Est. in 1921

UNION CHRISTIAN COLLEGE (AUTONOMOUS) ALUVA

Affiliated to Mahatma Gandhi University, Kottayam, India
NAAC Accredited with A++ Grade in Vth cycle
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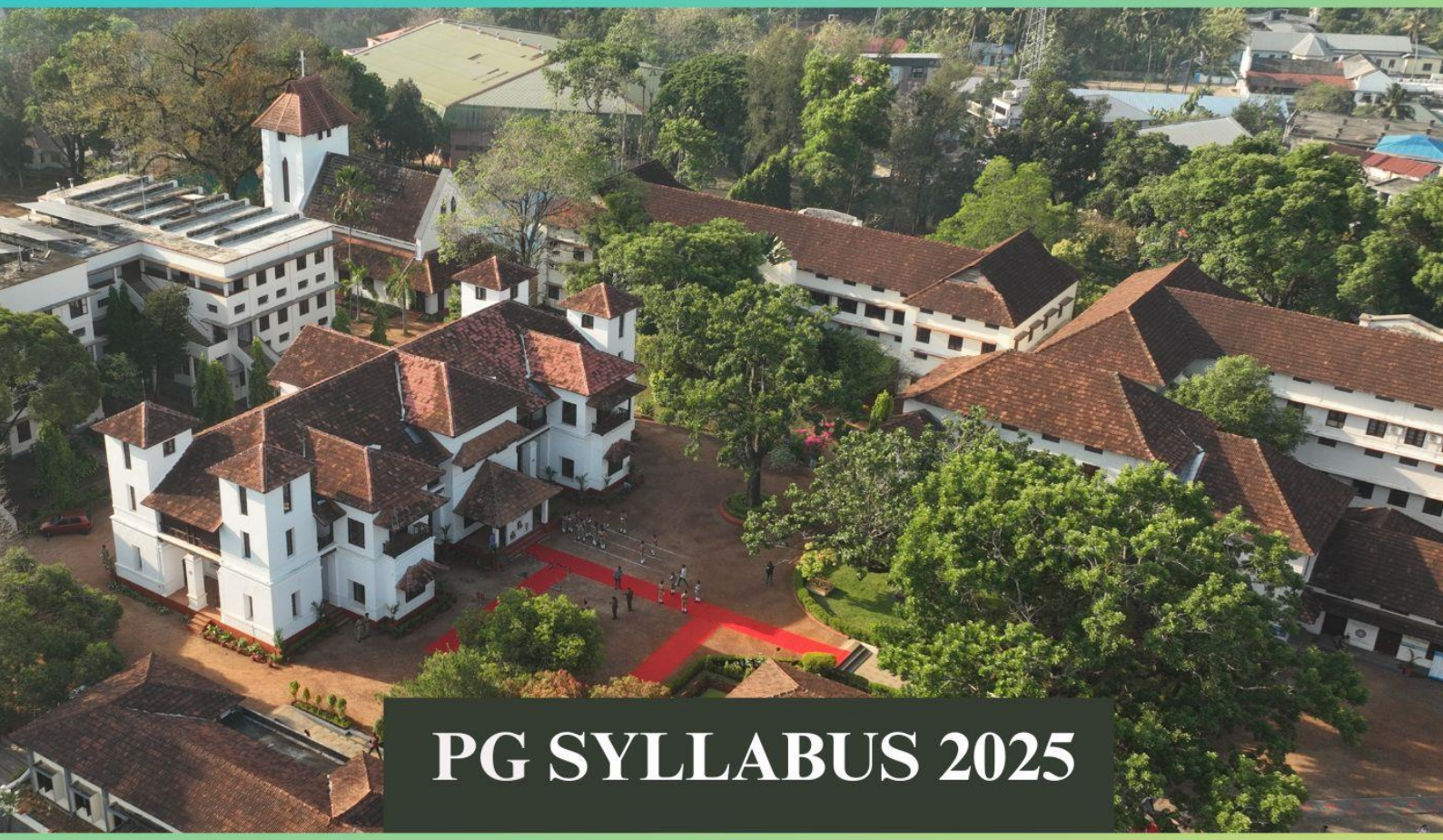
DEPARTMENT OF BIOSCIENCES



PG SYLLABUS 2025

POSTGRADUATE PROGRAMME {UCC PGP} IN BIOTECHNOLOGY

Master of Science in Biotechnology

PROGRAMME STRUCTURE AND SYLLABUS
2025-26 ADMISSIONS ONWARDS

BOARD OF STUDIES IN Biotechnology (PG)
UNION CHRISTIAN COLLEGE, ALUVA
(Autonomous)
2025

PREFACE

We are pleased to introduce the syllabus for the Postgraduate Program in Biotechnology, tailored to meet the evolving and multifaceted nature of today's biotechnology. This curriculum reflects our unwavering commitment to academic excellence, innovation, and the comprehensive development of postgraduate students in this rapidly evolving field. We sincerely thank the PG Board of Studies in Biotechnology, Mahatma Gandhi University, for their valuable contributions in designing this robust and forward-looking syllabus. Biotechnology, as a vital branch of life sciences, holds immense potential in addressing global challenges such as healthcare advancement, sustainable agriculture, environmental protection, and industrial innovation.

The postgraduate curriculum is therefore thoughtfully structured to provide students with in-depth knowledge of molecular biology, genetic engineering, bioinformatics, and bioprocess technology, while also fostering analytical thinking, research competence, and scientific integrity.This program provides a balanced blend of theoretical learning, practical skills, and research exposure. The curriculum spans core areas like Biochemistry, Cell and Molecular Biology, Microbiology Environmental and Food Biotechnology and Bioinformatics, with hands-on practicals in each subject. Seminars, project work, and experiential learning further enrich the academic experience, preparing students for careers in research, healthcare, industry, and entrepreneurship.

We believe that postgraduate education in biotechnology is not merely about mastering techniques but about cultivating a spirit of curiosity, innovation, and lifelong scientific exploration. It is our earnest hope that this syllabus provides a solid academic foundation for our students and empowers them to contribute meaningfully to scientific progress and the sustainable advancement of society.

Dr.Sareen Sarah John
Chairperson
PG Board of Studies in Biotechnology

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21	**Dr. Liji Thomas,** Assistant Professor, Department of Biochemistry, Sree Sankara College, Kalady	Member

Table of Contents

M.Sc BIOTECHNOLOGY DEGREE PROGRAMME

1. **Aim of the Program**:
   Understanding various disciplines in biotechnology and acquire methodological knowledge in them. Application of this knowledge in a suitable manner in required fields.

2. **Eligibility for Admissions**

A candidate seeking admission to M.Sc Biotechnology must have at least 50% marks in any branch of Life Sciences viz. Zoology, Botany, Biochemistry, Biotechnology, Microbiology, Biological Techniques & Specimen Preparation and Microbiology or Chemistry at the graduate level; Candidates having BSc degree in Industrial Microbiology / Medical Microbiology/ MLT with 50% marks are also eligible. MBBS/ BSc Agriculture/ BVSc/ B.F.Sc/ B.Tech (Biotechnology) Degree holders can also apply.

3. **Duration of the course:** The duration of the course is 2 years. First year consists of I and II semester and second year consists of III and IV semesters.

4. **Medium of Instruction and Assessment**: English. External and Internal evaluation as per university regulations.

5. **Faculty under which the Degree is Awarded:** Faculty of Science

6. **Specializations offered, if any** : NIL

7. **Note on compliance with the UGC Minimum Standards for the conduct and award of Post Graduate Degrees:**

The programme and syllabus are in compliance with the UGC minimum standards for the conduct and award of post graduate degree.

8. **Programme Outcomes:**

- **PO1.** Nurturing novel ideas and meaningful insights through scientific thinking.
- **PO2.** Enabling critical analysis of problems and situations to reach solutions.
- **PO3.** Development of communication skills to present scientific data in oral and written formats.
- **PO4.** Providing a platform for individual and collective work.
- **PO5**. Understanding the significance of sustainable scientific processes to support the environment.

9. **Programme Specific Outcome:**

- **PSO1.** Imparting basic knowledge in interdisciplinary fields of biotechnology.

- **PSO2**. Using modern tools to study and analyse biological data
- **PSO3.** To equip the candidates to meet the demands of the society to get sustainable products and processes through biotechnology.
- **PSO4**. To be aware of the ethical issues, personal and environmental safety during biotechnology practices.
- **PSO5**. Promoting scientific discoveries and familiarizing research methodology through implementation of projects.

1. THE PROGRAMME STRUCTURE

Course Code	Title of the Course	Type of the Course	Hours per Week	Credits (80)	Total credits
FIRST SEMESTER					
UCBT0101	General Biochemistry	Theory	**4**	**4**	**19**
UCBT0102	Cell Biology and genetics	Theory	**4**	**4**	
UCBT0103	Instrumentation and Biostatistics	Theory	**4**	**4**	
UCBT0104	Biophysics and Bioinformatics	Theory	**3**	**3**	
UCBT0105	Lab course I	**Practical**	**10**	**4**	
SECOND SEMESTER					
UCBT0201	Microbiology	Theory	**4**	**4**	**19**
UCBT0202	Immunology	Theory	**4**	**4**	
UCBT0203	Molecular Biology	Theory	**4**	**4**	
UCBT0204	Enzymology and metabolism	Theory	**3**	**3**	
UCBT0205	Lab course II	**Practical**	**10**	**4**	
THIRD SEMESTER					
UCBT0301	Bioprocess Technology	Theory	**4**	**4**	**19**
UCBT0302	Recombinant DNA Technology	Theory	**4**	**4**	
UCBT0303	Environmental biotechnology	Theory	**4**	**4**	
UCBT0304	Plant and Animal biotechnology	Theory	**3**	**3**	
UCBT0305	Lab Course III	**Practical**	**10**	**4**	
FOURTH SEMESTER					
UCBT0401	Lab Course	**Practical**	**10**	4	
UCBT0402	Project and Dissertation			4	
UCBT0403	Comprehensive viva voce			3	
	Elective I	Theory	**5**	4	
	Elective II	Theory	**5**	4	
	Elective III	Theory	**5**	4	
Total					**80**

THE PROGRAMME STRUCTURE: ELECTIVES:

Course Code	Elective Groups	Elective courses	Credit
UCBT0404	Elective Group I	Environment and Biotechnology	**4**
UCBT0405		Food Biotechnology	**4**
UCBT0406		Advanced Molecular Techniques	**4**
UCBT0407	Elective Group II	Physiology and Biotechnology	**4**
UCBT0408		Microbial Food Technology	**4**
UCBT0409		IPR and Biotechnology	**4**
UCBT0410	Elective Group III	Molecular biology of Development	**4**
UCBT0411		Cancer Biology	**4**
UCBT0412		Genomics: Techniques and Applications	**4**

PATTERN OF QUESTIONS

a) The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E grades.

b). Weight: Different types of questions shall be given different weights to quantify their range as follows:

c) Maximum weight for external evaluation is **30.** Therefore, Maximum Weighted Grade Point (WGP) is **150.**

Sl. No.	Type of Questions	Weight	Number of questions to be answered
1.	Short Answer type questions	1	8 out of 10
2	Short essay/ problem solving type Questions	2	6 out of 8
3.	Long Essay type questions	5	2 out of 4

DIRECT GRADING SYSTEM

Direct Grading System based on a 7 – point scale is used to evaluate the performance (External and Internal Examination of students)

For all courses (theory & practical) / semester/overall programme Letter grades and **GPA/SGPA/CGPA** are given on the following scale :

Range	Grade	Indicator
4.50 to 5.00	**A+**	**Outstanding**
4.00 to 4.49	**A**	**Excellent**
3.50 to 3.99	**B+**	**Very good**
3.00 to 3.49	**B**	**Good(Average)**
2.50 to 2.99	**C+**	**Fair**
2.00 to 2.49	**C**	**Marginal**
up to 1.99	**D**	**Deficient(Fail)**

1. **Evaluation first stage** - Both internal and external (to be done by the teacher)

Grade	Grade Points
A+	**5**
A	**4**
B	**3**
C	**2**
D	**1**
E	**0**

2. **Evaluation Second stage**– Calculation of Grade Point Average **(GPA)** of a course (to be done by the University)
3. **Evaluation Third stage** -Semester Grade Point Average **(SGPA)** (to be done by the University)
4. **Evaluation- Fourth stage** - Cumulative Grade Point Average**(CGPA)** (to be done by the University)

PG CSS BIOTECHNOLOGY PROGRAMME SYLLABUS

FIRST SEMESTER COURSES

1	**UCBT0101**	General Biochemistry
2	**UCBT0102**	Cell Biology and genetics
3	**UCBT0103**	Instrumentation and Biostatistics
4	**UCBT0104**	Biophysics and Bioinformatics
5	**UCBT0105**	Lab course I

I SEMESTER
UCBT0101 GENERAL BIOCHEMISTRY

4hours/week **Credit:4**

Course outcome: The student is exposed to:

The biochemical composition of the cell. The structure and types of nutrient components. The major metabolic pathways and their significance. The coordination of metabolic pathways.

Module I:

Carbohydrates-structure, properties and classification. Monosaccharides-Classification and structure, Isomerism in monosaccharides; Oligosaccharides -homo-oligosaccharides and hetero-oligosaccharides, Disaccharides-types, biological significance and function, Glycosidic bond. Polysaccharides- Classification-homopolysaccharides and heteropolysaccharides, storage polysaccharides and structural polysaccharides, Glycosaminoglycans-structure and function. Characterization and purification of Polysaccharides.

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Module II

Introduction, Definition, Structure, classification and functions of lipids, Simple lipids-oils and fats, Triglycerides-structure and function. Compound lipids-Phospholipids-Glycerophospholipids: Structure and function of (Phosphatic acid, cardiolipin, Phosphatidyl serine, Phosphatidyl ethanolamine, Phosphatidyl glycerol, Phosphatidyl choline, Phosphatidyl inositol), CDP-diacylglycerol, Lung surfactants, Glycosphingolipids: Structure and function of (Sphingosine, ceramides& sphingomyelins). Glycolipids (Glycosphingolipids)- cerebrosides, globosides, gangliosides, sulfatides. Lipoproteins; Derived lipids. Eicosanoids: Prostaglandins, Leukotrienes and Thromboxanes- Chemistry, formation and physiological function. Cholesterol, Steroids: Steroids in animal system: Glucocorticoids, mineralocorticoids, Sterols in Plant system: Phytohormones: Brassinosteroids (functions) 16

Module III

Proteins-Classification of proteins, building units of proteins. Amino acids-Structure, properties and function, classification of amino acids, peptide bonds Ramachandran plot, oligopeptides, polypeptides, structure of proteins-Primary, Secondary, Tertiary and Quaternary structure of Proteins Globular protein Hemoglobin and Myoglobin, Fibrous protein: Collagen, Membrane Protein, ATP synthetase, Protein sequencing, Evolutionary divergence of organisms and its relationship to protein structure and function, protein folding**.**15

Module IV

Fat soluble and water-soluble vitamins: structure and function, cofactors and coenzymes: structure and function Coenzymes and their functions - NAD, $NADP^+$, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin. 12

Module V

Nucleic acids - Classification of nucleic acids, building blocks of nucleic acids, structure of nucleotides, classification of nucleotides, purines, pyrimidines, structure and function of DNA and RNA. Watson Crick pairing.

Hormones**:** Classification; site of formation, target organs; mechanism of action of peptide and steroid hormones: insulin, glucagon, epinephrine, norepinephrine, thyroid hormones, testosterone, estrogen, progesterone, pheromones. 15

Reference

1. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
2. A Text Book of Biochemistry, E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen Oxford and IBH Publishing Co., New Delhi, 1974
3. Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
5. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
6. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko Lubert Stryer Publisher: B.i.publicationsPvt.Ltd ISBN:071676766X ISBN-13: 9780716767664, 978-716767664
7. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-245

UCBT0102 CELL BIOLOGY AND GENETICS

4 hours/week **Credit: 4**

Course outcome:

The student can understand how the cell is equipped with machineries to conduct activities as the basic structural and functional unit of life. The structural features of cell organelles/machineries. The functional mechanisms of cellular phenomena. The fundamental principles of heredity and deviations from mendelian behavior. The effect of mutations and mutational analysis. Principles of behavioral and population genetics.

Module 1

Cell: An Introduction. Membrane proteins, lipids. Fluid mosaic model, membrane fluidity, membrane asymmetry, lipid raft. Functions of the membrane. Membrane transport: Passive transport- Diffusion, facilitated diffusion- glucose porter molecules. Channel proteins- aquaporins. Ionic channels- voltage gated and ligand gated channels. Transmission of electrical impulses- resting and action potential. Active transport: Features, Na^+ K^+ pump. Cell junctions: Adherens junctions, desmosomes, tight junction, gap junction. **12**

Module 2

Extracellular matrix: composition and functions. Cell signaling- G protein coupled receptors, Ion channel coupled receptors- synaptic transmission. Enzyme coupled receptors- ras pathway. cAMP as second messengers- glycogen breakdown by epinephrine.ca ions as second messenger. ER: structure and function, Golgi complex: structure, types, protein sorting and trafficking, exocytosis and endocytosis, coated pits and vesicles. Lysosomes and peroxisomes: enzymatic components and functions, Mechanism of autophagy. Cytoskeleton: Microtubule, assembly and organization, microfilaments: actin structure and assembly, filament-based movement in muscle, sliding filament model. Intermediate filaments-types and functions. **17**

Module 3

Mitochondrion: structural features and functions, Chemiosmotic coupling, Chloroplast - structural features and functions, LHC, rubisco. Nucleus, nuclear pore complex, structure of chromosomes, chromosome banding, mitosis and meiosis, Model organisms in cell biology. Cell cycle: G1, S, G2, M phases, MPF, cyclins, checkpoints, Role of Rb & p53. Cell cycle inhibitors, Aging- significance of glutathione. Apoptosis and necrosis, apoptotic pathways. Types of tumor, induction of cancer, properties of cancer cells, oncogenes and c onco genes, tumor suppressors, Molecular pathways- PIP3 Akt, JAK STAT. **17**

Module 4

Mendel's laws, dominance, epistasis, pleiotropic interactions, multiple alleles-ABO blood groups, pseudo alleles, atavism, linkage, sex linkage, linkage groups, two point and three point test crosses, determination of gene order, chromosome mapping, sex influenced genes, sex limited genes, inherited disorders in metabolism-maple syrup urine disease, Lesch Nyhan syndrome, Down's syndrome, polyploidy, aneuploidy, Cytoplasmic inheritance, cytoplasmic male sterility. **20**

Module 5

Behavioral genetics, Hardy Weinberg principle- natural selection, genetic drift, Genetic variation, Allele frequencies and its changes, mutation, gene flow, random mating, inbreeding, outbreeding, assortative mating, hybrid vigor. Mutational analysis using principles of probability-Chi square test. **10**

Reference:

1. Principles of Genetics, Snustad D P, Simmons and Jenkins, John Wiley And Sons Inc **ISBN**-13: 978-1118129210
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Fundamentals of Genetics, B D Singh, Kalyani Publishers
4. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart, Suzuki and Miller, Freeman's and Co, New York
5. Principles of Genetics: M J Gardner, John Wiley and sons.
6. Cell Biology, Smith and Wood
7. Cell and Molecular Biology by Gerald Karp, Academic Press
8. Cell and Molecular Biology Cooper, Hausman, ASM Press. ISBN: 9781605351551
9. World of the Cell, Becker, Reece, Poenie, The Benjamin/Cumming's Pub. **ISBN**-10: 0134145798
10. Cell Biology, Lodish et al, W H Freeman and Co., New York. ISBN-13: 978-1429234139
11. Cell Biology, Thomas D Pollard and W.C. Earnshaw, Saunder's Publishers ISBN: 9780323341264.
12. Cell Biology Organelle, structure and function: David E Sadava. Jones and Barlette series in Biology. **ISBN**-10: 9780867202281
13. Cell and Molecular biology: C S Rastogi NEW Age International Pub. **ISBN**-13: 978-8122416886

UCBT0103 INSTRUMENTATION AND BIOSTATISTICS

Number of Hours / Week: 4 **Credits: 4**

Course outcome: The student gets an awareness in: The techniques used in the visualization of cellular components and macromolecules. Analytical techniques used in detection and quantification of biological compounds and the separation techniques used in biology. The application of statistical principles in biological studies. The research methodology and documentation.

Module 1.

Light Microscopy: Introduction- Magnification, Resolution, and Numerical aperture. Principle, design, working, applications, advantages and disadvantages of Light, phase contrast, polarization, confocal and interference microscopes. Principle and design of charge coupled device. Electron microscopy: SEM and TEM. Introduction to Atomic force microscopy. Spectroscopy: Beer-Lamberts law -Principle; Design, working and applications of UV-Visible, IR, Raman, Fluorescence, NMR and ESR spectroscopes. **15**

Module 2

Principle, instrument design, working and applications of Light scattering, Refractometry and Flowcytometry; X-ray diffraction and Electron diffraction-application in Biology; Autoradiography- GM counter and Liquid scintillation counter; Biosensors. **12**

Module 3

Principle, instrument design, working and applications of Dialysis, Ultrafiltration, Chromatography- Principle, instrument design, methods and applications of Paper, TLC, ion exchange, molecular sieve, affinity chromatography, GC, HPLC; Centrifugation and Ultra centrifugation; Principle, instrument design, methods and applications of AGE, PAGE, SDS PAGE, Capillary Electrophoresis, Isoelectric focusing, Principle, instrument design, methods and applications of Potentiometer, pH meter and Ion selective electrodes. **18**

Module 4

Introduction and scope of Biostatistics; Methods of sampling; Collection, classification, tabulation and presentation- graphical and diagrammatic- of data. Analysis of data- Measures of central tendency-mean, median, mode, GM and HM; Measures of dispersion-Range, Quartile deviation, MD, SD, Variance, coefficient of variance and Standard error. Probability and probability distributions, Correlation and Regression, Statistical packages-MS Excel, SPSS, SAS. **15**

Module 5

Test of significance. Basic idea of significance test- hypothesis testing, levels of significance, Chi-square test and goodness of fit. Research Design - Meaning, Needs and Features; Different research designs; Principles of experimental designs; Important experimental designs. Interpretation of results - meaning, techniques and precautions. Report writing- significance, steps, layout. Types of reports, Mechanics of writing reports and precautions. **15**

Reference

1. Practical biochemistry. Keith Wilson and John Walker. Cambridge edn.
2. Modern experimental Biochemistry- Rodney Boyer, Pearson education.
3. Statistical methods in Biology- Briley N.J.T
4. Biostatistics PN Arora and P K Malhan Himalaya Pub.
5. Biophysics- R N Roy, New Central Agency.
6. Research methodology- CR Kothari and Gaurav Garg, New Age International.

UCBT0104 BIOPHYSICS AND BIOINFORMATICS

3hours/week **Credit:3**

Course outcome: An exposure is given to students in: the bioenergetics of cell and the basic architecture of macromolecules. The interaction between macromolecules. The role of bioinformatics in biological data storage. The applications of bioinformatic tools in analyzing biological data.

Module1

Laws of thermodynamics, the concept of enthalpy, entropy and free energy, thermodynamic equilibrium, redox potential, high energy molecules- ATP, ADP, GTP, PEP, NADP, NAD, FAD, Phosphocreatine, acyl phosphate and thiol esters. Examples of redox potential in biological system. Stabilizing forces in macromolecules– Ionic, covalent, H bonding, Vanderwal's interaction, polar and nonpolar interactions **8**

Module 2

Structural polymorphism of DNA- A, B, Z and other structural forms, GC content and denaturation kinetics, melting temperature, Cot curve, DNA-Protein interaction-. Lambda repressor and cro binding to DNA. Interactions of transcription factors, Leucine Zipper TBP, homeodomain and types of Zinc fingers. Histone-DNA interaction, DNA-drug Interaction, RNA -protein interactions. **12**

Module 3

Structure and functional group properties of amino acids, primary and higher order structures, Structural implication of peptide bond**,** Ramachandran plot. Motifs and domains, super secondary structures- Greek keys and helix turn helix. Protein families-alpha domains, beta domains, alpha- beta domains, Peptide mass finger printing, MALDI-TOF. Protein-drug interaction, protein folding, Anfinsen's dogma, co operativity in protein folding and pathway in protein folding, Molecular chaperons. **10**

Module 4

Introduction to Bioinformatics. Biological data bases - Primary, secondary and Composite databases. Nucleotide sequence data bases NCBI, EMBL and DDBJ. Protein sequence data bases-PIR UniProt/Swiss-Prot, Sequence format, Protein structure database: PDB and MMDB. Drug Bank. Sequence alignment: Principle (Alignment parameter, Alignment score and optimum alignment), Types: Pairwise sequence alignment – Dot matrix, Dynamic programming and K-Tuple methods (BLAST and FASTA), Multiple Sequence alignment-ClustalW, Global and Local alignments. Sequence submission and retrieval system; BANKIT and SEQUIN. Gene prediction: PFAM. Protein sequence annotation**.** **12**

Module 5

Introduction to Phylogenetic analysis, Construction of phylogenetic tree- Distance matrix methods and parsimony methods. Phylogenetic Analysis tools- MEGA. Molecular Modeling of proteins – Comparative modeling (template identification, alignment correction, backbone generation, generation of loops, side chain generation & optimization, *Ab initio* loop building, overall model optimization, model verification). Molecular Docking – Identification of ligands, active site prediction, docking and evaluation. Molecular Docking software – AutoDock. Applications of Molecular Docking. Applications of Bioinformatics: pharmaceutical industry, immunology, agriculture, basic research, chemiinformatics in biology. Legal and ethical considerations. **12**

Reference:

1. Introduction to protein structure: Branden and Tooze, Garland Science Pub. **ISBN-13:**978-0815323051
2. Biophysics: An introduction-Rodney Cotterill. Wiley Pub.ISBN-13: 978-0471485384
3. Molecular Biophysics-Volkenstain M.V, Academic Press. **ISBN-13:** 978-0124125032
4. DNA topology- Andrew D Bates, Maxwell, Oxford University Press. ISBN 0198567097.
5. Biophysics an Introduction –Roland Glaser, Springer. ISBN-13: 978-3540670889
6. Bioinformatics: Sequence and Genome analysis- David Mount, Cold Spring Harbour Lab Press, New York. ISBN 978-087969712-9
7. Bionformatics and Molecular evolution: Paul G Higgs, Teresa K Attwood. Blackwell pub. *ISBN*: 978-1-405-10683-2
8. Bioinformatics - A Student's Companion. Syed Ibrahim, K. etal, Springer Pub. ISBN-10: 9811018561.
9. Protein Bioinformatics: From Protein Modifications and Networks to Proteomics Editors Wu, Cathy, Arighi, Cecilia, Ross, Karen (Eds.) ISBN 978-1-4939-6783-4. – Springer.
10. Physics in Biology and Medicine. Paul davidovitis. Academic Press ISBN: **9780128137161**

UCBT0105 LABORATORY COURSE 1

Number of Hours / Week: 10 **Credits: 4**

Course outcome: The students are able to understand: the basic principles of preparation of solutions. The detection, assay and purification of biological compounds. Design experiments and analyse results. Handling of required equipments. (Biochemistry, Cell biology& Genetics).

1. Preparation of solutions:
- Percentage solutions, Molar and Normal solutions, Dilution of Stock solutions
2. Preparation of buffers using the Henderson Hasselbach equation
3. Spectrophotometric experiments:
   Verification of Beer Lambert's law, Quantitative estimation of reducing sugars by Dinitro salicylic acid method, Quantitative estimation of Methionine by Nitroprusside method, estimation of protein- Biuret, Lowry, Bradford Method, Estimation of Cholesterol by Zak's method, Estimation of DNA, Estimation of RNA.
4. Chromatographic techniques
- Separation of amino acids by Paper chromatography (Descending /Ascending)
- Separation of Plant pigments by Thin layer chromatography
5. SDS PAGE.
6. Extraction of Polysaccharides (Starch, Glycogen), Proteins, from appropriate source:
- Quantification of isolated polysaccharide (anthrone method), protein and lipids
- Saponification value, iodine value, of fat sample
7. Identification of mitotic cell cycle stages, problems in Genetics.
8. Problems in biostatistics

Reference:

1. An Introduction to Practical Biochemistry. David T Plummer *ISBN*-13: 978-0070841659.
2. Biochemical Methods. S. Sadasivam and A Manickam. New Age International Publishers
3. Biochemical Calculations: Irwin H Segel. Wiley Pub. *ISBN*-13: 978-0471774211
4. Principles of Genetics: M J Gardner, John Wiley and sons.

II SEMESTER

1	**UCBT0201**	Microbiology
2	**UCBT0202**	Immunology
3	**UCBT0203**	Molecular Biology
4	**UCBT0204**	Enzymology and metabolism
5	**UCBT0205**	Lab course II

UCBT0201 Microbiology

Number of Hours / Week: 4 **Credits: 4**

Course Outcome: The students get an exposure in: Microbial grouping and its taxonomical significance. Cultivation and identification of microorganisms. Tools and techniques used in microbiology. Microbial metabolism and molecular processes.

Module 1

History of Microbiology. Principles of bacterial taxonomy. Taxonomical ranks, Bergey's manual; Bacteria and Archaea. Artificial (phenetic) system: Numerical taxonomy. Phylogenetic (Natural) classification (Natural): Ribotyping, Nucleic hybridization analysis. The Ultra structure of bacteria, virus, bacteriophage. Viral replication. Bacteriophage replication. Classes of fungi and its economic importance. **16**

Module II

Factors influencing microbial growth: Environmental and nutritional factors. Nutritional types of bacteria. Microbial locomotion: flagellar motility, gliding motility and amoeboid motion. Chemotaxis, Phototaxis and other taxes. Cultivation of bacteria: culture media and methods. Measurement of bacterial growth. Bacterial growth curve. Binary fission, Continuous culture. Maintenance and transport of bacterial cultures. **15**

Module III

Identification of bacteria: Staining reactions, Cultural, physiological and biochemical characteristics. Sterilization: Principle& physical and chemical methods. Disinfectants & modes of action. Testing of disinfectants. Antibiotics: mechanism of action. Drug resistance in bacteria. Antibiotic sensitivity test. **15**

Module IV

Genetic materials in bacteria. Bacterial chromosome. Extrachromosomal genetic elements: Plasmid, Transposons. Mechanism of gene transfer & transformation, transduction and conjugation. **15**

Module V

Microbial metabolism: Central pathways, Glycolysis, Pentose phosphate pathway, Entner Doudoroff pathway, TCA cycles, Electron transport chain. Aerobic and anaerobic respiration. Fermentation. Peptidoglycan synthesis. Bacterial photosynthesis. **15**

Reference

1. Principles and practice of disinfection, preservation and sterilization - Russel AD et al, Blackwell scientific publications. **ISBN 10 0632005475,ISBN 13 : 9780632005475**
2. Antimicrobial drug resistance, Bryan LE (Ed.), Academic press. **ISBN 0-12-138120-X**
3. Toplely and Wilson's Principles of bacteriology, virology and immunology - Arnold& Heinemann. **ISBN 10- 0713145943, ISBN13 978-0713145946**
4. Microbiology. Bernard D.Davis et al., Harper International Edition. **ISBN 10 0063201771,ISBN 13 978-0063201774**
5. Manual of methods for General Bacteriology. Gerhadt P et al., (ED.). American Society for Microbiology. **ISBN 10 0914826298, ISBN 13 978-0914826293**

6. Microbiology concepts and applications. Pelczer Jr. Chan. Creig. Mc Graw Hill, Inc. **ISBN 10.0070492603, ISBN 13 978-0070492608**
7. Lansing M. Prescott. Microbiology. McGraw-Hill Higher Education. **ISBN 10 0072320419,ISBN 13: 9780072320411**
8. Bergey's Manual of Systematic Bacteriology. Volumes 1-5. Williams & Wilkins. **ISBN 683041088,0683078933,0683079085, 0683090615978068304108 8, 9780683078930978068307893097806830790 81, 9780683090611 0693011189, 9780683011180**
9. Oladele Ogunseitan. Microbial Diversity - Form and Function in Prokaryotes. **ISBN 978-1- 405-1448-3**
10. S. Rajan. Medical Microbiology by MJP Publishers.**ISBN-13:9788180940293s**
11. Stephen H. Gillespie and Kathleen B. Bamford. Medical Microbiology and Infection at a Glance. **ISBN-10:0470655712. ISBN-13:9780470655719**
12. Madigan, M.T., Martinko, j. M., Stahl, D.A., and Clark, D.P. 2012. Brock"s Biology of Microorganisms. 13th Edition. Benjamin Cummings, San Francisco, CA. **ISBN-10:032164963X.ISBN-13:9780321649638**
13. Anaerobic Microbiology: A Practical Approach by P.N. Levett 1992. **ISBN-10;0199632049.ISBN-13:9780199632046**
14. Anaerobic Bacteria, Holland, K. T. 1987. **ISBN9781461317753**
15. Introductory Microbiology by J. Heritage, E.G.V. Erans, R.A. Killington, Cambridge University Press. **ISBN 0521449774**
16. Microbiology – Concepts and Application. John Wiley and Sons, New York, 1988. **ISBN- 10;0471021784. ISBN-13;9780471021780**

UCBT0202 IMMUNOLOGY

Number of Hours / Week: 4 **Credits: 4**

Course outcome: The students have knowledge of : The cells and organs associated with immune system. The details of immune system functioning. Analytical techniques based on immunological reactions. The after effects of defects in immune system.

Module I

Types of immunity- Innate, acquired, passive & active. Mechanisms of innate immunity. Organs and cells of immune system. Differentiation of Lymphocytes and lymphocyte maturation. Types of infections. Antigens-Properties and Types. Immunogenicity & Antigenicity. Epitopes, Adjuvants, Haptens, Super antigens 15

Module II

Antibodies, Immunoglobulin – structure, classes and functions. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements; somatic hypermutation and affinity maturation Antigen- antibody interactions, Agglutination, Precipitation, immunodiffusion, Immunofluorescence, Radio immuno assay, ELISA, Western blotting, immunoelectrophoresis. 15

Module III

Humoral and cell mediated immune response, Receptors on T and B cells, MHC, Clonal selection theory, Monoclonal antibodies – production and application, Complement system, Complement activation and pathways, Biological effects of complements, Complement fixation, Antigen processing and presentation, Activation of T-cells, T-cell function, Cytokines-Properties& therapeutic use. Primary and secondary immune modulation, Antibody engineering. 16

Module IV

Immunology of organ and tissue transplantation, Allograft reaction and GVH reaction, Factors influencing allograft survival, Immunology of malignancy, Tumor antigens, Immune response in malignancy, Immunotherapy of cancer, ABO and Rh blood group system, Immunology of blood transfusion. 15

Module V

Immunological Tolerance, Autoimmunity, Mechanisms of autoimmunization, Autoimmune diseases. Inflammation, Hypersensitivity – immediate and delayed reactions, Clinical types of hypersensitivity- Combs classification. Immunodeficiency diseases: Primary Immunodeficiency diseases- Humoral, cellular, combined, complement related and phagocytic. secondary Immunodeficiency diseases- AIDS. Immunoprophylaxis, Vaccines: types of vaccines. 15

Reference

1. Essential Immunology - Ivan M. Roitt and Peter J delves, Blackwell Publishing
2. Immunology - Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, and Janis Kuby, W H Freeman and Co.
3. Immunobiology - Charles A. Janeway Jr.,Paul Travers, Mark Walport and Mark J. Shlomchik, Garland Publishing.
4. Essential Clinical Immunology – Helen Chappel and Mansel Haeney, ELBS/Blackwell Scientific Publications
5. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition.
6. Text book of Microbiology – R. Ananthanarayanan and C K Jayaram Panicker. Orient Longman.

UCBT0203 MOLECULAR BIOLOGY

Number of Hours / Week: 4 **Credits: 4**

Course outcome: The student gets a comprehensive knowledge of: The structural and functional organization of genome. The molecular phenomena of DNA copying and transmission of information. The regulation of gene function and associated phenomena.

Module 1

Structural Organisation of genome: chromatin, nucleosome, chromosomes. Functional organization: genes, controlling sequence, split gene concept, exons, introns, intergenic DNA-repetitive sequences-interspersed repeats- SINE, LINE transposons- types (IS elements, replicative transposons, retroposons) &significance, tandem repeats- micro minisatellites.

DNA Replication- Models of DNA Replication, Conservative, Semiconservative and discontinuous, Meselson and Stahl experiment, Steps in initiation of replication, Enzymatic factors involved, Ori site, Okazaki fragments, Termination of replication, DNA polymerases in eukaryotes and prokaryotes, Klenow fragment, Primosome, SSB, Ligase, modes of replication, theta, rolling circle, d-loop replication, end problem of replication, telomerase-structure and functions, Inhibition of replication. Role of enzymes in proof reading, Repair mechanisms: Photolyase, Excision Repair- BER, NER. Mismatch repair, SOS repair, Recombination repair systems. **20**

Module 2

Process of transcription, promoters, Enhancers, stages in initiation, RNA polymerases in prokaryotes and eukaryotes, sigma factor in prokaryotes, elongation, Rho dependent and Rho independent termination, Transcription factors in Eukaryotes, CpG islands, Differences in transcription between prokaryotes and Eukaryotes, post transcriptional modifications, Polyadenylation, capping, r-RNA processing, Splicing-Spliceosome, lariat structure, Group I, II and III Introns, catalytic RNA Importance of ribozyme, properties, application, RNase P,RNAse III, RNAse H. monocistronic and polycistronic m-RNA, Joint transcript of r-RNA and t-RNA in prokaryotes and their processing, Trans-splicing, alternate splicing, inhibitors of Transcription, mRNA stability and degradation**.** **15**

Module 3

Genetic code, properties, wobble hypothesis. Eukaryotic and prokaryotic ribosomes, t-RNAs, aminoacyl t-RNA synthetases, Steps of translation. protein factors- initiation complex, peptidyl transferase, releasing factors, differences between prokaryotic and eukaryotic translation systems, inhibition of translation, post translational modifications. Protein folding, chaperones. **10**

Module 4

Molecular mechanism of gene regulation in prokaryotes-Transcriptional regulation in prokaryotes; Inducible & repressible system, positive & negative regulation; Operon concept, structure of operon, Lac, Trp, Catabolic repression, Attenuation, Multiple levels of eukaryotic gene regulation: Histone acetylation and deacetylation, methylation and demethylation, chromosome remodeling complex, Gene amplification, transcription level: differential transcription, Translational control, Intein splicing. Role of Hormones in gene regulation. **15**

Module 5

RNA interference, Antisense RNA, SiRNA, MicroRNA, Riboswitches & their applications; Nucleic acid as therapeutic agent, prions, prion disease in mammals – CJD, scrapie. Human genome project and its implications. Molecular mechanism of differentiation: maternal, segmentation and homeotic genes, hox genes, gene interactions bicoid- nanos system. Differentiation in plants, floral development-apetalous, pistillate, agamous interactions. **15**

Reference

1. Lewin's Cells. Lynne Cassimeris, Viswanath R, Lingappa, George Plopper Jones . Bartlett Publishers, London
2. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.

3. REA's Problem Solvers in Genetics, Research Education Association,61, Ethel Roadwest, New Jersey
4. Modern Genetic Analysis, Griffiths, Lewontin, Gelbart, and Miller, Freeman's and Co, New York
5. Lewin's Genes XII: Krebs, Glodstein and Kilpatrick. Pub: Jones and Barlett Learning.
6. Cell and Molecular Biology , Gerald Karp, Academic Press
7. Genomes: T A Brown, John Wiley & Sons Pub.
8. Molecular Biology: David P Clark, Elsevier.
9. Principles of gene manipulation and Genomics – Twyman R M and Primrose S B, Blackwell pub.ISBN:1405135441
10. Gene cloning and DNA analysis – T. A. Brown, Blackwell Publishing ISBN: 1405111216

UCBT0204 Metabolism and Enzymology

Number of Hours / Week: 3 **Credits: 3**

Course outcome:

Module 1

Metabolism of carbohydrates: Glycolysis, TCA cycle, pentose phosphate pathway, substrate level phosphorylation, oxidative phosphorylation, Electron transport chain: structural components of the chain, complexes, free elements; Chemiosmosis ATP synthesis: structural and functional properties of ATP synthesis; Inhibitor agents and decoupling agents of the respiratory chain and ATP synthesis; Regulation of glycolytic pathway, Gluconeogenesis and Glycogenesis. **10**

Module II

Metabolism of Proteins, and nucleic acids: Synthesis of amino acids, degradation, deamination, transamination, urea cycle Synthesis of purines and pyrimidines, salvage pathway, degradation, regulation of pathways **10**

Module III

Metabolism of lipids, Beta oxidation, synthesis of fatty acids, FAS, synthesis of cholesterol, degradation of cholesterol**.** **8**

Module IV

Holoenzyme, apoenzyme, and prosthetic group; Interaction between enzyme and substrate- Features of active site, activation energy, Rate Enhancement Through Transition State Stabilization, Enzyme specificity and types; Enzyme Commission system of classification and nomenclature of enzymes. Measurement and expression of enzyme activity, Definition of IU, katals, enzyme turnover number and specific activity, Isolation of enzymes and the criteria of purity; Characterization of enzymes Order of reaction, study of the factors affecting the velocity of enzyme catalyzed reaction- Derivation of Michaelis -Menten equation and Km value determination and its significance, Definition of V_{max} value of enzyme and its

significance, Lineweaver- Burk plot; Bi-substrate reactions: Classification, Reaction mechanisms; Allosteric enzymes: Examples, Sigmoidal Kinetics for Non allosteric Enzymes.
14

Module V

Enzyme inhibition and regulation**:** Reversible and irreversible – examples. Reversible-competitive, noncompetitive and uncompetitive inhibition; Structure—Activity Relationships and Inhibitor Design; Tight Binding Inhibitors: Identifying Tight Binding Inhibition, examples and Time-Dependent Inhibition: examples, without rate expression. Distinguishing between modes of inhibitor interaction with enzyme Covalently modulated enzymes with examples of adenylation and phosphorylation; Zymogen form of enzyme and zymogen activation; Multienzyme complexes and their role in regulation of metabolic pathways; Allosteric regulation: example Aspartate transcarbamoylase, Isoenzymes- Lactate dehydrogenase and creatine phosphokinase. Application of enzymes: Industrial uses of enzymes: Diagnostic and therapeutic enzymes
12

Reference

1. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Publisher: Oxford University Press, USA ISBN: 019850229X ISBN-13: 9780198502296, 978-0198502296
2. Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN: 8184890478 ISBN-13: 9788184890471, 978-8184890471
3. Biochemistry (2004) by Donald Voet, Judith G. Voet **Publisher:** John Wiley & Sons
4. Enzyme Mechanism by P.K. Shivraj Kumar (2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN-13: 9788176114233, 978-8176114233
5. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko Lubert Stryer **Publisher:** B.i.publicationsPvt.Ltd **ISBN:**071676766X **ISBN-13:** 9780716767664, 978-716767
6. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K **Publisher:** Pearson **ISBN:** 0131977369, **ISBN-13:**9780131977365, 978-0131977365
7. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing Limited ISBN: 1904275273ISBN-13:9781904275275,978-1904275275

UCBT0205 LABORATORY COURSE-II

Number of Hours / Week: 10 **Credits: 4**

Course outcome: The student can learn: The cultivation, observation and identification of microorganisms. The design of immunological experiments. The detection of compounds of interest in biological samples.

(Microbiology, Immunology and Enzymology)

- Microscopic examination of bacteria in living conditions
- Testing of motility
- Staining procedures- simple stain, differential staining- Gram staining, Acid fast staining. Special Staining-Capsular Staining, Volutin Granules, Endospore Staining
- Sterilisation methods
- Cultivation of bacteria and fungi
- Study of cultural characteristics and biochemical reaction of bacteria
- Testing of disinfectants
- Antibiotic sensitivity tests
- Immunodiffusion in gel
- Serological tests for the diagnosis of microbial infections-RPR, RF, ASO.
- Agglutination and precipitation tests
- ELISA

Metabolism and Enzymology

- Estimation of enzyme activity ALP, SGOT, SGPT
- Determination of Km and Vmax
- Effect of pH, Effect of temperature on enzyme activity
- Enzyme inhibition studies- estimation of KI.
- Purification of the enzyme- Ammonium sulphate precipitation

A) Dialysis B) Gel Filtration C)Ion Exchange chromatography

Reference

1. An Introduction to Practical Biochemistry. David T Plummer *ISBN*-13: 978-0070841659.
2. Biochemical Methods. S. Sadasivam and A Manickam. New Age International Publishers
3. Biochemical Calculations: Irwin H Segel. Wiley Pu b. *ISBN*-13: 978-0471774211
4. Practical Enzymology Hans Bisswanger Wiley and Blackwell Pub.
5. Practical immunology. Frank C Hay, Olwin M R Westwood. Wiley pub.
6. Practical Microbiology. Maheswari D K. S Chand Pub.
7. Microbiological Applications. Laboratory manual in General Microbiology. Harold J Benson. Mc Graw hill Pub.

III SEMESTER COURSES

1	**UCBT0301**	Bioprocess Technology
2	**UCBT0302**	Recombinant DNA Technology
3	**UCBT0303**	Environmental biotechnology
4	**UCBT0304**	Plant and Animal biotechnology
5	**UCBT0305**	Lab Course III

UCBT0301 BIOPROCESS TECHNOLOGY

Number of Hours / Week: 4 **Credits: 4**

Course outcome: The students are trained in: Screening for microbial strains from different samples. Types of Bioprocess and standard lab practices. Bioreactor designing and control. Industrial production conditions through fermentation.

Module 1

Isolation of Industrially important microorganism, Primary and secondary screening methods. Single cell sequencing in detecting microbiome. Methods of strain improvement. Preservation and maintenance. 8

Module 2

Batch culture- characteristics, specific growth rate, substrate saturation constant, yield coefficient, Monod kinetics, substrate affinity. Continuous culture- characteristics, dilution rate, washing out. Fed batch culture, Product yield, solid state and submerged fermentations, Immobilization of microbial cells- Methods, advantages and disadvantages. Media preparation- C, N, energy sources, minerals, vitamins, buffers, chelators, growth factors, buffers and antifoams. Examples of Industrial media- Molasses, Corn steep liquor. 18

Module 3

Bioreactor Design- desirable features, aseptic manipulation, probes, valves- gate valve, globe valve, piston valve, butterfly valve. Agitators, aerators, baffles. Types of bioreactors: CSTR, pneumatically driven fermenters, Airlift fermenter, Packed Bed reactor, Fluidized Bed reactor, Reactor performance. Oxygen transfer in reactor system, KLa, Determination of KLa- sulphite oxidation technique. Reynold's number, types of fluids- Newtonian and Nonnewtonian fluids. 16

Module 4

Bioreactor- online and offline control. pH probe, temperature probe, DO probe, Tacchometer, Load cells Control of Bioreactor, Downstream processing: filtration, centrifugation, cell disruption, liquid/liquid extraction, dialysis, Purification, Drying, Packing and labelling. Good Manufacturing Practices, Biosafety- laws and concerns at different levels- individual, institution and society. Forms of IPR and process of patenting. 18

Module 5

Industrial production of Primary metabolites and secondary metabolites-shikimic acid, flavonoids. Fermentative production of alcohol, acetone- butanol, citric acid, acetic acid, lactic acid. Amino acids- lysine and phenyl alanine, Vitamins- riboflavin and ascorbic acid. Antibiotics- penicillin, streptomycin, tetracycline. Microbial production of enzymes- amylase, protease, cellulase. SCP production. Bread manufacturing, beer manufacturing, Production of Cheese and other fermented dairy products -acidophilus milk, paneer, yogurt, butter milk. 15

Reference

1. Principles of Fermentation Technology, P.F.Stanbury, A Whitaker and S.J.Hall, 2008. Elsevier. ISBN 976-81-8147-406-5.
2. Bioprocess Technology, P.T. Kalichelvan and I Arul Pandi, , 2009,MJP Publishers, Chennai.

3. Bioprocess Engineering, M.Shuler & F.Kargi (2002). Prentice Hall (I) Ltd., N.Delhi.
4. Bioprocess Technology- Kinetics and reactors ,Antan Moser and Philip Manor,.1998, Springer
5. Fermentation Microbiology and Biotechnology ,E.M.T. Mansi, C.F.A . Bryce. A.L..Dmain, A.R.Alliman. ,2009, Taylor and Francis. New York
6. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9
7. Industrial Microbiology, Cassida L.E. 1968.John Wiley and Sons Publishers.

UCBT0302 RECOMBINANT DNA TECHNOLOGY

Number of Hours / Week: 4 **Credits: 4**

Course outcome: The student is exposed to the basic requirements to perform genetic engineering experiments. The techniques involved in the preparation and introduction of r DNA to the host. Applications of r DNA technology. Regulations in carrying out r DNA experiments.

Module I

History. Isolation of genetic material. Modification of genetic material for the preparation of r DNA- Enzymes for in vitro modification of nucleic acids– Kinases, Phosphatases, Exonucleases, Endonucleases, Restriction Endonucleases, Site specific recombinases, topoisomerases, Ligases and Terminal Transferases. Types and properties of restriction enzymes. Modification of Ends - Adapters, Linkers, Homopolymer Tailing. Genomic and c DNA library construction. **14**

Module II

Cloning Vectors- Plasmids and their desirable properties, E coli-based vectors- pBR, pSC, pUC, pGEM3Z. M13vectors mp7, Bacteriophages λ EMBL Cosmids, Phasmid, Phagemids with special reference to pBluescript, pLITMUS. In vitro packaging, phage display. Gateway Cloning, TA cloning. Shuttle Vectors -pCAMBIA, Vectors for Yeast (YEP, YIP, YRP, YCP, YAC) Artificial Chromosomes- BAC, AC. Viral and virus derived vectors for animal cells- SV40, Adenovirus vectors, Baculovirus, lentivirus, poxvirus. Plant vectors – gemini virus, Ti plasmid. **15**

Module III

Introduction of r DNA to host cells-micro injection, electroporation, biolistic, Gene transfer by Chemical transfection: Calcium phosphate mediated, Polyplexes mediated, Liposomes and lipoplexes mediated. Markers in prokaryotes. Selection of recombinants. Blue white screening, screening for Antibiotic resistance. Genetic markers in plants- Kanamycin, neomycin, Hygromycin B, Bromoxynil, Methotrexate, chloramphenicol. Animal markers: Maximizing protein expression in Bacteria, fungi and animal cells – Promoters- Ca MV promoter, Maize actin 1 gene. Reporter systems- lux genes, GFP. Expression vectors, Fusion tagged expression system, affinity tag. Studying the translation product- hybrid arrest and hybrid release translations, immunochemical methods. Nuclear transfer technology, Inducible expression system and control of transgene expression through naturally inducible promoters – lac and tet. Steroid hormones as heterologous Inducers. Chemically induced

dimerization (CID) as inducible transgene regulation. Site specific recombination for efficient gene targeting. **16**

Module IV

Chemical synthesis of DNA, Blotting techniques: Southern, Northern, Southwestern, Far western. colony hybridization PCR types and applications. DNA foot printing, finger printing, gel shift analysis, DNA microarray, RFLP, RAPD, advanced molecular markers, chromosome walking, jumping and landing. DNA sequencing- Maxam and gilbert, enzymatic method, pyrosequencing, Next generation sequencing. Site directed Mutagenesis: methods. **16**

Module V

Applications of recombinant DNA technology- Production and purification of recombinant proteins- insulin and somatostatin. Gene therapy. Metabolite engineering. Imparting new agronomic traits to plants to improve quality and quantity. Gene Silencing through RNA interference and antisense therapy. CRISPR-CAS 9 system. Gene Knockout. Animal pharming, nanoparticles for labeling, delivery of drugs, DNA and RNA. Bioethics: laws, possible hazards and merits to society or nature. **15**

Reference

1. Principles of gene manipulation and Genomics – Twyman R M and Primrose S B, Blackwell pub.ISBN:1405135441
2. Gene cloning and DNA analysis – T. A. Brown, Blackwell Publishing ISBN: 1405111216
3. DNA science : A first course in rDNA Technology: David Mickols, Carolina Biological Supply.
4. Molecular cloning : A laboratory Manual, Sambrook and Russel, Cold spring Harbor Lab Pub
5. Biotechnology: An Introduction, Susan R Barnum. Pub: Thomson, Brooks/Cole
6. Molecular Biotechnology – B. R. Glick and J J. Pasternac Pub: American Society for Microbiology
7. From gene to genomes:Concepts and Applications of DNA Technology – J W Dale, M Shantz, Wiley- Blackwell

UCBT0303 ENVIRONMENTAL BIOTECHNOLOGY

Hour/ week: 4 **Credits: 4**

Course outcome: The student is able to understand: the role of biotechnology in environmental applications. Degradation of recalcitrant compounds by biological agents. Treatment technologies involved in the processing of solid and liquid waste. Alternate green energy sources and green technologies.

Module1

Xenobiotics, biological impacts of polychlorinated biphenyls and dioxins, synthetic polymers, alkyl benzyl sulphonates, hydrocarbons, chlorinated pesticides, heavy metals- Mercury, lead. Biomagnification of recalcitrant molecules Microbial infallibility, types of biodegradations, factors affecting biodegradation, enzymes involved in biodegradation, catabolic plasmids, super bugs, Biodegradation of Hydrocarbons, cellulose, lignin, and pesticides. Bioremediation strategies. 15

Module II

Bacillus thuringiensis as a pesticide, viral pesticides. Biological fertilizers- biological nitrogen fixation: Mycorrhizae, AM, cyanobacteria, molecular mechanism of nitrogen fixation in root nodules, nonsymbiotic nitrogen fixation- C*lostridium* sp. Nif gene data base. Biosurfactants, Biofouling, Bioleaching**.** **12**

Module III

Types of industrial effluents, characterization of the wastewater- Chemical Oxygen Demand, Biological Oxygen Demand, Total organic carbon, Nitrogen contents, Suspended solids. Total heterotrophic bacterial population. Bacteriological analysis of drinking water, E. coli as a water quality indicator. Presumptive, completed, and confirmed test. Treatment strategies: Preliminary and primary phases. Secondary treatment: Aerobic biological treatment methods- Floc based and film -based strategies. Activated sludge process and its different stages, Types. Trickling filter process, Rotating Biological contactor, Submerged aerobic filters, Fluidized Bed Reactor, Packed bed reactor, Oxidation lagoons. UASB**.** 20

Module IV

Tertiary treatment methods: Columns of activated and granulated charcoal, ion exchange methods, reverse osmosis, Nitrogen removal- air stripping, break point chlorination biological denitrification. Removal of phosphate- biological and other methods. Ultra and nanofiltration. Disinfection- Chlorination, chlorination derived byproducts, chloramines, Copper- silver method, ozone, UV methods. Solid waste- Characterization and sorting of wastes. Treatment methods- Landfills, incineration, pyrolysis. Composting- stages in composting, Types of composting. Vermi composting. DRANCO. Anaerobic reactors - Stages in anaerobic digestion, methanogens. Biogas generation. Household treatment strategies- septic tank, small scale composting using pot, pipe etc. **18**

Module V

Introduction to: Biofuels- biogas, syngas, biodiesel, ethanol. Bioelectricity, biocementation and bio cement, Bioplastics- PHB, PLA, cellulose and protein-based plastics. Green composite – starch based. Concept of green patent. Advantages of bioprocessing in space. Biological indicators, DNA barcoding. **10**

Reference

1. Environmental Biotechnology, Christopher. F Forster, D.A.John Wase, 1987 Ellis Harwood.
2. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9
3. Waste water Microbiology, Gabriel Bitton, 2005, John Wiley and Sons, Wiley series in Ecological and Applied Microbiology.
4. Microbial Ecology. Fundamentals and Applications. Atlas and Bartha, Pearson Education, Benjamin Cummings publishing company. Inc. New Jersy
   Environmental Biotechnology, sries in Handbook of Environmental Engineering.Vol.10.Wang, L.K., Ivanov V.,Tayi,J.H and Hung Y.T (eds),2010, Humana Press.

UCBT0304 ANIMAL AND PLANT BIOTECHNOLOGY

Number of Hours / Week: 3 **Credits: 3**

Course outcome: Students get familiarized with the fundamental requirements and design of lab to carry out plant and animal cell culture experiments. The different approaches and techniques involved in creating recombinant plant and animals. The applications and demerits of genetic modification in plants and animals.

Module I

History of animal cell culture; Laboratory setup and equipment; Types of cell culture media, media constituents, CO2 incubation & bicarbonate Buffering. Sterilization of cell culture media; Isolation of tissue. Disaggregation of tissue – Mechanical and Enzymatic methods. Different culture techniques, Secondary culture. Passaging number; characteristics of animal cells in cultures; Suspension culture; Histotypic cultures; Embryonic and Adult stem cell culture. Continuous cell lines, Maintenance of cell Lines- Cryopreservation and Germplasm storage. **10**

Module II

Vectors for animal cells- adeno based vectors, SV 40, baculovirus. Measurement of viability & cytotoxicity; Cell cloning and selection; Cell synchronization; Hybridoma technology and its application; Application of animal cell culture technology: Production of human and animal vaccines and pharmaceutical protein. Animal bioreactors. Three-dimensional culture and tissue engineering for organ replacement.; *In vitro* testing of drugs, testing of toxicity of environmental pollutants and carcinogens; As model systems for basic research; Fetal cell culture to detect genetic abnormalities. Transgenesis, transgenic mice and cattle. Artificial cells. **10**

Module III

Conventional plant breeding. Introduction to cell and tissue culture; Requirements of tissue culture lab, Tissue culture media: Composition and Preparation. Sterilization and agents of sterilization used in tissue culture labs. Initiation and maintenance of callus and suspension cultures. Somoclonal variation. Shoot tip culture; micropropagation, Rapid clonal propagation and production of virus-free plants. Organ culture, Embryo culture and embryo rescue; Single

cell clones. Organogenesis; Somatic embryogenesis; Transfer and establishment of whole Anther, pollen and ovary culture for production of haploid plants and homozygous lines. Bulbosum technique, triploid production, Hardening, synthetic seeds. 14

Module IV

Agrobacterium mediated DNA transfer- Features and Use of *Ti* and *Ri* plasmids; Mechanism of DNA transfer; triparental mating, Binary vectors. Methods of nuclear transformation, Viral vectors and their applications; Multiple gene transfers, Vector-less or direct DNA transfer, Transformation of monocots- Gemini virus, Plant promoters: Ca MV35Spromoter, Rice actin 1 promoter, Maize ubiquitin1 promoter. Transgene stability and gene silencing. **8**

Module V

Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids. Chloroplast transformation; Cryopreservation; Slow growth cultures and DNA banking for germplasm conservation. Application of plant transformation for enhanced quality: Herbicide resistance, insect resistance, Bt genes, Non Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated disease resistance, Pathogen identification by SCAR. Movement protein mediated disease resistance, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stresses; marker aided breeding –an introduction– Advantages, Plantibodies. Metabolic engineering and industrial products – Plant secondary metabolites. 12

Reference

1. Freshney, culture of Animal cell, 5th editionEd. John R.W Masters Animal cell culture-Practical approach 3rd edition, Oxford university press-2000
2. In Vitro cultivation of Animal cells. Elsevier India PVT LTD-17-A/1 Main Ring Road, New Delhi-110024
3. R. Sasidhara, Animal Biotechnology MJP publishers-Chennai.
4. Plant biotechnology – J Hammond, et. al., Springer Verlag.
5. Biotechnology in crop improvement – H S Chawla.
6. Practical application of plant molecular biology – R J Henry, Chapman & Hall.
7. Elements of biotechnology – P K Gupta.
8. An introduction to plant tissue culture – M K Razdan.
9. Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.
10. Principles of plant biotechnology: An introduction to genetic engineering in plants – SH Mantell,

UCBT0305 LABORATORY COURSE III

Number of Hours / Week: 4 **Credits: 4**

Course outcome: Students are trained in: Characterizing waste water, bacteriological analysis of water and food, plant tissue culture techniques and other lab scale bioprocesses.

1. Bacteriological examination of water. MPN Method
2. Bacteriological examination of food and milk sample
3. Methylene blue reductase test for milk quality
3. Fermentative production of wine and estimation of alcohol content
4. Fermentative production through Solid state fermentation
5. Immobilisation of microbial cells for enzyme production
6. Estimation of COD
7. Estimation of BOD
8. Bioreactor studies for waste management
9. Biogas production
10. Composting techniques
11. Mushroom cultivation
12. Fermentative production of industrially useful enzyme
13. Plant tissue culture techniques
14. Surface sterilization
16. Callus culture
17. Anther culture
18. Embryo culture
19. Protoplast isolation
20. Somatic Hybridization

Reference :

1. Practical Microbiology. Maheswari D K. S Chand Pub.
2. Microbiological Applications. Laboratory manual in General Microbiology. Harold J Benson. Mc Graw hill Pub.
3. Plant tissue culture: Theory and Practice - S.S Bhojwani and M.K. Razdan. Elsevier
4. Plant, Cell, Tissue and Organ Culture Fundamental Methods - Gamborg and Phillips, Narosa Publishers.
5. Experiments in Microbiology, Plant Pathology and Biotechnology. K R Aneja. New Age International.

FOURTH SEMESTER

1	**UCBT0401**	Lab Course	Practical	10	4
2	**UCBT0402**	Project			4
3	**UCBT0403**	Course viva			3
4		Electives			

IV SEMESTER
UCBT0401 Laboratory Course IV

Number of Hours / Week: 4 **Credits: 4**

Course outcome: Students are trained in: Isolation of genetic material, purification. Modification of genetic material, generation and introduction of r DNA, analysis of genome.

1. DNA isolation
2. RNA isolation
3. Conjugation
4. cDNA preparation
5. Competent cell preparation
6. Transformation
7. Plasmid isolation
8. Restriction enzyme digestion
9. Ligation
10. Screening of recombinants
11. Expression and purification of recombinant proteins
12. Blotting techniques
13. RFLP,
14 Amplification of selective gene by PCR
15. Molecular marker studies: RAPD, SCAR, AFLP, SNP
16. Basics of Bioinformatics

Reference:

1. Molecular cloning : A laboratory Manual, Sambrook and Russel, Cold spring Harbor Lab Pub
2. Experiments in Microbiology, Plant Pathology and Biotechnology. K R Aneja. New Age International
3. Biotechnology: Procedures and Experiments Hand book: S. Harisha. Infinity Science Press. *ISBN*:9788170088790
4. Practical Handbook of Biochemistry and Molecular biology. Ed. Fasman. CRC Press.ISBN0-8493-3705-4

ELECTIVES

Course Code	Elective Groups	Elective courses	Credit
UCBT0404	**Elective Group I**	Environment and Biotechnology	**4**
UCBT0405		Food Biotechnology	**4**
UCBT0406		Advanced Molecular Techniques	**4**
UCBT0407	**Elective Group II**	Physiology	**4**
UCBT0408		Microbial Food Technology	**4**
UCBT0409		IPR and Biotechnology	**4**
UCBT0410	**Elective Group III**	Molecular biology of Development	**4**
UCBT0411		Cancer Biology	**4**
UCBT0412		Genomics: Techniques and Applications	**4**

ELECTIVE GROUP I

UCBT0404 ENVIROMENT AND BIOTECHNOLGY

Credit-4

Syllabus outcome: The students are exposed to:

The structure of the environment, the role of other organisms in the survival of man as a species, the global environmental issues, the necessity to conserve environment and strategies for conservation, the Biotechnological approaches in environmental studies.

Module I

Principles and scope of environmental science, autecology, synecology, habitat, niche, fundamental and realized niches, trophic levels, food chains, food web, ecosystem, biotic and abiotic components, pyramid of numbers, pyramid of biomass, energy transfer in ecosystem.

12

Module II

Biogeochemical cycles- nitrogen, sulfur, phosphorus cycles and their significance. Microorganisms in extreme environment, biological indicators of environmental quality- lichen, frogs and toads. **10**

Module III

Biomes: Types. Tropical rain forest as a typical example of biome. Ecological succession – xerosere and hydrosere, Edge effect and ecotones, Endangered and Threatened Species. Sentinel species, Environmental genomics: High throughput sequencing in the detection of unknown DNA from environment, DNA barcoding. **18**

Module IV

Environmental issues and problems: Ozone depletion, global warming and climatic change, acid rain, pollution by oil spillage, desertification, eutrophication, underground water pollution, heavy metal poisoning- mercury, lead, arsenic, cadmium, hazards of radio activity, bioweapons, pollution in extreme environment. Carbon foot print. **16**

Module V

International and national efforts for environment Protection and Conservation of biodiversity: Biodiversity status, monitoring and documentation. Biodiversity management approaches, principles of conservation and wild life management, ex situ and in situ methods of conservation, biological parks, nature reserves, sanctuaries, cryopreservation, gene bank, germplasm conservation, Hotspots of biodiversity. **16**

Reference

1. A textbook of environmental sciences, Arvind kumar.
2. Basics of environmental science. Alleby M. Routledge, Newyork
3. Cunningham, W. P and Siago, B. W ,Environmental science.
4. Ecology principles and applications. Chapman and Reiss,Cambridge University.

ISBN-13: 978-0521588027

5. Environmental biology, Jobes A. M., Routledge, London.
6. Environmental Genomics,. Ed. **Martin**, C. Cristofre, Springer
ISBN 978-1-59745-548- 0
7. Fundamentals of ecology. Odum E. P and Barret G W,W. B Saunders company, Philadelphia.
8. Kewin T. P and Owen C. A., Introduction to global environmental issues. Routledge, London.Chiras,D.D, Environmental science
9. Microbial Ecology. Fundamentals and Applications. Atlas and Bartha, Pearson Education, Benjamin Cummings publishing company.Inc.New Jersy
10. Odum E. P. Basic ecology. Saunders College.

UCBT0405 FOOD BIOTECHNOLOGY

Credit 4

Course outcome: Students can understand: Applications of biotechnology in food production. Enhancing the quality and quantity of food materials through genetic engineering, The rules and regulations in genetic modification of food.

Module I

Food production through fermentation- Bread making, cheese production-process, starter culture, types of cheese. Other fermented dairy products- buttermilk, acidophilus milk, yogurt, butter, paneer, kefir, marine fermented foods, koji, tempeh. Fermented beverages- beer and wine. Enzymes in food processing: amylase, protease, chymosin, lipase, cellulase, hemicellulase, pectinase, pectin lyase, catalase, glycosidase, invertase, glucose oxidase, glucose isomerase 15

Module II

Single cell protein- from bacteria and algae- spirulina, probiotics- significance, role in health, prebiotics, Edible mushrooms, Steps of mushroom production, microbial production of vitamins-riboflavin, vitamin C, lite beer, HFCS (High Fructose corn syrup). Buffalo cloning in India. 12

Module III

Transgenic plants-Flavr -savr tomato; Methionine-enriched oil; Frost-resistant food; - Starlink corn, Bt maize; Fungal Resistant potatoes; Transgenic Fish -Atlantic salmon. Plant Pharmaceuticals, Biopharming -beta -carotene in rice; Edible vaccines -Hepatitis B vaccine in maize-Cholera vaccine in potatoes; Bovine Somatotropin in Milk; Chymosine and mycoproteins. Growth hormone gene in pigs - alpha-lactalbumin and lactoferrin in milk; 15

Module IV

Food preservation: contamination of milk, Preservation of milk, microbial contamination and spoilage of food, foodborne illness- salmonellosis, listeriosis, botulism, staphylococcal infection, preservation methods: Effect of low temperature, freezing, effect of heat, drying, concentration, fermentation, canning, radiation, chemical preservatives. 15

Module V

Significance of food safety assessments & surveillance. GM food: Regulations, Risks, possible danger to individuals, society or nature- Terminator genes and loss of biodiversity. HACCP concepts and risk assessment. Government regulatory agencies and food policies - Food and Drug Administration, The Centers for Disease Control and Prevention, The Environmental Protection Agency; 15

Reference:

1. Bioprocess Technology: P T Kalaichelvan, I Arul Pandy : MJP Publishers.
2. Biotechnological innovations in foodprocessing: Editor : Dr. J Green, Butterworth-Heinman Pub.
3. Food-Facts and PrinciplesII Ed: N Shakuntala Manay, M. Shadakshara Swamy. New Age International Pub:
4. George J.B., "Basic Food Microbiology", CBS Publishers & Distributors, 1987
5. Roger A., Gorden B., and John T., " Food Biotechnology", 1989

UCBT0406 ADVANCED MOLECULAR TECHNIQUES

Credit-4

Course outcome:

Module I

DNA Extraction: Phenol-chloroform method. Representational Difference Analysis (RDA), Serial Analysis of Gene Expression (SAGE), Differential Display. Electrophoretic Methods for mutation detection: SSCP (Single-Strand Conformational Polymorphism), Heteroduplex analysis, DGGE (Denaturing Gradient Gel Electrophoresis), Chemical Cleavage of mismatched nucleotides, Ribonuclease cleavage of mismatched DNA: RNA duplexes. 15

Module II

Modifications of PCR: Gene amplification and Analysis-PCR, Multiplex Amplification, Labeling PCR, Allele-Specific PCR, Real-Time PCR, Quantitative fluorescent PCR, Rolling-Circle Amplification (RCA) and Multiple Displacement Amplification (MDA), ARMS-PCR (Amplification-Refractory Mutation System-PCR), Oligonucleotide Ligation Assay, Primer Extension. Isothermal Amplification: TMA (Transcription-Mediated **Amplification**), NASBA (Nucleic Acid Sequence-Based **Amplification**), SDA (Strand Displacement Amplification), Multiple Thermal Amplification: Linked Linear Amplification, LCR (Ligase Chain Reaction); 15

Module III

Next-Generation Sequencing: Massively Parallel Sequencing Platforms: 454/Roche GS FLX technology overview, Research Application. Illumina Genome Analyzer II: Library Preparation, Cluster Creation, Data Analysis, Paired-End Sequencing. SOLiD 3 System: SOLiD (Sequencing by Oligonucleotide Ligation and Detection) platform, SOLiD system application. (2 base encoding). **15hrs**

Module IV

DNA Profiling in forensic analysis: Concept of sequence variation - VNTR, STRs (Short Tandem Repeat), Mini STRs, SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP (Amplified Fragment Length Polymorphism), Y-STR (Short Tandem Repeat on Y-chromosome), Evaluation of results. Allele frequency determination, Match probability – Database, Quality control, Certification and Accreditation. Mitochondrial DNA analysis.

15hrs

Module V

DNA profiling applications in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases. Legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns. Status of development of DNA profiling in India & abroad. Limitations of DNA profiling. **12 hrs**

Reference

1. Anolles, G. C. and Gresshoff, P.M., DNA markers – protocols, applications and overviews. Wiley – Liss, NewYork, 1997
2. Clark, D. P., Molecular Biology, Elsevier, USA, 2005.
3. Henry R. J., Plant Genotyping: The DNA fingerprinting of plants. CABI, New Delhi, 2005.
4. Patterson, Molecular dissection of complex traits, CRC Publications, Washington, 1998.
5. Purohit, S. S., Biotechnology – Fundamentals and Applications, 8th Edition, Agrobios, India, 2007.

ELECTIVE GROUP II

UCBT0407 Biotechnology and Physiology

Credit 4

Course outcome: The students become familiar with: The functional significance of organ systems. Role of plant metabolic pathways and their steps. Applications of biotechnology in human cell and organ culture.

Module I

Composition and functions of blood. Hemopoiesis. Plasma and formed elements. Plasma - function, Clotting factors- production through r DNA technology. Role of Hemoglobin. Thalassemia – genetic diagnosis and gene therapy. Hemostasis– mechanisms. Blood groups: ABO system, determination, importance, Rh. Culture of blood cells. Cardiac cycle, blood pressure, Neural and chemical regulation. 15

Module II

Physiology of excretion, Kidney, Urine formation, Urine concentration, Micturition, Regulation of water balance, electrolyte balance, acid-base balance. Functional anatomy, Phases of respiration transport of gases, Neural and chemical regulation of respiration. Organ culture and its applications 15

Module III:

Nervous system - Neurons, Action potential, Gross neuro – anatomy of the brain and spinal cord, Central and peripheral nervous system, Neural control of muscle tone and posture. Neural circuit. Fluorescent labeling and detection of neurons. Culture of neuronal cells. Endocrinology and reproduction - Endocrine glands, Basic mechanism of hormone action, Hormones and diseases 15

Module IV:

Photosynthesis - Light harvesting complexes, mechanisms of electron transport, photo protective mechanisms, CO2 fixation-C3, C4 and CAM pathways. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis, photorespiration. Transpiration. Reverse photosynthesis- production of biofuels. 15

Module V

Absorption and transport of water, Macro &micro nutrients, Plant hormones, plant movements, photoperiodism, vernalization, **Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Stress tolerant plant production through biotechnology. 12

Reference

1. Biotechnology in crop improvement – H S Chawla.
2. Ed. John R.W Masters Animal cell culture- Practical approach 3rd edition, Oxford university press-2000
3. Essentials of Medical Physiology. K. Sembulingam & Prema Sembulingam
4. Freshney, culture of Animal cell, 5th edition
5. In Vitro cultivation of Animal cells. Elsevier India PVT LTD-17-A/1 Main Ring Road, New Delhi-110024
6. Physiological basis of Medical Practice. John. B. west
7. Plant biotechnology – J Hammond, et. al., Springer Verlag.
8. R.Sasidhara, Animal Biotechnology MJP publishers-Chennai.
9. Review of Medical Physiology. William. F. Ganong
10. Text book of Medical Physiology. Arthur. C. Guyton & John. E. Hall
11. Vander's Human Physiology- The Mechanism of Body function. Widmaier, Raff, Strang

UCBT0408 MICROBIAL FOOD TECHNOLOGY

Course outcom **Credit 4**

The students is able to understand: The role of microbial fermentation in food production and factors affecting it. Role of biotechnology in food production and modification.

Module I **15h**

Primary Sources of microbes in food*[1]. Intrinsic parameters of food that affect microbial growth: pH, water activity, oxidation reduction potential, nutrient content, antimicrobial constituents & biological structures*[2]. Extrinsic parameters of food that affect microbial growth: relative humidity, storage temperature, gaseous environment*[2]. Cross contamination. Role of microbes in bread making, cheese production, acidophilus milk, yoghurt, tempeh, sauerkraut, beer and wine. Single cell protein. Definition & mechanism- probiotics, prebiotics & synbiotics. Functional foods-from plant sources: tomatoes & oats; animal sources: fish. Nutraceuticals. Methods of food preservation, food borne illness and quality control.

Module II **15h**

Spoilage of fish- mechanism of meat spoilage*[3].Spoilage of dairy products *[4].Principles of food preservation- commercially sterile, pasteurization, pickling, drying, canning, curing. Food preservation with chemicals. Radiation preservation of food.

Module III **15h**

Foodborne diseases: infections, food-poisoning, toxico-infections; Microbiological hazards in food: *Salmonella, Clostridium botulinum*, *Vibrio, Hepatitis A, Campylobacter jejuni*, *Listeria monocytogenes, Bovine Spongiform Encephalopathy*; Fungal Toxins. Emerging foodborne pathogens: *E. coli* O157.

Module IV **15h**

Microbial indicators of food safety and quality: coliforms- detection & enumeration, coliform criteria & standards[5]. Aerobic Plate Count, Methylene blue reductase test& phosphatase test. Risk associated with ready to eat food(RTF). Microbiological examination of food: Detection of *Salmonella* in food[6].Food Safety and standards authority of India, United States Food and Drug Administration US-FDA, *Codex Alimentarius*; Microbiological safety of food: HACCP concepts in ensuring food safety.

Module V **10 h**

GM food: Risks, possible danger to individuals, society or nature, labeling of GM food. Safety assessment of GM food. Transgenic tomato; Methionine-enriched oil; Frost-resistant food; Bt. maize; beta-carotene in rice. Edible vaccines. Transgenic Animals: Growth hormone gene in pigs; Transgenic salmon; Bovine Somatotropin in Milk.

References:

1. Potten N.M. "Food Science" The AVL Publishing Co. 2002
2. Piefzer F.M. "Food Microbiology" Academic Press, 1989
3. Roger A., Gorden B., and John T., " Food Biotechnology", 1989

4. Bioprocess Technology: P T Kalaichelvan, I Arul Pandy : MJP Publishers.
5. James M.Jay. "Modern Food Microbiology", CBS Publishers & Distributors, 1987.
6. *1- James M.Jay. "Modern Food Microbiology", CBS Publishers & Distributors, 1987 pp17-20
7. *2 James M.Jay. "Modern Food Microbiology", CBS Publishers & Distributors, 1987 chapter 3.
8. *3 James M.Jay. "Modern Food Microbiology", CBS Publishers & Distributors, 1987 pp221-225
9. *4 James M.Jay. "Modern Food Microbiology", CBS Publishers & Distributors, 1987 pp237-239.
10. *5 Bacteriological Analytical Manual Chapter 3*Reference: Bacteriological Analytical Manual, 8th Edition, Revision A, 1998. Chapter 4; Microbiological analysis –Manual FSSAI, India - pp28-36; Reference: Bacteriological Analytical Manual, 8th Edition, Revision A, 1998. Pp51-62.
11. Review- The Role of Functional Foods, Nutraceuticals, and Food Supplements in Intestinal Health 2010, A. Cencic and W. Chingwaru*Nutrients* 2010, 2, 611-625 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257668/pdf/nutrients-02-00611.pdf.

ELECTIVE-4
UCBT0409 IPR & BIOTECHNOLOGY

Credit-4

Course outcome:

The student will be able to understand:

Intellectual property and its different forms. The National and international approaches to protect the IPR. The guidelines for biosafety. Genetic modification of food crops and animals and the ethical issues.

Module I

Introduction to Intellectual Property. Types of IP: Patents, Trademarks, Trade dress, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. WTO regime - consumer protection and plant genetic resources-GATT and TRIPS. Patent protection to GMO. Objects of Intellectual property law. 15

Module II

Types of patents; Indian Patent Act 1970; Recent Amendments; Patent application- forms and guidelines, fee structure, time frames; Filing of a patent application; Precautions before patenting- disclosure/non-disclosure; Types of patent applications: provisional and complete specifications; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.). Rights of patent holder. Basmati rice patent issue: a Case study. 20

Module III

Introduction to Biosafety levels. Primary Containment for Biohazards; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines. Regulatory bodies of India-RCGM and GEAC. 15

Module IV

GM crops- versus organic and traditional crops, global status of GM crops, genetic engineering of Bt brinjal and Bt cotton, Golden rice, edible vaccines. Advantages and disadvantages of GM foods, Biosafety and environmental safety concerns, public perceptions, Environmental release of GMOs; Genetically modified Organisms in India. Labeling of GM foods; 10

Module V

Ethical and legal implications of Human genome project, genetic testing and screening, stem cell research, Bioweapons and bioterrorism. Patenting of gene, Patenting of microbes- International Microorganism Deposit system of WIPO, 15

Reference

1. P. Narayanan, Intellectual Property Laws, Eastern Law House.2001
2. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.2009
3. Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.
4. John E. Smith,Biotechnology, 3rd Ed. Cambridge University Press.
5. Molecular Biotechnology – Glick and Pasternac
6. Gene cloning :An Introduction, T A Brown, Chapman and Hall Pub
7. Principles of gene manipulation – Old and Primrose, Blackwell Scietific publishers

http://www.w3.org/IPR/ http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/ - 31k http://www.cbd.int/biosafety/background.shtml
http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html
https://www.wipo.int/treaties/en/registration/budapest/

ELECTIVE GROUP III
UCBT0410 MOLECULAR BIOLOGY OF DEVELOPMENT

Course outcome: The students are exposed to : The cellular processes leading to organogenesis and development. Significance of molecular patterns and molecular mechanisms of development in plants and animals. Basic mechanism of senescence and cell death.

Module 1

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. 15

Module II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. 15

Module III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination. 15

Module IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*. Introduction to B chromosomes in plants. 15

Module V

Programmed cell death, aging and senescence

Necrosis, Apoptosis, role of caspases, apoptotic pathways-Extrinsic and intrinsic pathway. FADD. Aging, theories of aging mitochondrial stress, senescence 12

Reference

1. Lewin's Cells. Lynne Cassimeris,Viswanath R, Lingappa, George Plopper Jones . Bartlett Publishers, London
2. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.
3. Scott F. Gilbert,Developmental Biology, Seventh Edition,2003,Sinauer Associates, Inc., Sunderland, MA,ISBN 0-87893-258-5
4. John Gerhart and Marc Kirschner,Cells, Embryos, And Evolution,1997,Blackwell Science,ISBN 0-86542-574-4,
5. Fred H. Wilt & Sarah C. Hake,Principles of evelopmental Biology,2004,W.W. Norton & Company, Inc., New York, NY,ISBN 0-393-97430-8
6. Sally A. Moody, Editor,Cell Lineage and Fate Determination**,**October 1998,Academic Press, Inc.,ISBN 0-12-505255-3
7. Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith,**Principles of Development**, Second Edition,2002,Oxford University Press, ISBN 0-19-924939-3

UCBT0411 CANCER BIOLOGY

Course outcome: The students are able to understand: Basic aspects of cancer pathology. Mechanisms of Carcinogenesis and metastasis. Diagnostic techniques and treatment approaches.

Module I

Fundamentals of cancer biology: Introduction to Cancer Biology, Different forms of cancers, Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer. 15

Module II

Principles of carcinogenesis: Theory of Carcinogenesis, Chemical carcinogenesis, principles of physical carcinogenesis, X-ray radiation-mechanisms of radiation carcinogenesis, Diet and cancer. 15

Module III

Principles of molecular cell biology of cancer: Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, Oncogenes/protooncogene activity, Growth factors related to transformation, Telomerases. Tumor suppressor genes, modulation of cell cycle in cancer. 15

Module IV

Principles of cancer metastasis: Clinical significances of invasion, Metastatic cascade, Basement membrane disruption, proteinase and tumor cell invasion. 12

Module V

New molecules for cancer therapy: Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy. 15

Reference

1. Maly B.W.J, "Virology A Practical Approach", IRLl Press, Oxford, 1987.
2. Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.
3. Biotechnology- Applying genetic revolution. David P Clark, Nanette J Pazdernik. Elsevier, New York
4. Lewin's Cells. Lynne Cassimeris, Viswanath R, Lingappa, George Plopper Jones. Bartlett Publishers, London
5. The Cell – A molecular Approach. Geoffrey M Cooper, Robert E Hausman, ASM Press, Washington.

UCBT0412 GENOMICS: TECHNIQUES AND APPLICATIONS

Course outcome: The student will be aware of: The structural and functional organization of genome. Human genomic structure and implications of HGP. Techniques involved in genomics and their applications.

Module I

Overview: Genomes of Bacteria, Archaea, and Eukarya; chromatin, supercoiling and packaging; karyotype. Genetic mapping: linkage map and gene association analysis. Genome signature. Coding sequences- Genes and gene families. Noncoding sequences- pseudogenes, Regulatory sequences, repetitive sequences. Transposable elements. 15

Module II

Human Genome Project- brief history, techniques and outcomes. LINE(L1) sequences in human genome. Human mitochondrial genome - A structural outline. mitochondrial eve. Mitochondrial gene deletion related syndrome- Kearns-Sayre syndrome, Mitochondrial Diabetes and Deafness (MIDD). Human gene data base- OMIM. 15

Module III

European Genome-phenome archive (EGA) European Nucleotide Archive (ENA), Techniques in functional genomics: Genetic interaction mapping, ENCODE. Gene finding and annotation; sequence annotation and bioinformatics tools for genomics – Phred, RAST. Analyzing gene expression-DNA microarray-design, analysis and visualization of data. Application of DNA microarrays, SAGE. RNA sequencing. Spliceman, EST, SNP, RFLP's. 15

Module IV

Pharmacogenomics- basic principles and benefits. Cytochrome p 450 in drug metabolism. Predictive prescribing. Molecular medicine. gene medicine- Gene therapy- Types, methods and applications. Guidelines of gene therapy. DNA vaccines, Antisense therapy, Nucleic acid drugs. 15

Module V

Synthetic biology- artificial gene synthesis (DNA printing) and its applications. Genome editing- role of TALEN, CRISPR and mega nucleases. Peptide Nucleic Acid, Threose nucleic acid. Human artificial chromosome (HAC). 12

Reference

1. Genomes. Brown, T.A., Wiley - Lis Publications, 2002.
2. Mount David W. Bioinformatics Sequence and Genome Analysis. Cold Spring Harbor Lab Press, CSH New York, 2002.
3. Stephen Misener and S. A. Krawetz. Bioinformatics Methods and Protocols. Humana Press. 2000.
4. Rastogi, S.C, N. Mendiratta, P. Rastogi. Bioinformatics Methods and Applications. Prentice Hall of India, 2004.
5. Krebes, J E, GoldsteinE. S and Kilpatrick ST. B Lewin's Genes XI. Jones and

Bartlett learning.
6. Lewis D. Solomon (Editor). Synthetic Biology: Science, Business, and Policy. 2017 . Routeledge Pub.
7. https://www.ncbi.nlm.nih.gov/pmc/articles
8. https://www.genome.gov/
9. https://www.ebi.ac.uk/training/online/course/genomics-introduction-ebi-resources/european-genome-phenome-archive-ega

MODEL QUESTIONS

Model Question Paper format

M Sc Biotechnology Degree (C.S.S) Examination

I Semester

UCBT0101 Biochemistry

Time: Three hours Max. Weight: 30

Section- A (Answer any **eight** questions. Each question carries a weight of 1)

1. Glycosidic bonds
2. Glycolipids
3. Phosphatidyl ethanolamine
4. Chitin
5. Watson and crick base pairing
6. Epinephrine
7. Ascorbic Acid
8. ATP Synthase
9. FAD
10. Glutathione **(8 x 1 = 8)**

Section B (Answer any **six** questions. Each question carries a weight of 2)

11. Glycoprotein
12. Heteropolysaccharides
13. Bacterial peptidoglycans
14. Coenzymes and co factors
15. Insulin
16. Night Blindness
17. Sphingomyelin
18. Sequencing of proteins (**6 x 2 = 12**)

Section C (Answer any **two** questions. Each question carries a weight of 5.)

19. With a suitable example explain the mechanism of action of steroid hormones;
20. Compare the structure and function of Hb and myoglobin:
21. Structure and function of glycerophospholipids;
22. Classification and structure of carbohydrates; Give the structure, Dietary source, dietary requirement biochemical action and deficiency symptoms of any two fat soluble vitamins

QP Code **Reg. No.**

Name:

M Sc Biotechnology Degree (C.S.S) Examination

I Semester

UCBT0102 Cell Biology And Genetics

Section- A(Answer any **eight** questions. Each question carries a weight of 1)

1. Fluid Mosaic model of membranes
2. Oncogene
3. Tumor suppressor gene
4. Ribosome
5. Histones
6. Monohybrid ratio
7. Down's syndrome
8. Chloroplast
9. Apoptosis
10. Facilitated diffusion

Section- B(Answer any **six** questions. Each question carries a weight of 1)

11. Chromosome mapping
12. Cytoplasmic inheritance
13. Hardy Weinberg principle
14. Multiple alleles
15. Regulation of cell cycle
16. Inherited disorders in metabolism
17. Comment on the different theories of aging
18. Cell cycle check points

Section C(Answer any **two** questions. Each question carries a weight of 5.)

19. Membrane transport
20. With the help of a labeled diagram describe a typical cell and its constituents.
21. What are the causes of cancer? Describe the different stages of cancer development. Add a note on diagnosis and treatment.
22. Mitochondrion: structural features and functions

Model Question Paper format

QP Code **Reg. No:**

Name:

M Sc Biotechnology Degree (C.S.S) Examination

I Semester

UCBT0103 Instrumentation and Biostatistics

Time: Three hours Max. Weight: 30

Section- A (Answer any **eight** questions. Each question carries a weight of 1)

1Beer- Lambert's law.
2. Arithmetic mean
3 Resolving power of a microscope
4 State the use of cantilever in AFM
5. What is cation exchange resin
6. Define Isoelectric point
7. What is Ultrafiltration
8. What is Freeze fracture technique.
9. Define standard deviation
10. Principle of interference microscope.

Section- B(Answer any **six** questions. Each question carries a weight of 2)

11. Agarose as support matrix in electrophoresis
12. GM Counter
13. Tests of significance
14. density gradient centrifugation.
15. pulsed field gel electrophoresis.
16. immunoaffinity chromatography
17. Describe the different methods used for collection classification and tabulation of data.
18. Explain the working mechanism of HPLC.

Section- C(Answer any **two** questions. Each question carries a weight of 5)

19. Give an account of the different chromatographic techniques used for separation
20. What is SDS PAGE? Add a note on its working principles and significance.
21. Describe the. different spectroscopic techniques you have studied
22. Describe in detail the principle and working of confocal microscopy.

Model Question Paper format

QP Code **Reg. No.**

Name:

M Sc Biotechnology Degree (C.S.S) Examination

I Semester

UCBT0104 Biophysics and Bioinformatics

Time: 3 Hrs **Weightage: 30**

Section- A (Answer any **eight** questions. Each question carries a weight of 1)

1. State the advantages of Rasmol
2. Z DNA
3. Define Enthalpy
4. Leucine zipper motif
5. SWISSPROT
6. world wide web
7. similarity search
8. What are histones
9. State the application of Ramachandran plot
10. High energy molecules

Section- B (Answer any **six** questions. Each question carries a weight of 2)

11. Zinc fingers
12. BLAST
13. Biological databases
14. globin fold
15. Construction of phylogenetic tree
16. Laws of thermodynamics
17. Give an account of the different protein structural data bases
18. Applications of Bioinformatics in genetic research

Section- C (Answer any **two** questions. Each question carries a weight of **5**)

19. Comment on DNA- Protein interactions you have studied
20. What is DNA polymorphism?
21. Describe the Applications of Bioinformatics in drug designing. different spectroscopic techniques you have studied
22. Describe in detail sequencing of DNA principle and working of confocal microscopy.

II SEMESTER

Model Question Paper format

QP Code **Reg. No.**

Name:

M Sc Biotechnology Degree (C.S.S) Examination

II Semester

UCBT0201 Microbiology

Time: Three hours Max. Weight: 30

Section A: (Answer any **eight** questions. Each question carries a weight of 1)

1) Insertion sequences
2) Enrichment media
3) Fermentation
4) Transformation
5) Lyophilization
6) Photoreactivation repair
7) Blood agar
8) Dry heat Sterilization
9. Lophotrichous bacteria
10. Catalase test

Section B(Answer any **six** questions. Each question carries a weight of 2)

11) Conjugation
12) Hexokinase
13) Transposons
14) Phenol Coefficient Test
15) Ribotyping
14) Growth curve of a typical bacteria in culture.
15) Explain Flagellar Structure with a note on difference between prokaryotic & eukaryotic flagella.
16) Viral Classification
17. Elaborate on Generalized & Specialized transduction.
18. Purple sulfur bacteria

Section C(Answer any **two** questions. Each question carries a weight of 5.)

19) Elaborate on the structure of bacterial cell wall with a note on peptidoglycan synthesis.
20) Explain the mechanism of drug resistance in Bacteria
21) Write in detail about the glycolytic pathway.
22) Classify fungi, with a note on economic importance of fungi.

QP Code **Reg. No.**

NAME:

M Sc Biotechnology Degree (C.S.S) Examination

II Semester

UCBT0202 Immunology

Time: 3 Hrs **Weightage: 30**

Section A(Answer any **eight** questions. Each question carries a weight of 1.)

1) Adjuvants
2) Abzymes
3) Immunofluorescence
4) Chimeric antibody
5) Superantigens
6) Idiotype and Isotype
7) Dendritic cells
8) SCID
9) Active & Passive Immunization
10. Erythroblastosis fetalis

Section B(Answer any **six** questions. Each question carries a weight of 2.)

11) Describe the process of Inflammation
12) T- Cell Receptor Complex
13) MHC Molecules
14) ABO blood grouping
15) Mechanism involved in Graft Rejection
16) Mitogens
17) Classical pathway of complement.
18) B cell maturation

Section C(Answer any **two** questions. Each question carries a weight of 5.)

19) Elaborate on the molecular basis of Antibody Diversity. Write a note on class switching.
20) Describe the various Antigen- Antibody reactions in detail.
21) Describe the different types of Hypersensitivity reactions.
22) What is autoimmunity? Describe the various autoimmune diseases.

Model Question Paper format

QP Code **Reg. No.**

Name

M Sc Biotechnology Degree (C.S.S) Examination

II Semester

UCBT0203 Molecular Biology

Section A (Answer any **eight** questions. Each question carries a weight of 1.)

1. Release factors
2. Looping in Ara operon
3. DNA polymerase I
4. Scaffold DNA
5. C-value paradox
6. Ribozymes
7. Okazaki fragments
8. Topoisomerase
9. SINE
10. Promoters

Section B(Answer any **six** questions. Each question carries a weight of 2.)

11. Post transcriptional modification of eukaryotic mRNA
12. RNA polymerases in prokaryotes and eukaryotes,
13. Wobble hypothesis 14.Attenuation.
15. Human genome project
16. Difference between prokaryotic and eukaryotic replication
17. Lac operon
18. Types of transposons

Section C (Answer any **two** questions. Each question carries a weight of 5.)

19. Write in detail about repetitive sequences and their importance.
20. Explain the DNA repair mechanisms
21. Explain the different stages in transcription. Add a note on regulation of transcription.
22. Describe in detail the role of enzymes in DNA replication.

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

II Semester

UCBT0204 Enzymology and Metabolism

Section- A(Answer any **eight** questions. Each question carries a weight of 1)

1. Enzyme specificity
2. Specific activity
3. Activation energy
4. Time dependent inhibition
5. Glycogenesis
6. Redox potential
7. Amphibolic pathway
8. Criteria of purity of enzymes
9. Chemiosmosis
10. substrate level phosphorylation

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. Allosteric regulation of enzymes
12. Application of enzymes
13. Bi substrate reactions
14. Biosynthesis of sulphur containing amino acids
15. Oxidation of fatty acids
16. TCA cycle and its energetics
17. Acyl carrier protein and fatty acid synthesis
18. Michaelis Menten equation and its significance (**6 x 2 = 12**)

Section C (Answer any **two** questions. Each question carries a weight of 5.)

19. Describe the synthesis of cholesterol in animals.
20. Give a detailed account on degradation of amino acids.
21. Discuss the EMP and PPP Glycolytic pathways with the energy yield and regulation.
22. Compare competitive, noncompetitive and uncompetitive inhibition with example.

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

III Semester

UCBT0301 Bioprocess Technology

Time: Three hours Max. Weight: 30

Section- A (Answer any **eight** questions. Each question carries a weight of 1)

1. What is Fed batch culture
2. State the function of Sparger
3. What is Air lift fermentor
4. Mention the significance of Reynod's Number
5. Define Thermal death time
6. What is the mechanism of action of Antifoams
7. What is the significance Spirulina
8. Rennet
9. Aflatoxin
10. What is Solid state fermentation

Section B (Answer any six questions. Each question carries a weight of 1)

10. Ergot alkaloids
11. Methods of Secondary screening
12. Food poisoning
13. Microbial Transformation
14. Types of fluids
15. Kinetics of batch culture
16. Microbial production of pectinases 17. Fermented milk products
18. Describe the methods of control of bioreactors

Section C (Answer any two questions. Each question carries a weight of 5)

19. Describe the Design of a typical Fermentor.
20. Elaborate on role of microbes in production of antibiotics with an example.
21. Explain Microbiological aspects of manufacture of alcoholic beverages
22. Describe the methods of Control of Bioreactors.
22. Comment on the important points of media designing for a fermentation.

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

III Semester

UCBT0302 –Recombinant DNA technology

Time : 3 Hrs Weightage: 30

Section A(Answer any **eight** questions. Each question carries a weight of 1)

1. S1 nuclease 2.SNP
3. Homopolymer tailing
4. CAT assay
5. liposomes
6. Chromosome jumping 7. CTAB
8. Blue revolution
9. Nucleic acid probes
10. GFP

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. M13 vectors
12. In vitro packaging
13. Replica plating
14. HART
15. RNA interference
16. Production of pesticide resistant plant varieties. 17.Reporter gene
18.Alpha complementation

Section C(Answer any **two** questions. Each question carries a weight of 5)

18. Explain the steps of Southern blotting in detail with labelled diagrams.
19. Give an explanation on E coli -based vectors
20. Outline the production of insulin through rDNA technology. 21.Describe the construction of c DNA library.
22. Give an account on restriction enzymes.

QP Code **Reg. No.**

Name

M Sc Biotechnology Degree (C.S.S) Examination

III Semester

UCBT0303 ENVIRONMENTAL BIOTECHNOLOGY

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1) **(8 x 1 = 8)**

1.Differentiate between BOD and COD
2. What are Catabolic plasmids
3. What is DRANCO
4. What are oxidation lagoons
5. Expand VAM. Mention its significance.
6. Write the important features of UASB
7. What is GMP
8. Ti plasmid
9. List out four demerits of Landfills
10. State the function of leghemoglobin.

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. Virus as a biopesticide. 12.Biochemistry of Lignin biodegradation.
13.Important features of GATT. 14.Cheemical diversity of Biosurfactants.
15.Write notes on Vermicomposting 16.Processes in an Anaerobic digestor.
17. Working of Trickling filter.
18. Explain the hazardous effects of xenobiotics. **(6 x 2 = 12**)

Section C

(Answer any **two** questions. Each question carries a weight of 5.) (**2 x 5 = 10)**
19. Describe the tertiary treatment strategies for waste water.
20. Explain Symbiotic nitrogen fixation.
21. Describe the Steps of water quality testing.
22. Process of patenting

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

III Semester

UCBT0304 Plant and Animal Biotechnology

Time : 3 Hrs Weightage: 30

Section A(Answer any **eight** questions. Each question carries a weight of 1)

1. Surface sterilization
2. Lenti virus
3. Ca MV promoter
4. Balanced salt solution
5. Triploids
6. Binary vector 7. Auxin
8. Anchorage dependence
9. Endosperm culture
10. Applications of MAb

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. suspension culture of plant cells
12. Animal pharming 13.Somoclonal variation.
14. Gene therapy
15. primary cell lines
16. organ culture
17. Gene transfer Methods in animal cells.
18. Describe haploid production and its significance.

Section C(Answer any **two** questions. Each question carries a weight of 5)

19. Write an essay on Medicinal applications of animal cell culture.
20. Give a detailed description of Agrobacterium based genetic transfer in plants.
21. Describe in detail the Principles and method of preservation of animal cells.
22. Describe the points to be considered during the designing of a tissue culture lab.

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester

UCBT0404 Environment and Biotechnology

Time : 3 Hrs Weightage: 30

Section A(Answer any **eight** questions. Each question carries a weight of 1)

1. Food web
2. Red data book
3. Fundamental and realized niche
4. Edge effect
5. Minamata disease
6. Autecology
7. Denitrification
8. Greenhouse gases
9. Gene bank
10. Secondary succession

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. Effects of lead poisoning
12. Carbon cycle
13. Energy flow in an ecosystem
14. Hydrosere
15. National parks
16. Acid rain
17. Ozone depletion
18. 1Tropical rain forest

Section C(Answer any **two** questions. Each question carries a weight of 5)

19. Microorganisms in Extreme environment.
20. Effects of global warming
21. Strategies for conservation of biodiversity
22. Endangered animals and plants
23. Desert biomes

QP Code **Reg. No.**

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester

UCBT0405 Food Biotechnology

Section A(Answer any **eight** questions. Each question carries a weight of 1)

1. Starter culture
2. Pectinase
3. Chymosine
4. Prebiotics
5. Spawning.
6. Blue cheese.
7. Edible vaccines.
8. samroopa.
9. Frost resistant fruits.
10. Biocassava.

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. Star link corn.
12. Steps in mushroom production
13. Marine fermented products
14. Application of proteases and amylases in food industry
15. GMO
16. Terminator genes
17. Disadvantages of SCP
18. Golden rice

Section C(Answer any **two** questions. Each question carries a weight of 5)

19. Write an essay on SCP
20. Explain steps of cheese making
21. Transgenic organisms in food production.
22. Probiotics and their effects on health.

QP Code **Reg. No.**

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester

UCBT0406 Advanced molecular techniques

Section A(Answer any **eight** questions. Each question carries a weight of 1)

a. Salting out
b. Phenol chloroform extraction in DNA isolation
c. Ribonuclease
d. Taq polymerase
e. SAGE
f. SNP
g. SMD
h. Electrokinetic Molecule focusing
i. Paired end sequencing
j. Adapter

Section B(Answer any **six** questions. Each question carries a weight of 2)

k. Ligase chain reaction
l. Fluorescent PCR
m. RNA isolation
n. Oligonucleotide Ligation Assay
o. NASBA
p. Riboswitches.
q. Microarray tcchnique
r. Microfluidic DNA sequencer

Section C(Answer any **two** questions. Each question carries a weight of 5)

s. Discuss the various types of PCR
t. Explain the different types of new generation sequencing
u. Specify the importance of various PCR based molecular markers
v. Discuss DNA barcoding and specify its applications

ELECTIVE II

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester, Faculty of Science

UCBT0407 Physiology and Biotechnology

Section A(Answer any **eight** questions. Each question carries a weight of 1)

1. Hemopoiesis
2. Rh factor
3. ECG
4. Cardiac cycle
5. Action potential
6. Rubisco
7. Vernalization
8. Plant hormones
9. Respiratory biosurfactant.
10. Ischemia

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. Blood volume, Blood volume regulation
12. Taste and Tactile response.
13. C3, C4 and CAM pathways
14. Photoperiodism
15. Absorption and transport of water
16. Photorespiration.
17. Neuroendocrine regulation
18. Haemostasis– mechanisms

Section C(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss the plant mitochondrial electron transport system and ATP synthesis
20. Explain the physiology in the various responses of plants to biotic and abiotic stresses.
21. Discuss the significance of regulation of water balance, electrolyte balance and acid-base balance in human physiology system..
22. Discuss the growth of microorganisms. Specify the various stages in the growth cycle. Comment on the yield and rate of growth

QP Code

Reg. No.
Name

M Sc Biotechnology Degree (C.S.S) Examination
IV Semester
UCBT0408 Microbial Food technology

Section A(Answer any **eight** questions. Each question carries a weight of 1)

1. Define water activity.
2. Define nutraceuticals.
3. Write down general steps in cheese production.
4. Discuss the risk associated with RTE food
5. Codex Alimentarius commission
6. Golden rice
7. What is ropiness in milk spoilage?
8. Single cell protein
9. Canning
10. Edible vaccine

Section B(Answer any **six** questions. Each question carries a weight of 2)

11. Write note on mechanisms of fish spoilage.
12. Explain fermentative production of beer.
13. Write briefly on radiation preservation
14. a. Standard labeling of GM food b.Risks associated with GM food
15. Mycotoxins
16. What are the prerequisites for using a microbial strain to use as probiotics.
17. Give a brief account of the common foodborne illness.
18. Explain briefly on lab diagnosis and detection of salmonellosis in food.

Section C (Answer any **two** questions. Each question carries a weight of 5)

19. 'Adequate assessment, surveillance and regulations are necessary to ensure effective food safety'. Explain the statement with respect to FSSAI food safety measures.
20. Write an essay on the contribution of transgenic plants and animals to food security.
21. Write an essay on HACCP concepts in ensuring international food safety.
22. Explain the principle of different chemical food preservation techniques.

QP Code **Reg. No.**
Name

M Sc Biotechnology Degree (C.S.S) Examination
IV Semester
UCBT0409 IPR and Biotechnology

Section A (Answer any **eight** questions. Each question carries a weight of 1)

1. Copy right
2. USPTO
3. Biohazard
4. Biosafety cabinet
5. RCGM
6. Cartagena Protocol
7. UPOV
8. PGRFA
9. Seed bank
10. Patent

Section B (Answer any **six** questions. Each question carries a weight of 2)

11. Impact of GM crops on biodiversity
12. International treaties on biodiversity
13. Climate change and conservation of plant genetic resources
14. Role of institutional biosafety committees
15. Environmental release of GMO
16. Biosafety guidelines in India
17. Discuss the importance of patenting. Explain the advantages of patenting scientific inventions
18. What are the various types of patents/ Discuss each with examples.

Section C (Answer any **two** questions. Each question carries a weight of 5)

19. Discuss the various requirements of patenting. Comment on each requirement.
20. Discuss the recommended biosafety levels of specific microorganisms in India
21. Discuss the various regulations in the analysis, assessment and management of risk in India
22. Discuss the biodiversity act in India and comment on its merits and demerits.

ELECTIVE III

QP Code **Reg. No.**

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester

UCBT0410 Molecular biology of development

Section A (Answer any **eight** questions. Each question carries a weight of 1)

1. Totipotency
2. Mutant
3. Cleavage
4. Gastrula
5. Define metamorphosis
6. Homeo box
7. Floral meristem
8. Bicoid protein.
9. Amniotic fluid.
10. Gene Superman.

Section B (Answer any **six** questions. Each question carries a weight of 2)

11. Features of necrosis
12. FADD
13. Significance of B chromosomes
14. Caspases
15. Genomic imprinting
16. Germ layers in animals
17. Mechanism of eye lens induction
18. Influence of environment on development.

Section C(Answer any **two** questions. Each question carries a weight of 5)

19. Theories on aging
20. Pattern formation in drosophila
21. Mitochondrial pathways of apoptosis
22. Sex determination

QP Code Reg. No

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester

UCBT0411 Cancer Biology

Section A (Answer any **eight** questions. Each question carries a weight of 1)

1. CpG islands
2. Epigenetics
3. SNP
4. Telomerase and cancer
5. Tumor suppressor genes
6. SSCP
7. Survivin
8. Phage display
9. BRCA 1
10. Cisplatin

Section B (Answer any **six** questions. Each question carries a weight of 2)

11. Protein chips in cancer detection.
12. Real time PCR in cancer detection
13. COLD PCR and its application
14. Antibody microarray
15. Glycans as biomarkers of tumor
16. DNA methylation and significance.
17. p53 and its importance in the cancer disease
18. Early detection of colorectal carcinoma

Section C(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss gene expression profiling
20. Explain the importance of sequence-based approaches in the early detection of cancer
21. Discuss the various cancer associated mutations and specify its importance
22. Discuss the various assays based on proteins and enzymes for the detection of cancer

QP Code **Reg. No**

Name

M Sc Biotechnology Degree (C.S.S) Examination

IV Semester

UCBT0412 Advances in Genomics

Section A (Answer any **eight** questions. Each question carries a weight of 1)

1. Pseudogenes
2. IS elements.
3. OMIM.
4. Linkage.
5. ENA.
6. Karyotype.
7. exons.
8. Antisense RNA.
9. Promoter sequence.
10. Bermuda principles of HGP.

Section B (Answer any **six** questions. Each question carries a weight of 2)

11. Split genes.
12. Gene interaction mapping.
13. Gene families.
14. RFLP.
15. Human mitochondrial genome.
16. Gene family.
17. Archaeal genome.
18. Microarray.

Section C (Answer any **two** questions. Each question carries a weight of 5)

19. Write a detailed note on Gene therapy
20. Describe RNA sequencing and its significance
21. Comment on HGP and its implications
22. Describe the types of transposons.