering, Academic Press Inc. Florida, USA.

5. Sambrooket al (2000) Molecular Cloning Volumes I, II, & III Cold spring Harbor Laboratory Press, New York, USA

6. Walker J.M. and Gingold, E.B. (1983) Molecular Biology and Biotechnology (Indian Edition) Royal Society of Chemistry U.K

7. Karp.G (2002) Cell and Molecular Biology, 3rd Edition, John Wiley and Sons; INC

8. Cell and Molecular Biology- P.K. Gupta, Rastogi Publishers, Meerut.

9. Bruce alberts et al (2008) Molecular Biology of the Cell, Fifth ed, , Garland Science, Taylor and Francis group

10. Voet and Voet , Biochemistry (2004) John Willey and Sons Inc.

11. Benjamin Lewin Genes IX, (2007) John Willy & Sons.

12. Molecular Biology of the Genes (2007) James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Inglis CSHLP (2007), Benjamin Cummings

13. Molecular Cell Biology (2007) Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, HiddePloegh, Paul Matsudaira, Freeman & Co.

BBI041A: Practicals of Molecular Biology **Credit(s): 1**

1. To Isolate genomic DNA
2. To perform Gel electrophoresis
3. To perform SDS-PAGE
4. To perform Quantification of RNA
5. To perform Quantification of DNA
6. To perform transformation
7. To perform phage titration
8. To perform conjugation

Subject- Plant Biotechnology
BBI042A
Lectures: 4Hrs/week

UNIT 1	**History and Aseptic techniques**
UNIT 2	**Tissue culture media, Cell and Suspension culture**
UNIT 3	**Protoplast technology**
UNIT 4	**Genetic Transformations**
UNIT 5	**Somo-clonal variation and micro-propagation; Conservation**

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain the historical scenario of plant tissue culture and sterilization techniques

CO-2 Students will be able to learn different type of tissue culture media, cell and suspension culture

CO-3 Students will be able to explains the techniques for protoplast fusion

CO-4 Students will be able to explain the steps involved in genetic transformation and basic techniques for somatic embryogenesis and plant part culture techniques

CO-5 Students will be able to understand the somoclonal variation and micropropagation

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	M	L	L			L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L			L	
CO5	H	H	M	M	H	M	

L – LOW , M- MEDIUM , H-HIGH

BBI042A: Plant Biotechnology Credit(s): 4

Unit-I

History: Milestones in the history of plant tissue culture, Cellular totipotency: 'Explant' for plant tissue culture: Laboratory Requirements for plant tissue culture laboratory different work areas, equipments & instruments required, techniques, other requirements.

Aseptic techniques: Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions;

Unit-II

Tissue Culture Media: Introduction, nutritional requirements of the explants, PGR's and their *in vitro* roles, media constituents, media selection, media preparation; Callus culture technique

Cell and Suspension Culture: Introduction, principle, isolation of single cells, suspension cultures, culture of single cells, types, growth & growth measurement, synchronization,

Unit-III

Protoplast Technology: Protoplast isolation, culture and regeneration of cell wall, Somatic hybridization – Protoplast fusion techniques, selection of hybrids, production of symmetric & asymmetric hybrids & cybrid production. Application of protoplast culture

Unit-IV

Genetic transformations –*Agrobacterium* mediated transformations, direct DNA transfer methods – electroporation, microprojectile bombardment, and microinjection, use of marker genes, integration & expression of foreign DNA

Somatic embryogenesis, organogenesis, Haploid Plant Production: Anther, pollen, ovule and ovary culture, artificial seed, types, uses and advantages

Unit-V

Somaclonal variation and micropropagation Embryo rescue, embryo culture, Transgenic plant- Herbicide resistance plant, insect resistant plants, improving the quality of oils and fats, biodegradable plastic, Edible vaccine, Stress tolerance plants. Germplasm **Conservation:** Introduction, long-term storages, short or medium term storage, cryopreservation, Gene Bank

Text / Reference Books

1. Experiments in Plant Tissue Culture by John H. Dodds & Lorin W. Robert.

2. Plant tissue Culture: Theory and Practice by S.S. Bhojwani and M.K. Razdan (1996) Elsevier, Amsterdam.

3. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002

BBI043A: Practicals of Plant Tissue Culture **Credit(s): 1**

1. To Prepare stock solution for M.S. media
2. To prepare and inoculate node and inter node
3. To culture callus
4. To perform suspension culture
5. To prepare media and inoculate shoot tip
6. To prepare media and inoculate root tip
7. To prepare media and inoculate anther
8. To Prepare the synthetic seeds
9. To perform Bergmann's cell plating technique for single cell culture
10. To determine the Composition of various plant tissue culture media
11. To Prepare stock solution for various growth hormones
12. To Prepare M.S. media for seed inoculation
13. To Inoculate seed in M.S. media for micro-propagation

Department of Biotechnology,
JECRC University
B.Sc Semester- IV
Subject- Bioprocess Engineering
BBI044A
Lectures: 4Hrs/week

UNIT 1	**Introduction to Bioprocessing technqiues**
UNIT 2	**Biosynthesis, production and selection of Microorganisms**
UNIT 3	**Fermentation technology**
UNIT 4	**Up-scaling Process**
UNIT 5	**Enzyme technology**

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to whichthese assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context sociotechnological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

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Course outcome

CO-1 Students will be able to explain bioprocessing techniques for microbial culture

CO-2 Students will be able to identify biosynthesis, production and selection of microorganisms

CO-3 Students will be able to explains fermentation technology and bioreactors prototypes

CO-4 Students will be able to explain up-scaling process for microorganisms

CO-5 Students will be able to explain different enzymes technology, production and purification of enzymes

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2		M	L	L		L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L			L	
CO5		H	H	M	M	H	M

L – LOW , M- MEDIUM , H-HIGH

BBI044A: Bioprocess Engineering and Technology **Credit(s): 4**

Unit-I

Introduction, Objectives and Scope; Characteristic and comparison of bioprocessing with chemical processing, Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology, Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture

Unit-II

Biosynthesis, production, selection of Microorganisms, extraction, Gibberellic acid, production, extraction, Metabolic basis for product formation; Production of secondary metabolites-penicillin, tetracycline etc; Process technology for the production of Eathonal, amino acid production, single cell protein, Production of Commercial Products: Baker's Yeast, Amino Acids, Xanthan Gum), Vitamins B12, Pigments (Shikonin)

Unit-III

Fermentation technology- definition, stages of fermentation, designing of bioreactors, formulation of medium, sterilization of medium, isolation and selection of microorganisms, production of stock culture.

Introduction to oxygen requirement in bioprocess, mass transfer coefficient; factors affecting KLa, Bioprocess measurement and control system with special reference to computer aided process control

Unit-IV

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes.

Principles of upstream processing – Media preparation, Inoculam development and sterilization., downstream processes, fermentation products, amino acids, alcohols, organic acids, polysaccharides, Biofuels

Unit-V

Enzyme technology- enzyme versus catalyst, microbial production of enzyme, mechanisms of enzyme action, extraction and purification of enzymes, storage of enzyme, immobilization of enzyme, industrial application of microbial enzyme and production of industrial enzymes-glucose Isomerase, cellulase and lipases

Text / Reference Books

1. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.

2. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.

3. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.

4. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.

5. Bioprocess Technology- fundamentals and applications, S O Enfors & L Hagstrom (1992), RIT, Stockholm.

6. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.

7. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.

8. Microbial Biotechnology: Channarayaappa, University press, Hyderabad, 2003

9. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)

10. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited.

BBI045A: Practical of Fermentation Technology **Credit(s): 1**

1. To perform Sauerkraut Production
2. To Prepare ginger wine
3. To Prepare grape wine
4. To prepare apple wine
5. To perform the Production of citric acid
6. To estimate the Production of citric acid by *Aspergilles niger*
7. To perform MBRT test
8. Primary screening for amylase, protease and caiseinase producing potent microbial strain
9. To perform various biochemical tests (MRVP, Catalase, Oxidase, etc.)
10. Determination of bacterial growth by turbid metric method

JECRC University
Department of Biotechnology
B.Sc. Semester- IV
Course- Microbial Physiology
Course Code: BBI067A
Lectures: 4 Hrs/week

UNIT 1	**Nutritional Classification of microorganisms**
UNIT 2	**Microbial Growth**
UNIT 3	**Effect of environment on microbial growth**
UNIT 4	**Phototrophic metabolism**
UNIT 5	**Stress Physiology**

PROGRAM OUTCOME

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PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to describe classification of microbes on the basis of mode of nutrition. Understand the principle of metabolite transport.

CO-2 Students will be able to identify and explain various phases of bacterial growth, mathematics of growth, different types of bacterial culture.

CO-3 Students will be able to describe the effect of environmental factors on microbial growth

CO-4 Students will be able to able to understand and describe principle and process of phototrophic metabolism

CO-5 Students will be able to understand stress physiology and processes involved.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	H	L	M	H	L	L
CO3	H	H	M	L	M	M	M
CO4	M	L	L	M	L	L	H
CO5	H	H	L	M	H	M	L

L – LOW, M- MEDIUM, H-HIGH

BBI067A: **Microbial Physiology** **Credit(s):4**

Unit I

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.

Unit II

Microbial Growth- Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxie growth curve. Measurement of microbial growth, Measurement of cell numbers, cell mass and metabolic activity

Unit III

Effect of the environment on microbial growth Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure.

Unit IV

Phototrophic metabolism- Historical account of photosynthesis, diversity of phototrophic bacteria, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic

photophosphorylation. Red Drop, Emerson Effect, Carbon dioxide fixation, Calvin cycle and reductive TCA cycle and C4 Cycle.

Unit V

Chemotaxis, Quorum sensing- Quorum sensing, Nitrogen fixation, Stress physiology- effect of oxygen toxicity, pH, osmotic pressure, heat shock etc on bacteria Adaptations in thermophiles, halophiles, alkaliphiles ,acidophiles , Extremophiles – adaptations & significance in biotechnology

Text / Reference Books

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms.10th edition. Pearson/ Benjamin Cummings.

3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.

4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.

5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.

6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

BBI068: Practicals of Microbial Physiology **Credit(s): 1**

1. To study and plot the growth curve of *E coli* using turbidometric method and to calculate specific growth rate and generation time.
2. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
3. To study the effect of pH on the growth of *E. coli*
4. To study the effect of temperature of *Aspergillus niger* by dry weight method.
5. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

SEMESTER-V

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	

BBI047A	**Proteomics and Genomics**	**4**	**-**	**2**	**4**	**1**	**5**
BBI069A	**Animal Tissue Culture**	**4**	**-**	**2**	**4**	**1**	**5**
BBI070A	**Environmental Biotechnology**	**4**	**-**	**2**	**4**	**1**	**5**
BMC113A	**Communication skills**	**3**	**-**	**-**	**3**		**3**
BMC109A	**Value Education Human rights and Legislative Procedures**						**3**
BBI054A	**Dissertation**			**18**		**6**	**6**
							27

Department of Biotechnology
JECRC University
B.Sc Semester- V
Subject- Proteomics and Genomics
BBI047A
Lectures: 4Hrs/week

UNIT 1	**Introduction to Genomic data and Data organization**
UNIT 2	**Introduction to MSDN(Microbial strain data network)**
UNIT 3	**BLAST, FASTA algorithms**
UNIT 4	**Secondary structure predictions**
UNIT 5	**Data Banks in Biotechnology/life sciences/biodiversity**

PROGRAM OUTCOME

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to whichthese assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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Program Specific Outcome

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PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain concept of genomic data and its organization

CO-2 Students will be able to explain microbial strain data network

CO-3 Students will be able to explain different algorithms (BLAST and FASTA) to analyze sequence data

CO-4 Students will be able to able to predict secondary and tertiary data

CO-5 Students will be able to understand about the data bank in the area of biotechnology/life sciences/biodiversity

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M		L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L			L	
CO5	H	H	M	M	H	M	

L – LOW , M- MEDIUM , H-HIGH

BBI047A: Proteomics and Genomics **Credit(s): 4**

Unit-I

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clonecontig) methods, Computer tools for sequencing projects: Genome sequence assembly software. Introduction to sequence date banks-protein sequence data bank. NBFR-PIR, SWISSPROT, Signal peptide data bank, Nucleic acid sequence data bank-Gene Bank, EMBL nucleotide sequence data bank.

Unit-II

Introduction to MSDN (Microbial Strain Data Network): Numerical Coding Systems of Microbes, Hybridoma Data Bank Structure, Virus Information System Cell line information system.

Unit-III

BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles. Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases

Unit-IV

Secondary Structure predictions; prediction algorithms; Tertiary Structure predictions Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation,

solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data

Unit V

Important Data banks in the area of Biotechnology/life sciences/biodiversity; Sequence analysis: Analysis Tools for Sequence Data Banks. Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE); Native PAGE, Determination of covalent structures Edman degradation.

Text / Reference Books

1. Lesk, Introduction to Bio Informatics, OUP

2. Developing Bioinformatics Computer Skills, Cynthia Gibas and Per Jambeck, 2001 SPD

3. Introduction to Bioinformatics, Atwood, Pearson Education

4. Beginning Perl for Bio-informatics, Tisdall, SPD

5. Biocomputing: Informatics and Genome Project, Smith, D.W., 1994, Academic Press, NY

6. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Baxevanis, A.D., Quellette, B.F.F., John Wiely & Sons.

BBI048A: Practical Exercises of Bioinformatics **Credit(s): 1**

1. To retrieve the sequence of the Human keratin protein from GenBank database and to interpret the results.
2. To retrieve the structure of a protein and viewing it in RASMOL viewer.
3. To find the similarity between sequences using BLAST
4. To find the similarity between sequences using FASTA
5. To align more than two sequences and find out the similarity between those sequences
6. To perform Sequence analysis by using EMBOSS
7. Use of SNP databases at NCBI and other sites

8. Use of OMIM database
9. Detection of Open Reading Frames using ORF Finder
10. Proteomics 2D PAGE database
11. Software for Protein localization.
12. Hydropathy plots
13. Native PAGE
14. SDS-PAGE

JECRC University
Department of Biotechnology
B.Sc. Semester-V
Course – Animal Tissue Culture
Course Code – BBI069A
Lectures: 4 Hrs/week

UNIT 1	**General Concepts of Animal cell/tissue culture**
UNIT 2	**Cell culture techniques**
UNIT 3	**Cell lines, tissue engineering and apoptosis**
UNIT 4	**Applications of animal cell culture**
UNIT 5	**Genetic Engineering in animal cells**

PROGRAM OUTCOME

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Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthusiase the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain pros and cons of animal tissue culture, aseptic techniques and instruments used in tissue culture technique and major components of cell and tissue culture media.

CO-2 Students will be able to describe various culture techniques used in animal tissue culture, characteristics and growth parameters of cells in culture.

CO-3 Students will be able to describe cell lines used in mammalian tissue culture, their origins and applications; tissue engineering, stem cell technology and measurement of cell death.

CO-4 Students will be able to describe the scale up methods for propagation of cell culture. Describe cell fusion techniques and production of monoclonal antibodies.

CO-5 Students will be able to describe how genetic engineering can be used for production of various useful products and how it can be implemented in animal cell lines.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	M	M	M
CO2	M	L	L	M	H	L	L
CO3	H	M	M	H	M	M	M
CO4	M	L	L	L	M	L	H
CO5	H	H	H	M	H	M	M

L – LOW, M- MEDIUM, H-HIGH

BBI069A: Animal Tissue Culture **Credit(s): 4**

Unit-I

Introduction: History and scope of animal cell and tissue cultures, advantages and disadvantages of tissue culture

Sterilization techniques: Aseptic techniques used in animal tissue culture laboratory, equipments used, maintenance of contamination free conditions; sterilization of culture media, glassware and tissue culture laboratory

Animal Tissue culture media: nutritional requirements of cells and growth media, components and their importance, natural media, synthetic media, basal salt solution (BSS), minimum essential medium, serum dependent defined media, serum independent defined media – Cell specific media

Unit-II

Animal Cell Culture Techniques: primary cultures, secondary cultures, established/continuous cell lines; Characteristics of cells in culture, Biology and Characterization of cultured cells: Contamination Testing of Culture, Measurement of viability and cytotoxicity, Measurement of growth parameters, Cell cycle analysis and Synchronization of cultures; Tissue culture (slide, flask and test tube cultures); organ culture; whole embryo culture

Unit-III

Commonly used animal cell lines: their origin and characteristic, growth kinetics of cells in culture, differentiation of cells,

Tissue engineering: artificial skin and artificial cartilage. Cell transformation; Scaling up of animal cell culture; Stem cell cultures; embryonic stem cells and their applications

Apoptosis: Measurement of cell death

Unit -IV

Applications: Scale up methods for animal cell culture, bioreactors for large scale culture of cells, transplanting cultured cells

Cell fusion: production of monoclonal antibodies and their uses

Unit-V

Genetic Engineering in animal cells: production of regulatory proteins, blood products, vaccines and hormones

Cloning: methodology and its applications, ethics in cloning

Transgenic animals: production, useful products in transgenic animals.

Assisted reproductive technology: *In vitro* fertilization, GIFT, ZIFT, IVC, cytoplasmic transfer (CT)

Text / Reference Books

1. Mammalian Cell Biotechnology – A Practical Approach- Butler, M.
2. Culture of Animal Cells- Freshney, R. T.
3. Human Cell Culture Protocols- Gareth, E.J.
4. The Animal Cell Culture and Technology- Butler, M.
5. Cell Biology-A Laboratory hand books- Julio, E., Celis
6. Gene Therapeutics- Wolff, J.E.D.
7. Genes in Medicine- Rasko, I., and Downes, C.S.
8. Molecular Biotechnology Therapeutic Application and Strategies- Maulik S. and Patel, S.D.
9. Mammalian Cell Biotechnology. A practical approach- Butler, M.C.
10. Culture of Animal Cells- Freshney, R.T.

BBI050A: Practical of Animal Biotechnology **Credit(s): 1**

1. To study Sterilization techniques: glassware sterilization, media sterilization, laboratory sterilization
2. To study Sources of contamination and decontamination measures.
3. To Prepare Hanks Balanced salt solution
4. To Prepare Minimal Essential Growth medium
5. To perform window making in egg
6. To analyze different stages of chick embryo

7. To perform Quantification of DNA

Department of Biotechnology
JECRC University
B.Sc Semester- V
Subject- -Environmental Biotechnology
Paper Code- BBI070A
Lectures: 4Hrs/week

UNIT 1	**Ecology & Biodiversity**
UNIT 2	**Waste Water Treatment**
UNIT 3	**Biological monitoring of hazardous wastes**:
UNIT 4	**Biomining definition bioleaching, Biosensors and Biochips**
UNIT 5	**Treatment of municipal waste and Industrial effluents, Bio-fertilizers**

PROGRAM OUTCOME

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Program Specific Outcome

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PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able to explain ecology and biodiversity

CO-2 Students will be able to explain waste water treatment

CO-3 Students will be able to understand biological monitoring of hazardous wastes

CO-4 Students will be able to explain biomining, bioleaching, biosensors and biochips

CO-5 Students will be able to analyze municipal Waste treatment.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	L	M	M	L	M	M
CO2	M	L	L	M		L	L
CO3	H	M	M	L	M	M	M
CO4	M	L	L			L	
CO5	H	H	M	M	H	M	

L – LOW , M- MEDIUM , H-HIGH

BBI070A: Environmental Biotechnology **Credit(s): 4**

Unit-I

Ecology & Biodiversity: Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

Unit-II

Waste Water Treatment- Sources and classification of pollutants, BOD, COD, DO, TDS. Biological waste water treatment, sewage treatment, primary treatment, secondary treatment, anaerobic digestion, tertiary treatment reuse of sewage,

Unit-III

Biological monitoring of hazardous wastes: degradation of Xenobiotic compounds, degrading agents, superbug, construction of superbug, bioremediation, phytoremediation, Anaerobic and aerobic composting, Vermiculture

Unit-IV

Biomining definition bioleaching, microorganisms involve in bioleaching, in situ bioleaching, removal of metal from water, microbial enhancement of oil recovery, advantages of Biomining,

Biosensors and Biochips: Definition, biosensors, types of biosensors, application of biosensors, Biochips

Unit V

Treatment of municipal waste and Industrial effluents, Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilizers (VAM) Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium) Environmental significance of genetically modified microbes, plants and animals

Text / Reference Books

1. Odum, E.P., Fundamentals of Ecology

2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 3rd ed., Tata McGrawhill

3. Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999

4. Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH

How to Write & Present Technical Information, 3rd Edition, Charles H. Sides, Cambridge University Press. 1999.

5. Garffey, Mary Ellen Business Communication, Cincinnati: South-Western College Publishing, 2000

6. Parley E Stevens and Daniel G Riardaw. Technical Report Writing Today N Delhi AITBS, 1998.

BBI052A: Practicals of Environmental Biotechnology **Credit(s): 1**

1. To determine Temporary Hardness,
2. To determine permanent hardness,
3. To determine Total hardness
4. To determine Alkanity and Acidity of water
5. To determine BOD in different water samples
6. To determine COD in different water samples
7. To determine DO of different water samples
8. To determine Total Salts and Total Dissolve Salts of water
9. To Estimate chloride in water
10. To perform IMVIC Test
11. To perform MPN test

BI071A: Dissertation **Credit(s): 6**

JECRC University on any topic related to the subject after one Educational tour at any place in India. The duration of tour should be at least one week at the spot. The work and tour should be documented and also student has to present his/her in front of an external.

SEMESTER VI

S. No.	Subject Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
						L	P	
1.	BBI072A	IPR, Biosafety, Bioeathics Entrepreneurship Development	4			4	1	5

2	**BBI074A**	**Basics of Forensic Science**	**4**			4	**1**	**5**
4	**BBI076A**	**Biotechnology and Human Welfare**	**4**			4	**1**	**5**
5	**BBI078A**	**Molecular Diagnostics**	**4**			4	**1**	**5**
6	**BBI080A**	**Industrial Fermentations**	**4**			4	**1**	**5**
								25

JECRC University
Department of Biotechnology
B.Sc. Semester-VI
Course-IPR, Biosafety, Bioethics Entrepreneurship Development
Course Code-BBI072A
Lectures: 4 Hrs/week

UNIT 1	**Introduction to Indian Patent Law**
UNIT 2	**Entrepreneurship**
UNIT 3	**Bioethics**
UNIT 4	**Biosafety**
UNIT 5	**International Business and Entrepreneurship**

PROGRAM OUTCOME

PO1.**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to whichthese assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context sociotechnological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will learn about the Indian Patent Law, intellectual/industrial property right and patenting.

CO-2 Students will be able to understand the concept of entrepreneurship. Explain the basic regulations of excise.

CO-3 Students will be able to describe principle and different paradigms of bioethics, ethical issues against the molecular technologies.

CO-4 Students will be able to describe biosafety and health hazards concerned to biotechnology. Introduction to GLP and GMP

CO-5 Students will be able to explain international business, selection of product and market for international business. Promotion, factors influencing and features of of entrepreneurship.

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	H	L	M	L	M	M
CO2	M	L	H	M	H	L	L
CO3	L	M	M	L	M	M	M
CO4	M	L	L	M	L	L	M

CO5	H	M	M	M	H	M	H

L – LOW, M- MEDIUM, H-HIGH

BBI072A- IPR, Biosafey, Bioethics Entrepreneurship Development

Unit I

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions, Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations

Unit II

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc**.**

Unit III

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies

Unit IV

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP)

Unit V

Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

Text / Reference Books

1. Entrepreneurship: New Venture Creation : David H. Holt

2. Patterns of Entrepreneurship : Jack M. Kaplan

3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.

4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.

5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers

Exercise Based on IPR, Bioethics Entrepreneurship Creadit-1

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive

JECRC University
Department of Biotechnology,
B.Sc. Semester – VI
Course – Basics of Forensic Science
Course Code – BBI074A
Lectures: 4 Hrs/week

UNIT 1	**Introduction of Forensic science**
UNIT 2	**Principles and laws of Forensic Sciences**
UNIT 3	**Significance of Toxicology**
UNIT 4	**DNA Fingerprinting and cyber security**
UNIT 5	**Evidence and proofs in forensic science**

PROGRAM OUTCOME

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies.

(Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able understand the principles of forensic science, injuries type and reasons of deaths

CO-2 Students will be able to understand laws, historical background, FSL labs of central and state, criminal behavior, crime scene and evidences

CO-3 Student will acquaint about Toxicology and its role in crime detection, fundamental of DNA fingerprinting

CO-4 Student will able to explain DNA Profiling and its importance. Student will also able to know about the cyber security.

CO-5 Students will be able to explain chemical crime evidences and proof for crime

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	H	L	H	L	L	L	L
CO3	M	M	M	L	M	M	M
CO4	M	M	L	L	L	L	M
CO5	H	H	M	M	H	M	M

L-LOW, M-MEDIUM, H-HIGH

Paper- BBI074A - Basics of Forensic Science **Credits- 4**

Unit I

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit II

Principles, Laws of Forensic Science, Historical Background Need of Forensic Science in present scenario, Forensic Science Laboratories, their types and Divisions, Forensic Examination, Organizational set up of Forensic Science Laboratories at central and state level, Introduction of BPR&D, NICFS, CDFD, CCMB, IITR, CDTS, NCRB, Crime : Definition, types of crime, causes of crime, prevention of crime, Difference in blue and white collar crime, Introduction of Cyber crime, Criminal Justice System, Criminal behavior , Crime Scene : Introduction, Significance, Role of Investigator, Evaluation of crime scene, protection of crime scene, Photography of Crime scene, Tools and techniques, Significance of Photography and Videography Location, Collection & Evaluation of various types of Tool Marks & Trace Evidences (Paint, Soil, Glass, Detective Dyes, GSR etc.)

Unit III

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification

Unit IV

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

Unit V

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives, General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples

Text / Reference Books

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001). _

3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002). _

4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005). _

5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997)

6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013)

BBI075A- Practicals of Forensic Science **Credit 1**

1. Documentation of crime scene by photography, sketching and field notes.
a. Simulation of a crime scene for training. b. To lift footprints from crime scene.
2. Case studies to depict different types of injuries and death.
3.Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
4. Investigate method for developing fingerprints by Iodine crystals.
5. PCR amplification on target DNA and DNA profiling,
6. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking

JECRC University
Department of Biotechnology,
B.Sc. Semester – VI
Course – Biotechnology and Human Welfare
Course Code – BBI076A
Lectures: 4 Hrs/week

UNIT 1	**Introduction of Protein Engineering**
UNIT 2	**Agriculture benefits and GM Crops, Biofertilizers**
UNIT 3	**Environmental pollutants, stress management and Biodegradable polymers**
UNIT 4	**Forensic sciences and DNA Fingerprinting**
UNIT 5	**Health and Therapeutic agents**

PROGRAM OUTCOME

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able understand the principles protein engineering, SCP and immobilization

CO-2 Students will be able to understand agriculture improvement, GM Crops, and Bio-pesticides

CO-3 Student will acquaint about Environmental pollutants, stress management and PHBs

CO-4 Student will able to explain forensic science

CO-5 Students will be able to explain health and therapeutic agents

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	H	L	H	L	L	L	L
CO3	M	M	M	L	M	M	M
CO4	M	M	L	L	L	L	M
CO5	H	H	M	M	H	M	M

L-LOW, M-MEDIUM, H-HIGH

Paper BBI076A Biotechnology and Human Welfare Credit- 4

Unit I

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation. Production of single cell proteins; immobilization of enzymes and whole cells and their applications

Unit II

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

GM crops: Herbicide resistant crops; insect resistant crops; disease resistant crops; stress tolerant crops; improvement of crop yield; seed nutritional quality improvement. Biopesticides and Biofertilziers.

Unit III

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

Unit IV

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

Unit V

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene Therapy, diagnostics, monoclonal in *E.coli*, human genome project, Genetic engineering and Health Care Products- Interferon, Interleukins, Blood clotting factor, edible Vaccine

Text / Reference Books

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.

2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers

BBI077A- Practicals based on Biotechnology and Human Welfare Credit 1

1. Perform of ethanolic fermentaion using Baker's yeast
2. Study of a plant part infected with a microbe

3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two)

JECRC University
Department of Biotechnology,
B.Sc. Semester – VI
Course – Molecular Diagnostics
Course Code – BBI078A
Lectures: 4 Hrs/week

UNIT 1	**Introduction to diagnosis, infectious diseases**
UNIT 2	**Introduction to traditional disease diagnosis methods and tools**
UNIT 3	**Major Metabolic disorders and causes**
UNIT 4	**Molecular Diagnosis, modern tools and techniques for testing**
UNIT 5	**Hybridization techniques and DNA sequencing methods in molecular diagnosis**

PROGRAM OUTCOME

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able understand about diagnostics, infectious diseases and host-parasite relationship

CO-2 Students will be able to understand traditional disease diagnosis methods and tools

CO-3 Student will acquaint about major metabolic disorders and their causes

CO-4 Student will able to explain molecular diagnosis tools and techniques

CO-5 Students will be able to explain hybridization and DNA sequencing techniques in molecular diagnosis

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	H	L	H	L	L	L	L
CO3	M	M	M	L	M	M	M
CO4	M	M	L	L	L	L	M
CO5	H	H	M	M	H	M	M

L-LOW, M-MEDIUM, H-HIGH

Paper BBI078A- Molecular Diagnostics Credits -4

Unit I

Introduction and History of diagnostics: Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of

transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. Philosophy and general approach to clinical specimens, Sample collection method of collection, transport and processing of samples, Interpretation of results, Normal microbial flora of the human body, Host - Parasite relationships

Unit II

Traditional disease diagnosis methods and tools: diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium, Diagnosis of fungal infections. Major fungal diseases: Dermetophytoses, Candidiosis and Aspergillosis. Diagnosis of DNA and RNA viruses - Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses. Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis. Study of helminthic diseases- Fasciola hepatica and Ascaris lumbricoides. Filariasis and Schistosomiasis.

Unit III

Major Metabolic disorders and its causes: Traditional methods for the diagnosis of metabolic errors. Disease due to genetic disorders-Identifying human disease genes

Cancer: different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes. Methods available for the diagnosis of genetic diseases and metabolic disorders

Genetic disorders: Sickle cell anemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis and Sex – linked inherited disorders.

Unit IV

Molecular Diagnosis: Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, In situ PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, Ligase Chain Reaction.

Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation, amino acid sequence analysis

Susceptibility tests: Micro-dilution and macro-dilution broth procedures. diffusion test procedures, tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests

Unit V

Hybridization techniques and DNA sequencing methods in molecular diagnosis: Southern, Northern, in-situ (including FISH), microarrays – types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot

Automated DNA sequencing- Principles, Methods and Instrumentation- Advances in DNA sequencing- New Generation sequencing Methods, Pyrosequencing, · Microarrays- Personalised Medicine- Pharmacogenomics (ADMET)

Text / Reference Books

1. Medical Microbiology, Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers.

2. Parasitology, Chatterjee K.D, Chatterjee Medical Publishers.

3. Bailey & Scott's Diagnostic Microbiology, Betty A. Forbes, Daniel F. Sahm, Alice S. Weissfeld , Ernest A. Trevino, Published by C.V. Mosby

4. Jawetz, Melnick, & Adelberg's Medical Microbiology, Geo F. Brooks, Stephen A. Morse, Janet S. Butel.

5. Fundamentals of Molecular Diagnostics. David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.

6. Henry's Clinical Diagnosis and Management By Laboratory Methods Mcpherson

7. Molecular Diagnostics: Fundamentals, Methods & Clinical applications. Lele Buckingham and Maribeth L. Flaws

8. Molecular Diagnostics for the Clinical Laboratorian 2Ed, W.B. Coleman. Humana Press.

9. Molecular Pathology in Clinical Practice, D. G. B. Leonard.

10. Microbial Functional Genomics by J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje. J.Wiley & Sons Publishers.

11. Human Molecular Genetics- Tom Strachan

12. Concepts of Genetics- William s. Klug

13. Emery's Elements of Medical Genetics- Robert F. Mueller & Ian D. Young

BBI079A - Practicals of Molecular Techniques **Credit 1**

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).
5. Perform any one immunodiagnostic test (Typhoid, Malaria, Dengue)

JECRC University
Department of Biotechnology,
B.Sc. Semester – VI
Course – Industrial Fermentations
Course Code – BBI080A
Lectures: 4 Hrs/week

UNIT 1	**Introduction to bio-production Industrial chemicals**
UNIT 2	**Microbial metabolites and commercialization**
UNIT 3	**Upstream and downstream processing**
UNIT 4	**Enzyme kinetics and fermentation**
UNIT 5	**Metabolic engineering of commercial enzymes**

PROGRAM OUTCOME

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context social technological changes

Program Specific Outcome

PSO1: To impart training in Biotechnology at advanced level and enthuse the students to understand basic concept of Biotechnology (Understanding skills)

PSO2: To educate the students to make them confident and capable of accepting any challenge at Global Level (Problem-Solving Skills)

PSO3: To train the students for creating innovative career in research and for higher studies. (Successful Career and Entrepreneurship)

Course outcome

CO-1 Students will be able understand bio-production of industrial useful chemicals

CO-2 Students will be able to understand about the microbial metabolites and commercialization

CO-3 Student will acquaint about upstream and downstream processing methods

CO-4 Student will able to explain enzyme kinetics and fermentation

CO-5 Students will be able to explain metabolic engineering of commercial enzymes

Mapping of PO/CO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	M	L	M	M
CO2	H	L	H	L	L	L	L

CO3	M	M	M	L	M	M	M
CO4	M	M	L	L	L	L	M
CO5	H	H	M	M	H	M	M

L-LOW, M-MEDIUM, H-HIGH

Paper BBI080A- Industrial Fermentations **Credit 4**

Unit I

Production of industrial chemicals, biochemicals and chemotherapeutic products, Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

Unit II

Microbial products of pharmacological interest, steriod fermentations and transformations, Over production of microbial metabolite, Secondary metabolism – its significance and products, Metabolic engineering of secondary metabolism for highest productivity, Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

Unit III

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products, Experimental model for design of fermentation systems, Anaerobic fermentations.

Unit IV

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations;

single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up.

Unit V

Metabolic engineering of antibiotic biosynthetic pathways, introduction, oduction of citric acid, production of lactic acid, Industrial production of enzymes, introduction; general aspects, production of amylases& proteases, production of nucleotides&nucleotides, production of alcohols-acetone-butanol, production of ethanol, production of aminoacids-introduction, production of L- glutamic acid, production of vitamin B12, production of single cell proteins, production of yeast/ mushrooms, production of fermented foods, production of microbial insecticides, production of Biopolymers, Biofuels, biogas, production of Bioplastics, Biosurfactants, and Biofertilizers, General rules in patents and practices.

Text / Reference Books

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.

2nd edition. Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd

edition, Elsevier Science Ltd.

5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

BBI081A- Practicals of Fermentation **Credit 1**

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.

4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)