KONGUNADU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

COIMBATORE – 641 029

DEPARTMENT OF BIOTECHNOLOGY (PG)

CURRICULUM AND SCHEME OF EXAMINATIONS (CBCS)

(2022 - 2023 and onwards)

DEPARTMENT OF BIOTECHNOLOGY

Vision

To enable the students to comprehend the tool of Biotechnology so as to attain new vistas in core and applied areas of Biotechnology education and research; such that experiential learning and problem solving attribute shall continuously contribute to the nation building by maintaining high degree of ethical standard and integrity

Mission

- Build comprehensive quest for scientific inquiry prove the basic and advanced courses
- Provide a fundamental knowledge of the various application of Biotechnology and integrate it with cutting edge research in niche areas
- Pursue an integrative interdisciplinary and cross disciplinary approach in teaching, learning and research
- Foster industrial national and international institutional collaboration for promotion of research, innovation and entrepreneurship in Biotechnology

Goal

- Provide a holistic and self-reliant learning environment
- Promote diversity in teaching, learning and research
- Empower stakeholders through ample hands on studies, activity based learning method, Industry oriented case study and project work which shall make learning experience unique
- Enrich the teaching and learning process through adequate industry/local community partnership
- Inculcate high standards of ethic, professionalism and responsibility among the stakeholders

Programme Outcomes (PO)

The Student will be able to:

PO1: Demonstrate their knowledge and technical skills in core and allied areas of Biotechnology

PO2: Possess adequate theoretical and practical knowledge, Skill and attitude to pursue higher studies/research in biotechnology and allied areas of Biological Science

PO3: Demonstrate application of knowledge through Critical thinking to decipher and devise potential solutions to existing issues in the industry/society

PO4: Employ the various tools of Biotechnology and Bioinformatics to arrive at viable solutions to address problems which require immediate action

PO5: Communicate appropriately and effectively to all stake holders in biotechnology education/industry/research

PO6: Contribute to the growth of Nation's GDP by establishing enterprise/startup/bio business ventures

PO7: Adopt high standards of ethics in all transactions in the field of biotechnology education, research, publication and dissemination of knowledge to all the stake holders

PO8: Develop and sustain Knowledge, Skills and Attitude for a continuous and lifelong learning and Continuous Professional Development

M.Sc., Biotechnology

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1: Demonstrate and apply their basic knowledge from courses like cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of biotechnology in an application-oriented fashion

PSO2: Able to elaborate concepts of applied biotechnology to design and execute experiments and be highly adaptable in handling laboratory instruments, design SOP's and interpret the results

PSO3: Through the structured project work and case studies, the student will be competent enough to address and arrive at solutions to day-to-day problems in the industry and society by way of creating a product/process or a start-up.

PSO4: Empower the students to acquire technological knowhow by connecting core, interdisciplinary and cross disciplinary aspects of biotechnology education and research.

PSO5: Recognize the importance of Bioethics, IPR, Bio entrepreneurship, Communication and management skills so as to lead the next generation of Indian industrialists

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

COIMBATORE – 641 029

Course Name: M.Sc., Biotechnology

Curriculum and scheme of Examination under CBCS

(Applicable to the students admitted during the Academic Year 2022-2023)

Semester	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
				CIA	ESE	TOTAL		
I	22PBT101	Core Paper 1- Biochemistry	5	50	50	100	3	4
	22PBT102	Core Paper 2 - Biology of Cell	5	50	50	100	3	4
	22PBT103	Core Paper 3 -Applied Microbiology	5	50	50	100	3	4
	22PBT104	Core Paper 4- Bioinformatics	4	100	-	100	3	4
	22PBT1CL	Core Practical 1- Lab in Microbiology and Cellular Biology	6	50	50	100	6	3
	22PBT1E1	Major Elective 1	5	50	50	100	3	5
	Total		**30**	**-**	**-**	**600**	**-**	**24**
II	22PBT205	Core Paper 5- Molecular Biology and Human Genetics	5	50	50	100	3	4
	22PBT206	Core Paper 6- Genetic Engineering	4	50	50	100	3	4
	22PBT207	Core Paper 7- Immunology and Immunotechnology	4	50	50	100	3	4
	22PBT2CM	Core Practical 2- Lab in Molecular Biology and Genetics	6	50	50	100	6	3
	22PBT2CN	Core Practical 3- Lab in Genetic Engineering and Immunotechnology	6	50	50	100	6	3
	22PBT2E2	Major Elective 2	**5**	50	50	**100**	**3**	**5**
	Total		**30**	**-**	**-**	**600**	**-**	**23**

III	22PBT308	Core Paper 08 - Plant and Animal Transgenics	4	50	50	100	3	4
	22PBT309	Core Paper 09 - Industrial Applications of Biotechnology	4	50	50	100	3	4
	22PBT310	Core Paper 10 – Genomics, Proteomics and Metabolomics	4	50	50	100	3	4
	22PBT3CO	Core Practical 4 - Lab in Plant and Animal Biotechnology	6	50	50	100	6	4
	22PBT3CP	Core Practical 5 -Lab in Applied Biotechnology	6	50	50	100	6	3
	22PBT3N1	Non Major Elective I (on-line)	4	50	50	**100**	**3**	**4**
		Extra Departmental Course	2	100	-	**100**	**3**	**2**
	22PBT3ST	Internship Training @	-	-	-	-	-	-
	Total		**30**	**-**	**-**	**700**	**-**	**25**
IV	22PBT411	Core Paper 11- Pharmaceutical Biotechnology	5	50	50	100	3	4
	22PBT4N2	Non Major Elective II #	**4**	100	-	**100**	**3**	**4**
	22PBT4Z1	Project and Viva voce	**21***	50	50	**100**	**-**	**8**
	-	SWAYAM – MOOC	**-**	**-**	**-**	**-**	**-**	**2**
	Total		**30**	**-**	**-**	**300**	**-**	**18**
Grand Total				**-**	**-**	**2200**	**-**	**90**

Note: CBCS – Choice Based Credit System; CIA – Continuous Internal Assessment; ESE – End of Semester Examinations; C.P. - Core Paper; C. Pr. – Core Practical

@Students shall undertake an internship in core industry/company/startup/research institute of National importance for a period of 15 days during the summer vacation of 1st year. Evaluation will be done by the guide and the industry jointly. Mark tally table and grades given below based on marks obtained.

Components	Marks
Evaluation by guide	
Report	30
Log note submission	25
Viva voce	20
Evaluation by industry personnel	
Daily log note	20
Attendance	5
Total	100

Marks %	Grade
85-100	O
70-84	D
60-69	A
50-59	B
40-49	C
<40	U (Reappear)

Major Elective Papers – Semester 1 *(2 papers are to be chosen from the following 4 papers)*

1. Environmental Biotechnology
2. Nano Biotechnology
3. Post Production System of Foods
4. Plant therapeutics and phytoproducts

Major Elective Papers – Semester 2 *(2 papers are to be chosen from the following 4 papers)*

1. Research Methodology
2. IPR, Biosafety and Bioethics
3. Marine and Algal Biotechnology
4. Total Quality Control and Management

Non-Major Elective papers (on-line) *(2 papers are to be chosen from the following 4 papers)*

1. Aptitude and Reasoning Skills
2. Cancer Biology
3. Nutraceuticals
4. Information Security#

* to be offered by the respective departments.

Extra Departmental Course – 22PBT3X1 – Business ventures in Biosciences

Tally Table:

Subject	No. of Subjects	Total Marks	Credits
Core – Theory / Practical / Project	17	1700	68
SWAYAM – MOOC	-	-	2
Major Elective Papers	2	200	10
EDC Paper	1	100	2
Non Major Elective Paper	2	200	8
Grand Total	**22**	**2200**	**90**

Job Oriented Courses (JOC):

1. JOC 1 – Food Safety and HACCP (22PB0TJ1)
2. JOC 2 – Natural Farming, Biofertilizers and Biopesticides (22PBT0J2)
3. ALC 1 – Forensic biotechnology (22PBT0D1)
4. ALC 2 – Stem cell and Neuroscience (22PBT0D2)

Note: JOC and ALC which are offered at present will be applicable for the students admitted during the academic year 2022-2023 and will be considered as extra credit courses.

- 50 % CIA is applicable to all subjects except ALC and COP. 50% CIA is not applicable to EDC, Non-Major Elective paper - Information Security and Core Paper 4 Bioinformatics
- The students should complete a **SWAYAM-MOOC** before the completion of the 3rd semester and the course completed certificate should be submitted through the HOD to the Controller of Examinations. Two credits will be given to the candidates who have successfully completed. In case the students have completed more than one online course, the appropriate 2 extra credits shall be awarded to such candidates upon the submission of certificate through the HOD to the Controller of Examinations
- A **Field Training/ onsite training** preferably relevant to the course should be undertaken every year based on the norms prescribed by the institution and the discretionary power of the HoD, Dean and Principal

Components of Continuous Internal Assessment (50 Marks)

Components		Marks	Total
Theory			
CIA I	75	(75+75) converted to 30	50
CIA II	75		
Problem based Assignment**		10	
Attendance		5	
Others*		5	
Practical			
CIA Practical		(50) converted to 30	50
Observation Notebook		15	
Attendance		5	
Project			
Review		45	50
Regularity		5	

* Class Participation, Case Studies Presentation, Field Work, Field Survey, Group Discussion, Term Paper, Workshop/Conference Participation. Presentation of Papers in Conferences, Quiz, Report/Content writing. Etc.

** Two Assignments to be given. (Each 5marks)

Components of 100 % Continuous Internal Assessment

Components		Marks	Total Mark
Theory			
CIA I	55	(55+55 = 110/2) 55	55
CIA II	55		
Assignment/Seminar*		5	10
Attendance		5	
Practical			
CIA Practical Breakup of Marks Protocol - 15 Result & viva - 15		30	35
Record Notebook		5	
		TOTAL	**100**

* Class Participation, Case Studies Presentation, Field Work, Field Survey, Group Discussion, Term Paper, Workshop/Conference Participation. Presentation of Papers in Conferences, Quiz, Report/Content writing. Etc.

****** Two Assignments to be given. (Each 5 marks)

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remember; **K2**-Understanding; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate

1. **Theory Examination - Part I, II & III**
   CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 – K2 Q1 to 20	A (Answer all)	20 x 1 = 20	MCQ-10/ Fill ups-5/ One word-5	75**
K2 – K5 Q21 to 28	B (5 out of 8)	5 x 5= 25	Short Answers	
K2 – K5 Q29 to 33	C (3 out of 5)	3 x 10 = 30	Descriptive / Detailed	

****For ESE 75 marks converted to 50 marks.**

2. **ESE Practical Examination:**

Knowledge Level	Section	Marks	Total
K3	Experiments	45	50
K4	Record Work	05	
K5			

Practical Examination mark breakup:

Knowledge Level	Section
K3 ↕ K5	**Experiments:** **Major:** Protocol -10 Performance-5 Result-5 **Minor:** Protocol -5 Performance-5 Result-5 Q&A – 5 Viva – 5
	Record work – 5

3. **ESE Project Viva Voce:**

Knowledge Level	Section	Marks	Total
K3	Project Report	35	50
K4	Viva voce	15	
K5			

Project mark breakup:

Knowledge Level	Section
K3 ↕ K5	**Project Report:** Content – 10 Presentation – 10 R&D – 10 Review – 5
	Viva Voce: Layout of presentation – 5 Clarity – 5 Defense – 5

Contents

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT101		Core Paper 1- Biochemistry		
Batch 2022-2023	Semester I	Hours / Week 5	Total Hours 65	Credits 4

Course objectives

1. To appraise the role of biomolecules in cells
2. To study about the structure and biological functions of macromolecules such as proteins, polysaccharides, lipids
3. To Describe the basic reaction types and mechanisms of biomolecules
4. To Identify the structural differences and its properties

Course outcomes

After completion of the course, the students will be able to:

K1	CO1	Employ the principles of thermodynamics to various systems
↑	CO2	Explain the structure and properties of carbohydrates and Proteins
	CO3	Classify lipids with examples, Combine the structure and functions of lipids
↓	CO4	Analyze and study the chemical and biochemical properties of biomolecules
K5	CO5	Correlate the metabolism of different biomolecules

Syllabus

Unit I **(12hours)**

Biomolecules in their cellular environment: The cellular basis of life,Physical properties and structure of water molecule, pH, Buffers, pH calculation biological buffer systems (body fluids and their principal buffers).Thermodynamics- Laws of Thermodynamics – First, Second, Third law, Entropy, Enthalpy, Gibbs Free Energy, Henderson Hasselbalch Equation*.

Unit II **(15hours)**

Carbohydrates: Structure, occurrence, properties and biological functions of Monosaccharides, Disaccharides, O-linked and N-linked oligosaccharides, Polysaccharides: Homoglycans: Structure, occurrence, properties and biological functions of chitin, starch and cellulose. Heteroglycans: Structure, occurrence, properties and biological functions of glycosaminoglycans. Structure and biological role of peptidoglycans, lipopolysaccharides and proteoglycans.

Unit III **(14hours)**

Proteins: Structural organization of protein: Primary structure. Determination of protein structure: Ramachandran plot. Polypeptide synthesis. Secondary structures – αhelix, β-sheet and β-turns, Pauling and Corey model for fibrous proteins, Reverse turns and super secondary structures, Collagen triple helix. Tertiary structure – α and β domains. Conformational properties of silk fibroin. Quarternary structure of proteins: Structure and functions of Myoglobin and haemoglobin. protein folding biophysical and cellular aspects.

Unit IV **(12hours)**

Lipids and Nucleic acids: Classification, structure, functions and properties of lipids. Fatty acids saturated and unsaturated. Structure, properties and functions: Phospholipids (Cephalin, Lecithin and Sphingolipids) and glycolipids. Eicosanoids-structure and biological role of prostaglandins, thrombaxanes and leucotrienes. Steroids: structure and functions of cholesterol. Nucleic acids: Structure and Different forms of DNA and RNA. Chemical synthesis of DNA. **Structure and biological functions of major forms of RNA: mRNA, r RNA, t RNA and non coding RNA*.**

Unit V **(12hours)**

Vitamins: **Enzymes**: Basic concept, Enzyme Classification, active site, specificity, kinetics (Negative and positive cooperativity) inhibitors (reversible and irreversible),Feed back inhibition, isoenzymes, allosteric enzymes, co-enzymes (NAD), Ribozyme, hammer head, hair pin and other ribozymes, strategies for designing ribozymes. Abzyme: structure and drug targets (enzymes and receptors)

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Nelson, N., David, L., and Cox, C. (2017). Lehninger Principles of Biochemistry. (7th edition). W.H.Freeman and Co., NY.

2. Jain, JL., Jain, S.,and Jain, N. (2008). Fundamentals of Biochemistry. (2nd Edition). S. Chand& Co Ltd.

Reference Books

1. Voet, D., Voet, J.G., and Pratt, C.W. (2013). Principles of Biochemistry. (4th edition). John Wiley & Sons, New Delhi.

2. Garrette, RH., and Grisham, CM. (2013). Principles of Biochemistry. (5th edition). Saunders college publishers.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	H	L
CO2	S	M	M	M	M
CO3	S	L	H	L	L
CO4	H	L	L	M	M
CO5	S	M	L	L	L

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT102		Core Paper 2 – Biology of Cell		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	I	5	65	4

Course Objectives

1. To stimulate exploration of concepts and current approaches in modern cell biology
2. To sensitize students to the dynamic behavior of Cytoskeleton
3. To illustrate the interconnection and feedback between the matrix surroundings of cells
4. To provide an in depth knowledge on cell division cycle and cancer

Course Outcomes

After completion of the course, the students will be able to:

K1	CO1	Quantify and purify different cell types
↕	CO2	Prudently use the basics of cellular communication for developing novel tools
	CO3	Devise new molecular tools for prognosis of cancer
	CO4	Correlate the cell cycle to onset of cancer and progression
K5	CO5	Comprehend signaling networks to decipher cellular conditions

Syllabus

Unit I **(13hours)**

Basic Cellular architecture and methods to study cells: Cytoskeletal structure and cell Motility- Dynamics of microtubules, Microfilaments and Intermediate filaments, Molecular Motors and sarcomere regulation, Cellular imaging, , Cell quantification and viability, Cellular tensegrity, Flow cytometry and cell sorting Methods for disrupting tissues and cells, , organ and tissue slice techniques, **cell fixation - fluid fixatives, freezing and section drying, fixation for electron microscopy***

Unit II **(13hours)**

The cell Exterior and Cell- Cell Interaction: Differentiation of cell membrane - microvilli, tight junctions, epithelia, Bell and spot desmosomes - mechanical function, cell-cell interaction, cell adhesion proteins, cell junctions, tight junctions, Integrins as Mechanosensors, Asymmetry and Polarity, cell surface of plant cells , Cellular differentiation, manipulating cell differentiation. Cancer cells and metastasis, **Targeting Angiogenesis***

Unit III **(13hours)**

Membrane architecture and Transport: Cell membranes- structure and models for plasma membrane

architecture, Overview of membrane protein - peripheral and integral, molecular model of cell membrane - fluidity, dynamism in proteins and lipids of the membrane, solute transport across membrane - passive transport, active transport by ATP powered pumps, types of transport systems, Na+ K+ pump, Chloride ion pump, calcium channels

Unit IV **(13hours)**

Internal Compartmentalization and functions: Nucleus - internal organization, traffic between the nucleus the nucleolus, and cytoplasm, endoplasmic reticulum - protein sorting and transport, golgi apparatus and lysosomes, mitochondria, chloroplasts and peroxisomes, glyoxysomes

Unit V **(13hours)**

Cell Division Cycle and Cancer: Cell cycle and checkpoints, Cell cycle events in yeast and Xenopus oocyte, Cell aging and death - necrosis and apoptosis - mitochondrial and death receptor pathway. Quorum sensing, Cell signaling - signaling molecules and their receptors, functions of cell surface receptors and intracellular receptors, pathways of intracellular signal transduction, G protein coupled receptors, receptors tyrosine kinases, ras, MAP kinase pathways, JAK/STAT Pathway, Sensory Signaling, Notch and **lipid signaling***

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Lodish, U. H. (2016). Molecular Cell Biology. W.H. Freeman and Company, USA.
2. Cooper, G. M., & Hausman, R. E. (2009). The cell: A molecular approach. Washington, D.C: ASM Press

Reference Books

1. Alberts, B. (2015). Molecular biology of the cell.7th Edition. Garland Science,New York.
2. Sheeler, P., & Bianchi, D. E. (2014). Cell and molecular biology. New York: John Wiley & Sons.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	S	M
CO2	S	H	M	S	M
CO3	M	S	H	S	H
CO4	M	M	S	H	M
CO5	H	H	S	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT103		Core Paper 3 – Applied Microbiology		
Batch 2022-2023	Semester I	Hours / Week 5	Total Hours 65	Credits 4

Course Objectives

1. To make the students to understand the basic concepts of the biology of microorganisms and its mechanism of action in host cells
2. To learn the microbiological techniques used for the classification of microorganisms
3. To understand the microbe-host interaction and their metabolic activities
4. To introduce the role of microorganisms in pathogenesis

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Recollect the early development and physiology of microbes
	CO2	Understand the microbial taxonomy and classification methods
↕	CO3	Apply the knowledge of microbiological methods to study about the microbes by phenotypic and genotypic methods
	CO4	Apply the knowledge to decipher food spoilage due to cause of microbial contamination and food preservation methods
K5	CO5	Devise methods of microbial containment in industrial and hospital environments

Syllabus

Unit I (13hours)

Characterization and identification of microorganisms. Microbial classification systems– Molecular systematics: Polyphasic approach –16S/18SrRNA gene sequencing, Mol % G+C analysis, DNA-DNA hybridization, Fatty Acid Methyl Ester (FAME) analysis. Ultra-structure of bacteria. General structure and characters of Actinomycetes, Fungi, Algae and Protozoa. Growth and maintenance of Microbes: Bacterial division and growth, measurement of bacterial growth, maintenance of microbes in pure culture and preservation. Viruses: Discovery, structure and classification (Baltimore cultivation), multiplication cycles, detection and enumeration.

Unit II (13hours)

Extra chromosomal elements- Plasmids and types (Resistance R- plasmids, Fertility F-plasmids, col Plasmid, virulence plasmids, degradative plasmids) Genetic recombination in bacteria (transformation, conjugation and transduction), Auxotrophic and prototropic mutants, selection of these mutants. Antibiotics and

chemotherapeutic agents – Characteristics and mechanism of action of antibiotics, Synthetic chemotherapeutic agents. Assays for assessment of antimicrobial action of antibiotics. Antibiotic resistance – Mechanisms of development of antibiotic resistance, Multi-drug resistance (MDR) strains. Phage therapy: Bacteriophage structure and life cycle, **bacteriophages as an alternative to antibiotics to combat resistance**.

Unit III **(13hours)**

Industrial and soil Microbiology: Microbial flora of soil – bacteria, fungi, algae and protozoa. Microbial interactions among soil microorganisms - microbial populations and their interaction with plants (N2 fixation). Biogeochemical cycles (C, N, P and S cycles). Aquatic Microbiology: Water pollution, indicators of water pollution, bacteriological evidence of water pollution and techniques to study them.

Unit IV **(13hours)**

Food Microbiology: Microorganisms of meats and fish, poultry and eggs, fruits and vegetables, and milk. Principles of food preservation –Aseptic handling, high temperature, low temperature, drying, radiation, chemicals, Canning and packaging. Contamination and spoilage of fresh foods and canned foods (meat, fish, milk, egg, vegetables and fruits). Food quality and control**.** Preservation and maintenance of microbes, Probiotics and Bacteriocins. **Microorganisms as food – Single cell proteins*.**

Unit V **(13hours)**

Medical Microbiology: Host parasite relationships; general epidemiology, pathogenesis, prevention and treatment of infectious microorganisms. Normal microflora of the human body, dual nature of normal flora with respect to disease, normal flora of major human body systems (respiratory tract & head, gastrointestinal tract, genitourinary system, skin). Human host defenses against viral infection, immunopathology, epidemiology of viral diseases, (age, immune status & other host factors), control of viral spread..

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text books

1. Willey, J. M., Sherwood, L., Woolverton, C. J., Coyette, J., Joseleau, J.-P., Perraud, R., & Willey, J. M. (2018). Microbiologie de Prescott. 9th EditionMcGraw-Hill Higher Education.
2. Pelczar, M. J., Chan, E. C. S., Krieg, N. R., Edwards, D. D., & Pelczar, M. F. (1993). Microbiology: Concepts and applications, McGraw-Hill,New York.

Reference books

1. Stainer, R Y. (1992). General Microbiology. 5th Edition. Macmillan Education Ltd., London.
2. Tortora, G. J. (1998). Microbiology.5th Edition. Menlo Park, Calif: Benjamin/Cummings Co. Inc., USA.
3. Frazier, W. C., & Westhoff, D. C. (2003). Food microbiology. McGraw-Hill.Frazier, New York.
4. Joanne Willey (2020). Prescott's Microbiology. 11th Edition. McGraw-Hill Higher Education publishers, New York.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	H	M	M
CO2	S	M	M	M	M
CO3	M	S	S	S	H
CO4	M	S	H	H	S
CO5	M	H	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT104		Core Paper 4- Bioinformatics		
Batch 2022-2023	Semester I	Hours / Week 4	Total Hours 60	Credits 4

Course Objectives

1. To inculcate students with the rapidly evolving field of bioinformatics
2. To learn about the bioinformatics databases, databanks and data format data retrieval from the online sources
3. To understand the essential features of the interdisciplinary field of science for better understanding biological data.
4. To provide a strong foundation for performing further research in bioinformatics

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Apply various computational methods and tools used for protein secondary structure prediction and genome analysis
↕	CO2	Describe about sequence alignment and similarity search tools
	CO3	Implement computational solutions to basic problems in biological science
	CO4	Analyze the docking studies of biomolecules and implement in pharmacological drug-lead compound analysis
K5	CO5	Relate the sequence, structure and functions of biological molecules

Syllabus

Unit I: Biological Databases (12hours)

Database- Introduction, Classification, Types and Importance of biological database; NCBI (National Center for Biotechnology Information), GenBank, EMBL (European Molecular Biology Laboratory), DDBJ (DNA Data Bank of Japan), PIR (Protein Information Resource); **SWISSPROT- UniProt- TrEMBL***; PubMed, PubChem, PDB (Protein Data Bank).

Exercises:

1. Retrieving Protein sequence data from Entrez
2. Retrieving Nucleotide Sequence from NCBI

Unit II: Sequence Analysis- I **(12hours)**

Introduction to sequence similarity, homology (Ortholog, paralog and homolog), Significance of sequence alignment, **Alignment methods- Local and Global alignment, Smith-Waterman Algorithm, Needleman-Wunsch algorithm***, Gaps and gap penalty, Scoring matrices- PAM and BLOSUM, Substitution matrices.

Exercise:

1. Locating the Gene on chromosome
2. Retrieving structural data of a protein using PDB database

Unit 3: Sequence Analysis- II **(12hours)**

Pair-wise alignment- Dot matrix, Dynamic Programming, Word-tuple method; Multiple Sequence Alignment (MSA), Applications, Dynamic programming, Progressive, Iterative Methods of MSA; FASTA, BLAST and Types of BLAST; Tools for MSA- ClustalW, T-Coffee.

Exercise:

1. Designing a primer
2. Visualizing the Secondary Structure of a Protein

Unit 4: Structure Analysis **(12hours)**

Visualization tools- Rasmol, PyMol, SPDBV, VMD; Expasy Tools; Protein secondary structure prediction- GOR, Chou-Fasman, PSI-Pred; Tertiary Structure Prediction- Homology model programs (SwissProt, Modeller), **Ab-initio method (I-tasser)**; Ramachandran Plot;

Exercise:

1. Finding the Active Site Pockets of a given Protein Molecule
2. Retrieving details of a drug molecule

Unit 5:Molecular Docking Analysis **(12hours)**

Small Molecule analysis-ChemSketch, Lipinski's rule of five, SMILES Notation, Molecular docking- Rigid docking, Flexible docking; Application of docking; Target and Lead identification, Docking Packages- AutoDock, Glide, ArgusLab

Exercise:

1. Converting chemical file formats
2. Protein- Ligand Interaction- Docking tool

****denotes self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class/ Hands on session/Exercises

Text books:

1. Rastogi, S. C., Mendiratta, N., & Rastogi, P. (2008). Bioinformatics: Concepts, skills & applications. PHI Learning. New Delhi.
2. Baxevanis, A. D., Bader, G. D., & Wishart, D. S. (2020). Bioinformatics: a practical guide to the analysis of genes and proteins. http://www.vlebooks.com/vleweb/product/openreader?id=none&isbn=9781119335962.
3. Attwood, T. K., David J. Parry-Smith, and Samiron Phukan. (2007). Introduction to bioinformatics. Pearson Education. New Delhi, India.
4. Misener, S., & Krawetz, S. A. (2000). Bioinformatics: Methods and protocols. Totowa: Humana Press.
5. Des Higgins., Willie Taylor.(2000). Bioinformatics sequence structure and Data Banks, A practical Approach. Oxford University Press, Oxford. ISBN 0 19 963791.

Reference Books:

1. Durbin, R. (2010). Biological sequence analysis: Probabilistic models of proteins and nucleic acids. Cambridge Univ. Press, Cambridge.
2. Doolittle, Russell F. (1997). Computer methods for macromolecular sequence analysis. Acad. Press. San Diego.
3. Bishop, M. J., and Christopher J. Rawlings. (1997). DNA and protein sequence analysis: a practical approach. IRL Press at Oxford University Press. Oxford.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	H	M	M
CO2	H	H	H	M	M
CO3	M	S	M	M	H
CO4	M	S	H	H	S
CO5	S	H	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT1CL		Core Practical 1- Lab in Microbiology and Cellular Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	I	6	75	3

Course Objectives

1. To get hands on experience and to learn the principles behind molecular and microbiological techniques
2. To give hands on experience in estimation of nucleic acids and isolation of cell organelles
3. To train the students on microbiological media preparation, isolation of microbes and staining techniques
4. To introduce the basic methods of cellular characterization

Course Outcomes (CO)

After completion of the course, the students will be able to:

K3 ↕ K5	CO1	Extend the hands on experience on standard solution preparation for experimentation
	CO2	Demonstrate the various pure culture as well as the staining techniques of microbiology and methods in Molecular Genetics
	CO2	Develop and apply molecular and microbiological techniques for research as well as for in the various fields of applied science
	CO4	Examine and analyze the results behind the molecular and microbiological techniques for the development of new techniques in future
	CO5	Employ various methods of cellular biology to the high end research

Syllabus

Prelab exercise:

1. Safety guidelines and Good microbiological Laboratory Practices
2. Sterilization Techniques
3. Biological calculations, reagent preparations and storage

BIOCHEMISTRY

1. Estimation of free glucose by DNSA method
2. Estimation of Phospholipids
3. Estimation of free Amino acid (Proline) by Ninhydrin method
4. Estimation of Total proteins -Biuret Method
5. Estimation of Protease
6. Estimation of RNA using Orcinol method

7. Estimation of DNA using diphenylamine method.
8. Separation of Natural Pigments by Paper chromatography and Thin Layer Chromatography

CELL BIOLOGY

1. Blood counting using Hemato analyser (Demo)
2. Subcellular fractionation of mitochondria and marker enzyme detection
3. Preparation of erythrocyte ghost
4. Histochemical staining to localize proteins, carbohydrates, Lipids in fixed tissue secession
5. Plasmolysis of onion peel

MICROBIOLOGY

1. Pure culture techniques - Pour, Spread and Streak plate methods
2. Staining techniques - Simple, Negative, Gram, Spore and fungal staining
3. Bacterial growth curve by spectrophotometric method
4. Biochemical test for identification of bacteria
5. Isolation of microbes (bacteria, fungi and actinomycetes) from soil, air and water
6. Antibiotic sensitivity test by disc diffusion method
7. Isolation of Rhizobium from root nodules of legumes/soil

Text Book

1. Rajendran, S., Dhiman, P. (2019). Biochemistry Practical Manual. Elsevier India.
2. Gupta, R., Makhija, S. (2018). Cell Biology: Practical Manual. Prestige Publishers.
3. Jain, A., Agarwal, J. (2018). Microbiology Practical Manual (1st Edition). Elsevier India.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S
CO2	H	H	S	H	S
CO3	H	M	S	S	S
CO4	H	M	M	H	H
CO5	M	M	M	H	S

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code:22PBT205		Core Paper 5- Molecular Biology and Human Genetics		
Batch 2022-2023	Semester II	Hours / Week 5	Total Hours 65	Credits 4

Course Objectives

1. To understand the concept of replication and mutation
2. To introduce the concepts of transcription and its regulation in eukaryotes
3. To understand the overall mechanism of protein synthesis machinery in prokaryote and eukaryote
4. To study the human inherited disorders and the factors determining the population genetics

Course Outcome (CO)

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	Describe the gene expression and its regulation mechanism
	CO2	Apply the mutational effects and its analysis in different fields
	CO3	Investigate the chromosome and gene linked inherited diseases
	CO4	Compare and contrast the variation in population genetics through different genetic analysis
	CO5	Interpret molecular events in eukaryotes

Syllabus

Unit I **(12hours)**

Replication: Eukaryote; Eukaryotic replication mechanism and its enzymology; Differences in replication of DNA in Prokaryote; RNA replication – Reverse transcriptase mediated mechanism and its enzymology. *Mutation:* Types, Mutagenesis – Spontaneous and Induced; Reversion and Suppression mutations. Mutational analysis: Forward and Reverse genetics; **Phenocopying*.** *Repair mechanism*: Mis Match Repair, Photoreactivation; Excision (Base and Nucleotide, Methyl Directed Mismatch Repair);Translesion DNA Synthesis and SOS response and Recombinational repair

Unit II (**17hours)**

Gene expression: Transcription mechanism in eukaryote and its enzymology; Post transcription modification (RNA editing in eukaryote – Capping, Polyadenylation and Splicing); Translation mechanism and its enzyme cofactors. *Gene regulation:* Transcription gene control: Operon model in prokaryote – *lac, trp and ara*; Gene battery model in eukaryote; Translation gene control in prokaryote (RNA-RNA hybridisation and Riboswitches); Control of gene expression in eukaryote: Chromatin structure and remodeling; DNA

methyltransferases and DNA methylation - Importance of DNA methylation in chromatin remodeling; **DNase hypersensitivity*.**

Unit III **(12hours)**

Post translation modification in eukaryotes: Covalent attachment and protein folding – Role of chaperones. Prokaryotic transposons – IS elements; Transposable elements in eukaryote – Retrotransposons, AC/DS, Ty elements, Drosophila P elements, LINES and SINES. *Recombination*: Homologous recombination (Holliday model); Site specific recombination – Cre/Lox system. Transcriptional switch genetics in Lambda phage: Cro and CI genes.

Unit IV **(12hours)**

Human Genetics: An overview of human genetic variation; Architecture of human genome. *Human genetic disease:* Chromosomal abnormalities and structural variants with special reference to Crohn Disease, Cystic Fibrosis, Duchenne Muscular Dystrophy and Breast Cancer ; Molecular pathology: Connecting phenotypes to genotypes- Loss and gain of function, Dynamic Mutations, Molecular pathology of Mitochondrial disorders **Genotype-Phenotype Correlation***

Unit V (**12hours)**

Applied human molecular genetics: Identifying susceptible factors and understanding pathogenesis**.** Mapping and identifying the genes for monogenic disorders; Genetic testing in healthcare and the law; model organisms and modeling disease; Genetic approaches to treating diseases- RNA Therapeutics

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Russell, P. J. (2010). iGenetics: A molecular approach. San Francisco [u.a]: Pearson/Benjamin Cummings.
2. Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., Martin, K. C., Amon, A. (2021). Molecular cell biology. 6th edition, Scientific American Books, Inc
3. David R Hyde, (2010). Genetics and Molecular Biology. Tata McGraw Hill Education Private Limited.
4. Tom Strachan and Andrew Read. 2019. Human Molecular Genetics. (5th Edition). 2019
5. Malacinski, G. M. (2008). Freidfelder's Essentials of Molecular Biology. 4th edition. Narosa Book Distributors Private Ltd.

Reference books

1. Lewin, B., Krebs, J. E., Kilpatrick, S. T., Goldstein, E. S., and Lewin, B. (2011). Lewin's genes X. Sudbury, Mass: Jones and Bartlett.
2. Hartl, D. L. (2000). A Primer of Population Genetics. 3rd Edition, Sinauer Associates Inc., Sunderland.
3. Bruce Alberts., Alexander D. Johnson., Julian Lewis., David Morgan., (2014). Molecular Biology of the CellCooper, GM. (2009). The Cell - A Molecular Approach.5th edition. ASM and Sinauer Press, Washington.
4. Strachan, T., Read, A. (2010). Human Molecular Genetics. 4th edition, Garland Science.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	M	M
CO2	M	H	S	H	H
CO3	H	S	M	S	S
CO4	S	M	S	M	H
CO5	M	H	S	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT206		Core Paper 6 - Genetic Engineering		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	II	4	60	4

Course Objectives:

1. To acquaint on the versatile tools and techniques employed in genetic engineering and recombinant DNA technology
2. To provide theoretical base to properties and applications of DNA modifying enzymes and cloning strategies
3. To understand vector types, host genotype specificities for selection and screening of recombinants and/or recombinant transformants
4. To comprehend the various strategies for studying recombinant DNA molecules and its application in myriad fields

Course Outcomes (CO):

After completion of the course, the students will be able to:

K1 ↑↓ K5	CO1	Apply the technical knowhow on manipulating genes and genomes
	CO2	Showcase the knowledge to construct clones and apply them for cloning in different hosts
	CO3	Be competent in handling PCR and related techniques for various applications
	CO4	Be proficient in conducting genetic engineering experiments
	CO5	Be competent enough to handle recombinant strains at an industrial scale

Syllabus

Unit I **(12hours)**

MOLECULAR TOOLS FOR GENE CLONING: Host controlled restriction modification system :Nomenclature, Type I-V restriction endonucleases; their properties, DNA Methyl transferases : CpG Methylase , Dam Methylase, Dcm Methylase, process and relevance of DNA Methylation, Generalized cloning schemes, host genotypes specificities; markers for selection of recombinants; Ligases and Ligation strategies: End modifications, Nucleases, Polynucleotide kinase, Phosphatase, homopolymeric tailing, use of adapters and linkers

Unit II **(12hours)**

Properties of vectors and Hosts: Natural plasmids- types, properties. Hosts for cloning: *E.coli*, yeast, Plant, Animal Systems and their properties. Artificial plasmids- pBR322- structure, construction and biology,

pUC18, Phagemids, Phasmids, Broad host range plasmids, Bacterial Artificial Chromosomes as vectors, Vectors for cloning in Bacillus and streptomyces, Yeast vectors- YIP, YEP, YCP, YRP and YAC

Unit III **(12hours)**

Lambda vectors , *In vitro* packaging, Selection strategies screening of lambda recombinants, Cosmid construction, Phage Artificial Chromosomes as vectors, Construction and screening of Genomic DNA library and cDNA Library, Protein Expression Vectors (expression systems for high level protein expression in *E.coli* and yeast, transcriptional efficiency, inducible promoters, translational efficiency, translational initiation, elongation, codon usage), protein extraction and purification (protein purification tags, histidine and GST tags, IMAC).

Unit IV **(12hours)**

Nucleic acid sequencing methodologies, Dye chemistries and platforms: Sanger's Di-deoxy Chain termination method (Use of M13 based ss DNA vectors to cycle sequencing, Next Generation Sequencing (NGS) and Nanopore Sequencing, Autoradiography and fluorescence, dye chemistries, Non Radioactive labeling methods, slab gel based electrophoresis (semi-automated) to capillary based gel electrophoresis (automated sequencing), Interpreting electropherograms, base calling and quality scores (Phred). Polymerase Chain reaction- basic chemistry, types of PCR- Inverse PCR, Real Time PCR, RACE, Reverse Transcriptase PCR. **Application of PCR in forensic science***

Unit V **(12hours)**

Site Directed Mutagenesis: PCR based methods for site-directed mutagenesis (Single primer methods viz. Mis-incorporation of mismatched oligos, Over-lap extension), whole plasmid single round PCR), mis-repair of mutant oligonucleotides, selection of mutant (dut/ung *E. coli* strains for SDM through uracil replacement), Ligase chain reaction. Application of recombinant DNA in production of pharmaceuticals- **Insulin***, glucagon, clotting factors. Targeted Genome Editing: ZFNs, TALENs, CRISPRs

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Winnacker, E.-L. (2003). From genes to clones: Introduction to gene technology.: Panima Publishing Corporation. New Delhi.

2. Primrose, S. B., and Twyman, R. M. (2014). Principles of gene manipulation and genomics., 8th Edition, Wiley- Blackwell, UK
3. Nicholl, D. S. T. (2008). An Introduction to genetic engineering. Cambridge University Press, New York.
4. Glick, B. R., and Patten, C. L. (2017). Molecular biotechnology: Principles and applications of recombinant DNA. DC ASM Press, Washington.

Reference Books:

1. Brown, T. A. (2021). Gene cloning and DNA analysis: An introduction.7th Edition.Hoboken, NJ:Wiley-Blackwell.
2. Sambrook, J., Fritsch, E. F., and Maniatis, T. (2012). Molecular cloning: A laboratory manual. Cold Spring Harbor: Cold Spring Harbor Laboratory Press. USA

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	M	M	M
CO2	M	H	H	H	H
CO3	H	S	S	S	S
CO4	M	H	S	M	H
CO5	M	H	S	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT207		Core Paper 7- Immunology and Immunotechnology		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	II	4	60	4

Course Objectives

1. To provide the students with a foundation in immunological processes
2. To understand the immune response made in humans to foreign antigens including microbial pathogens
3. To give the description of cells involved in the immune response as well to understand how the immune system recognizes self from non-self
4. To introduce the basic concepts of immuno diagnosis and therapy

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	Define the role of the immune system
	CO2	Demonstrate the basic knowledge of the organization and function of the immune system
	CO3	Develop immunological concepts and methods to diagnose immune disorders
	CO4	Distinguish the mechanisms that lead to beneficial immune responses and immune disorders
	CO5	Apply the basics of immunotechnology in diagnosis and treatment

Syllabus

Unit I **(12hours)**

Immune system: Organs of the immune system (primary and secondary lymphoid organs). Host resistance to infection. non-specific and specific mechanisms – Physiological barriers Role of antibacterial substances (lysozyme, amylase and other antimicrobial substances in tears), mucus, stomach acid, normal flora in inhibiting establishment of infection, Phagocytosis, reticuloendothelial system, inflammatory response. Immunity: Natural/Innate immunity and acquired/adaptive immunity, cells of the immune system (Polymorphonuclear (PMN) leukocytes, macrophages, dendritic cells, B, T cells). **Natural Killer (NK) cells and their role in innate immunity***, phagocytes and their killing mechanisms (oxygen dependent and independent mechanisms).

Unit II **(12hours)**

Antigens and antigenicity – Definition, essential features, Epitopes, Haptens. **Antibody structure, classes and function***. Immune receptors (Pattern Recognition Receptors) Pathogen Associated Molecular Pattern receptors (PAMP), Toll like receptors (TLR). Major histocompatibility Complex- MHC Class I and II molecules, antigen processing and presentation. Humoral immunity: B-lymphocytes and their activation, Clonal selection theory, antibody genes and generation of diversity, production of monoclonal antibodies, polyclonal antibodies and applications. Cell mediated immunity:cytokines, Thymus derived lymphocytes (T cells) – their ontogeny and types, T regulatory and T suppressor cells and their role in immune regulation.

Unit III **(12hours)**

Cytokines: Interleukins and interferons and its biological functions. Hypersensitivity reactions: Types and mechanisms. Immunodeficiency diseases. B cell deficiencies: Common variable immunodeficiency, X-linked agammaglobulinemia. T- cell deficiencies: DiGeorge'ssyndrome, X-linked lympho-proliferative syndrome. Combined B and T cell deficiencies: Ataxia-telangiectasia, Severe combined immunodeficiency (SCID). Criteria and causes of autoimmune disorders, types of autoimmunity, autoimmune disorders: Autoimmune haemolytic anemia, Idiopathic thrombocytopenic purpura, Rheumatoid arthritis, Type I Diabetes.

Unit IV **(12hours)**

Transplantation Immunology: Immune suppression, Graft Vs Host disease**.** Tumor immunology: Tumor antigens, tumor immune response and tumor Immunotherapy.Vaccines: Recombinant vaccines, anti-idiotype vaccines, mRNA vaccines. Hybridoma technology: Production of clones, monoclonal antibodies and applications: catalytic, chimeric and humanized antibodies, abzymes, magic bullets. antibody engineering and phage display. Passive immunization, toxins and toxoids.

Unit V **(12hours)**

Immune escape mechanisms by microorganisms: Virokines, viroceptors and their role in immune escape of viruses, Immune escape by HIV, *Mycobacterium tuberculosis* bacilli,*Burkholderia pseudomallei*. Immunotherapy with genetically engineered antibodies, Stem cells and applications to immunology, Immunotechnology: Immunoprecipitation, ELISA, ELISPOT, Immunohisto-chemistry,Western Blotting, Immunofluroscence and Flow cytometry (FACS), **cell isolation with immunomagnetic cell separation (MACS) and multiplex bead arrays*.**

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text books

1. Punt, J., Stranford, S. A., Jones, P. P., Owen, J. A., & Kuby, J. (2019). Kuby immunology, 7th Edition. W. H. Freeman and company, New York

2. Chakravarthy, A. (2009). Immunology and Immunotechnology, Oxford University Press, India

Reference books

1. Rao, CV. (2002). An introduction to Immunology, Narosa Publishing House, Chennai

2. Khan, Fahim Halim. (2009). The elements of Immunology, Pearson Education (I) Pvt. Ltd.

3. Tizard, I.R. (1995). Immunology: An Introduction. 4th Edition. Saunder's College Publishing, NY

4. Roitt, I. (1994). Essential Immunology. Blackwell Science, Singapore

5. Peter J. Delves., Seamus J. Martin., Dennis R. Burton., Ivan M. Roitt. (2016). Roitt's Essential Immunology, 13th edition. Wiley-Blackwell.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	S	S	S
CO2	S	M	H	M	H
CO3	M	H	S	S	H
CO4	S	S	M	H	M
CO5	M	M	M	H	M

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT2CM		Core Practical 2- Lab in Molecular Biology and Genetics		
Batch 2022-2023	Semester II	Hours / Week 6	Total Hours 70	Credits 3

Course Objectives

1. To enrich the students to have practical experience on molecular biology and Microbial genetics
2. To provide hands on experience in isolation of DNA, RNA and protein
3. To introduce basic microbial genetic experiments
4. To provide hands on experience in DNA and protein elution

Course Outcomes (CO)

After completion of the course, the students will be able to:

K3	CO1	Apply the technical skills involved in extraction, manipulation of biomolecules and quantification
↕	CO2	Understand the mechanisms of genetic exchange, mutations and their implications.
	CO3	Apply the practical skill for isolation of bacteria/plasmid DNA and its visualization in gel after separation by electrophoresis.
	CO4	Be competent in planning and execution of molecular genetic experiments
K5	CO5	Be capable of handling bacterial hosts and strains

Syllabus

Molecular Biology

Prelab exercise – Reagent preparations, Comprehending genotypes and physical/genetic maps of bacterial strains

1. Isolation and purification of genomic DNA from bacteria and human blood
2. Isolation of plasmid DNA from bacteria
3. Quantification of DNA, RNA and Protein by UV VIS spectroscopy
4. Competent cell preparation and Bacterial transformation
5. Yeast plug – Ingel Digestion
6. SDS PAGE (Denaturing gel)
7. Native PAGE (Non denaturing gel)

8. Gel elution of DNA fragments and analysis
9. Gel elution of Protein fragments and analysis
10. Agar overlay assay

Genetics

1. Mounting of polytene chromosomes
2. Mitosis onion root tip
3. Meiosis – flower buds of Rheo discolor
4. Plating of T4 Bacteriophage – Phage titration
5. Conjugation mapping by Interrupted mating technique
6. Transduction mapping using Mu phage (Demo)
7. Experiments with Gene Fusion (DEMO)

Textbooks

1. Gakhar, SK., Monika Miglani., Ashwani Kumar. Molecular Biology: A Laboratory Manual, Wiley publisher.
2. Ruhi Dixit, Kartikay Bisen, Ashwani Kumar, Ashim Borah, Chetan Keswani. (2016). Lab manual on molecular biology (1st Edition). Media Associates, Delhi.
3. Worku Mhiret. (2019). Laboratory Manual for Principles of Genetics. LAP LAMBERT Academic Publishing.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	H
CO2	H	H	S	H	H
CO3	H	H	S	S	S
CO4	H	M	M	H	H
CO5	H	M	M	H	S

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT2CN		Core Practical 3- Lab in Genetic Engineering and Immunotechnology		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	II	6	70	3

Course Objectives

1. To Acquire skills on techniques of construction of recombinant DNA - Cloning vectors and isolation of gene of interest
2. To have hands on experience in DNA manipulative enzymes
3. To give hands on experience in immunological techniques
4. To provide a basic understanding of labeling and detection techniques

Course Objectives (CO)

After completion of the course, the students will be able to:

K3 ↕ K5	CO1	Construct recombinant DNA molecule
	CO2	Understand the mechanisms of construction of genomic DNA library and cDNA Library
	CO3	Develop and apply the recent technology involved in diagnostic techniques of immunology
	CO4	Employ techniques like PCR for high end applications
	CO5	Plan and execute basic immunology experiments

Syllabus

Pre Lab Exercise:

1. Calculations for r DNA experiments
2. Chemical and hazardous safety procedures
3. Disposal of waste
4. Genetic maps of plasmids

Genetic Engineering

1. Phage titration
2. Restriction digestion and Ligation
3. Non radio-active labeling of DNA – Biotin (Demo)
4. Southern, northern and western blotting
5. Designing of specific primers using software
6. Amplification by Polymerase Chain Reaction - Colony PCR, Differential temperature PCR and touch-down PCR

7. cDNA synthesis
8. *in vitro* site directed mutagenesis by using PCR method (Demo)
9. Gene Expression - Real time PCR (Demo)

Immunotechnology

1. Production and purification of IgG
2. Immunoassay for particulate antigens
3. Qualitative and Quantitative haemagglutination
4. Radial immunodiffusion
5. Ouchterlony double diffusion
6. Immunoelectrophoresis
7. Rocket immunoelectrophoresis
8. Immunodiagnosis (ELISA)
9. DOT BLOT
10. Immunohistochemistry (DEMO)

References

1. Carson, S., Miller, HB., Witherow, DS., Srougi, MC. (2019). Molecular biology techniques: A classroom laboratory manual. London Academic Press.
2. Kurnaz, IA. (2015). Techniques in genetic engineering. CRC Press, Boca Raton.
3. Williams, HB. (1978). Laboratory manual of serology, immunology and blood banking. Conn: AVI Pub. Co, Westport.
4. Oliver, C. (2010). Immunocytochemical methods and protocols. Springer.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	S	M	H	M
CO2	H	M	H	M	H
CO3	M	H	H	S	S
CO4	H	M	M	S	H
CO5	M	M	M	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT308		Core Paper 08- Plant and Animal Transgenics		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	III	5	65	4

Course Objectives

1. Tofamiliarize the students plant genetic engineering and gene transfer techniques
2. To discuss the concepts on gene knockout and hybridoma technology.
3. To explain methods ofvarious viruses mediated gene transfer methods and somatic cell nuclear transfer.
4. Discuss ethical concerns over the use of animal and plant transgenics.

Course Outcomes (CO)

K1	CO1	Understand various types of vector system and gene delivery in plants.
↕	CO2	Categorize biotic and abiotic profile
	CO3	Investigate the importance of vector mediated gene transfer
	CO4	Understand the various concepts of animal transgenics
K5	CO5	Discuss the applications of plant and animal transgenics in human welfare

Syllabus

UNIT I **(15 Hours)**

Plant genetic Engineering: Introduction to plant tissue culture, Genetic materials of plant cells, Structure and functions of chloroplast and mitochondrial DNA. Types of plant expression vector system – Ti, Ri Plasmid, TMV, Potato virus X and Cauliflower mosaic virus. Modes of gene delivery in plants – Biolistics, electroporation, microinjection, Agrobacterium mediated gene transfer; Screening and selection of recombinants.

UNIT II **(15 Hours)**

Metabolic Engineering: Biotransformation overview, Advantages of cell, tissue and organ culture as source of secondary metabolites, Hairy root cultures; procedure for extraction of high value industrial products- Rubber, paper; Types of bioreactors for plant cell cultures; manipulation in production profile by biotic and abiotic elicitation. Principles and applications of flow cytometer and cell sorting.

Case Study I: Organic and GMO - Are these two agricultural technologies destined for co-existence or conflict?

UNIT III **(15 Hours)**

Genetic Engineering of Mammalian cells: Mammalian cell lines, viral vector mediated gene transfer in mammalian cells – Retrovirus, Adenovirus and Adeno Associated Virus.Somatic cell nuclear transfer, Hybridoma technology and storage, monoclonal antibodies and commercial production. Various methods of gene mapping. Gene knockout mice model for human genetic disorders.

UNIT IV **(15 Hours)**

Animal Transgenics: Production of transgenic animals (Cattle, mice, sheep, fish, birds) and chimeras. Artificial insemination and embryo transfer, cryostorage, Gene silencing and antisense therapy in the treatment of Huntington's disease. Transgenic manipulation of animal embryo. Shotgun cloning. Current status of gene therapy. **Ethical issues***.

UNIT V **(15 Hours)**

Applications: Production of virus free plants by meristem, shoot tip culture; protoclonal, somoclonal and gametoclonal variation for crop improvement; Transgenic plants - Bt cotton, golden rice, Biodegradable plastics, production of useful proteins and products in transgenic animals (blood products, harmones, vaccine) CRISPR-CAS 9 technology for gene editing, Plantibodies in animal health and **molecular pharming***.

Case Study II: Serious concerns over Bt Brinjal, Bt Cotton, Bt potato, Bt tobacco

**** denotes Self study***

Teaching Methods

Powerpoint presentation/ Google Class Rooms/Smart Class Rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Textbooks

1. Singh BD., (1998), Textbook of Biotechnology, Kalyani publications.
2. Bhojvani SS and Razdan MK, (1996). Plan tissue culture: theory and practice, Elsevier science
3. Brown TA, Gene Cloning (2002)
4. Gordon I (2005). Reproductive techniques in farm animals, CABI
5. Benson Jones Jr (2014). Growing plants hydrophobically, CRC Press.

References

1. Cseke LJ, Warber SL, Duke JA, Kirkosyan A, Kaufman PB and Brielmann HL (2006). Natural products from plants, 2nd edition, Taylor and Francis group.
2. Portner R (2007). Animal cell Biotechnology. Human Press.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	H	S
CO2	H	M	H	S	H
CO3	H	M	H	S	M
CO4	M	L	M	H	H
CO5	M	M	H	S	H

S – Strong H – High M – Medium L – Low

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT309		Core Paper 09- Industrial Applications of Biotechnology		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	III	5	70	4

Course Objectives

1. To acquaint students with technical and biological aspects of microbial utilization for production of metabolites
2. To study techniques for genetic improvements of microorganisms to improve yield of bioproducts.
3. To sensitize the students to basic bioreactor designs and uses
4. To expose to various biotechnological approaches for product production and recovery

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	Comprehend the role of industrial biotechnology in improving microbial cell as factories
	CO2	Design protocols for strain improvement and separation of molecules after fermentation process.
	CO3	Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale up.
	CO4	Integrate research lab and industry, identify problems and seek practical solutions for large scale implementation of Biotechnology.
	CO5	Apply methods of production of bioproducts at an industrial scale

Syllabus

UNIT I **(14hours)**

Biotechnology: Commercial potential of Biotechnology in India. Traditional and modern Biotechnology on industrial fermentation processes. An interdisciplinary challenge- Biotechnology & Bioprocess engineering; Overview of fermentation processing- pictorial representation. *Industrially important Microorganism:* Major classes of commercial products using microorganism; sources from ecological niche; isolation and screening techniques; Strain improvement: selection of natural variants; selection of induced mutants- auxotroph mutant for lysine and streptomycin- use of recombination system.

UNIT II **(14hours)**

Media for industrial fermentation: Constituents of media- defined media and undefined media, natural resources of media components, designing of media- submerged and solid state processes; Media

optimization. Development of inocula for Bacteria, yeast and fungal processes. Media sterilization; Batch sterilization process, Continuous sterilization process by heat; Sterilization of fermenter and other ancillaries, filter sterilization of air.

UNIT III (**14hours)**

Inoculum development for industrial fermentation & Microbial kinetics: Introduction, criteria for transfer of inoculum, inoculum development for bacteria, yeast and mycelial processes. Microbial growth kinetics: Growth cycles, measurement of growth, Batch culture, continuous culture, Fed batch culture, **applications and examples.***

UNIT IV **(14hours)**

Design of Bioreactor and types: Trickle bed, Bubble column, Airlift reactor, Packed bed, Fluidized bed, Membrane reactor, Solid State fermenter, Bioreactors for immobilized cells, animal cells. Specialized bioreactors: pulsed, fluidized and photobioreactors. Scale up and scale down studies in bioreactors. Heat and mass transfer in bioprocess. Measurement of temperature, pressure, pH, DO, form etc,; Automation (processes computerization), PID control. Overview of Product recovery and purification; product resolution-ion exchange chromatography; **product polishing**: **drying– spray driers, drum driers and freeze driers and crystallization***

UNIT V **(14hours)**

Biotechnological approaches on commercial product production: Organic acids (Citric acid & Acetic acid), Aminoacids (Glutamic acid, Phenyl alanine& Tryptophan), Alcohols (Ethanol & butanol), Enzymes (Asparaginase & Lipase), Vitamins (vit B12 & vit B2), Antibiotics (cephalosporin), Recombinant vaccine (hepatitis B, cholera vaccine, Covishield), ***SCP* *.** Biotechnology in modern industrial application: Retting of jute, Biopreservatives (Nisin) Biosweetners (Stevioside), Biopolymers (xanthan gum & Silk fibroin), **Biofilms, Biosurfactants***.

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Textbooks

1. Ghasern Najafpour., (2015). Biochemical engineering and Biotechnology, 2nd Edition,
2. Pauline and M. Doran., (2003). A Textbook of Industrial Microbiology. Panima Publishers Corporation New Delhi.

References

1. Stanbury PF, Whitaker A, Hall SJ., (2016). Principles of Fermentation Technology, 3rd edition. Butterworth-Heinemann Elsevier Ltd, Oxford, United Kingdom
2. Shuler ML, Kargi F., (2017). Bioprocess engineering, Basic Concepts, 3rd Edition, Prentice Hall, Engelwood Cliffs.
3. Rita Singh, Ghosh S,(2004). Industrial Biotechnology. Global Vision Publishing.
4. Casida L.E., (2002). Industrial Microbiology. John Wiley & Sons Inc., United States Industrial Microbiology.
5. Lancini G, Lorenzetti R., (2014). Biotechnology of Antibiotics and other Bioactive Microbial Metabolites, Springer publications, Germany.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	H	H	M
CO2	H	H	S	S	H
CO3	S	H	S	H	S
CO4	S	H	H	S	H
CO5	M	M	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT310		Core Paper 10 – Genomics, Proteomics and Metabolomics		
Batch 2022-2023	Semester III	Hours / Week 4	Total Hours 60	Credits 4

Course Objectives

1. To develop a basic understanding of OMICS and their myriad applications
2. Exposure to the technical knowledge requirement for OMICS
3. To comprehend the fundamentals of genome and proteome data mining.
4. To promote study of human genome project to develop cures for human diseases with skills
5. To use complex algorithms, computer databases and software.

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Interpret genome proteome data obtained through high throughput techniques
↕	CO2	Analyse and identify sequence similarity with skills that can empower biologists to make use of their own data for understanding of biological processes
	CO3	Suggest and provide solutions to theoretical and experimental problems in Genomics , Proteomics and Metabolomics
	CO4	Apply the acquired knowledge for pharmacogenomics and comprehend the techniques for drug design
K5	CO5	Use genome proteome and Metabolome information on agri and health sector

Syllabus

Unit I **(12hours)**

Genomics: Organization and structure of eukaryotic genomes, organellar and nuclear DNA, tandem repeats, dispersed repeats by transposons and retrotransposons, pseudogenes and duplication of genes, human Y chromosome, centromere repeats, telomeres- telomeric and subtelomeric regions, mapping and sequencing genomes, DNA polymorphisms- RFLP map, RAPD, VNTR, SNP, Gene fusion, AFLP, physical markers for cytogenetic maps, Bac Map and Hap Map, RH mapping, HAPPY mapping

Unit II **(12hours)**

Sequencing genomes: High throughput sequencing, Shotgun sequencing- gaps in sequences, comparative genomics of bacteria and eukaryotes. STR typing by PCR- gender identification, RNA-seq analyses. Differential expression, stochasticity, and FDR. Alternate splicing, ENCODE. Epigenomic analyses and cancer/ diseases. Bisulfite sequencing, Analysis of gene expression- qPCR, northern blot, southern blot; Transcriptome profiling; DNA microarrays; Copy number variation, sequence repeats, SNV, haplotype, and their relevance in diseases. Comparative genomics. Metagenomics

Unit III **(12hours)**

Proteomics : 2D electrophoresis , multiplexed analysis for protein expression profiles, multidimensional liquid chromatography, Mass Spectrophotometry for protein annotation, MALDI – TOF, ESI, LCMS, Gel free separation techniques. Protein microarrays, Antibody arrays, antigen arrays, protein arrays and expression profiling, CHIP in proteome applications, qualitative and differential quantitative proteomics. solution of protein structures on a large scale e cell, Protein interaction based on comparative genomics, library based screening for large scale analysis, yeast 2 hybrid system, random library methods.

Unit IV **(12hours)**

Metabolomics - an overview, basic sample preparation strategies- extraction, derivatization, Workflow for lipidomics; Introduction to mass spectrometry and modes of data acquisition, data repositories. Targeted Vs Untargeted metabolomics; development of targeted assays for small molecules, Metabolome Description, Analytical Methods in Metabolomics, **Examples of metabolomic studies on plant models*.**

Unit V **(12hours)**

Mutation detection in Human Genes: Electrophoretic shift assay – EMSA, protein truncation test. Application of protein microarrays for biomarker discovery to detect cancer antigens. High density protein microarray to detect autoantibodies in breast cancer, cell free protein array methods. Inclusion of metabolites into biosynthetic pathways, Structural elucidation of new compounds, **Integration of metabolomics with other omics approaches as genomics, transcriptomics and proteomics*.** Databases for genomic/proteomic and Metabolomic studies.

***denotes self study**

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text books

1. Lämmerhofer, M., & Weckwerth, W. (2013). Metabolomics in practice: Successful strategies to generate and analyze metabolic data. Weinheim: Wiley-VCH Verlag.
2. Thangadurai, D., & Sangeetha, J. (2015). Genomics and proteomics: Principles, technologies, and applications. Oakville: Apple academic Press..
3. Strachan, T., & Read, A. P. (2019). Human molecular genetics. 5th Edition. CRC Press.
4. Primrose, S. B., & Twyman, R. M. (2006). Principles of gene manipulation and genomics. 7th Edition. Wiley Blackwell Publishers. New Delhi**.**

Reference Books:

1. Buckingham, L. (2019). Molecular diagnostics: Fundamentals, methods, and clinical applications.2nd Edition. F.A. Davis Company, Philadelphia.
2. Lovric, J. (2017). Introducing proteomics: From concepts to sample separation, mass spectrometry and data analysis. Wiley-Blackwell.
3. Hardy, N. W., Hall, R. D., & Humana Press Inc. (2016). Plant Metabolomics: Methods and Protocols. Totowa Humana Press.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	H	H
CO2	H	H	M	S	H
CO3	H	M	S	H	S
CO4	S	M	H	M	H
CO5	M	H	S	S	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT3CO		Core Practical 4- Lab in Plant and Animal Biotechnology		
Batch 2022-2023	Semester III	Hours / Week 6	Total Hours 70	Credits 4

Course Objectives

1. To make the students to be skilled in plant tissue culture techniques
2. To enhance the secondary metabolites through *in vitro* techniques
3. To equip the students with animal cell culture techniques
4. To provide a basic understanding of application of plant and animal culturing

Course Objectives (CO)

After completion of the course, the students will be able to:

K3	CO1	Conserve the endangered species using *in vitro* culture techniques
↕	CO2	Perform tissue culture techniques can be useful for bioprospecting important natural compounds
	CO3	Employ *in vitro* animal cell culture techniques to evaluate the bioactive properties of samples
K5	CO4	Plan and execute commercial *in vitro* plant propagation
	CO5	Be competent in handling cell lines for various applications

Syllabus

Prelab Exercises

1. Safety guidelines and Good Laboratory Practices
2. Media for animal cell culture and plant tissue culture preparation and its sterilization techniques
3. Design of a typical Plant and Animal cell culture laboratory

Plant Biotechnology

1. Micropropagation- Nodal and shoot tip culture
2. Callus culture
3. Cell suspension culture
4. Synthetic seed preparation
5. Somatic Embryogenesis
6. Anther culture
7. Regeneration and Hardening

8. Agrobacterium mediated transformation – hairy root culture (Demo)
9. Isolation and purification of RNA from plant

Animal Biotechnology

1. Primary cell culture technique using chick embryo
2. Preparation of Established Cell Lines from primary culture and check viability by trypan blue exclusion test
3. Trypsinisation, passaging and growth curve
4. Migration - Scratch Assay
5. Cytotoxicity test - MTT Assay
6. Interferon production from cell lines and estimation by ELISA
7. COMET Assay (Demo)

Textbooks

1. Punia, MS. (2018). Plant Biotechnology and Molecular Biology: A Laboratory Manual. Scientific Publishers.
2. Reinert, J., Yeoman, M.M. (1982). Plant Cell and Tissue Culture-A Laboratory Manual. Springer-Verlag Berlin Heidelberg.
3. Portner. (2020). Animplasmidal Cell Biotechnology – Methods and Protocols Ralf (Ed), (1st Edition). Humana Press.
4. Ian Freshney. R (2005). Culture of Animal Cells: A Manual of Basic Technique, John Wiley & Sons

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	H	S	M
CO2	H	M	S	M	S
CO3	M	H	H	S	S
CO4	H	S	M	H	H
CO5	H	H	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT3CP		Core Practical 5-Lab in Applied Biotechnology		
Batch 2022-2023	Semester III	Hours / Week 6	Total Hours 70	Credits 3

Course Objectives

1. To impart hand-on experience and laboratory skills to students in area of bioprocess
2. To train students to set up different fermentation processes with special emphasis on the downstream processing of bio-molecules purification and characterization
3. To expose to basic Omics experiments and data analysis
4. To introduce basic concepts of herbal drug preparation

Course Outcomes (CO)

After completion of the course, the students will be able to:

K3 ↕ K5	CO1	Acquire General bacteriology and microbial techniques for isolation of pure cultures of microbes from different food, agricultural and environmental sources
	CO2	Downstream processing of the bio-molecules and characterization such as stability at different pH and Temperature
	CO3	Be compatible in basic methods of herbal drug preparation and testing
	CO4	Analyse protein and metabolite databases and infer
	CO5	Apply drug preparation methods for new product development

Prelab exercise –

Bioprocess laboratory organisation and its safety guidelines

Pharmaceutical Biotechnology

1. Preparation of a herbal hydrogel
2. Preparation of ethosomes with a herbal drug
3. Preparation of SLP NP's with a herbal drug
4. Conversion of a herbal oil to gel
5. Testing haemagglutination and hemolytic activity of a herbal drug
6. Determining the antibacterial spectrum of drugs/antibiotics
7. Preparation of a herbal formulation and qualitative analysis
8. Preparation of niosomes with a herbal drug

Genomics and Proteomics

1. Isolation of LDH isoenzyme and separation on Starch gel
2. Proteogenomic data analysis using Integrative genomic viewer

3. Metabolite identification using NIST standard reference database

Industrial applications of Biotechnology

1. Isolation and preservation Protease producing bacteria from soil
2. Optimization of culture condition for growth and protease production (media, pH & temperature) and Production of industrially important protease enzyme by solid state fermentation
3. Partial purification of enzyme by ammonium sulphate precipitation and Dialysis
4. Purification of fermentation product by Ion exchange Chromatography
5. Cell disruption for endoenzymes by sonication.
6. Immobilization of cells and test for its activity
7. Wine production and Analysis- sampling and total and viable yeast cells
8. Production and estimation of citric acid (using *Aspergillus niger*) by titrimetric method
9. Product polishing- Spray drying and Crystallization. (DEMO)
10. Spawn production and Cultivation of edible mushrooms(DEMO)

Textbooks

1. Dr. Mrs. Varsha Tiwari. (2020). A practical book for herbal technology. 1st Edition. Nirali Prakashan Publishers, Pune, India.
2. Kulandaivel, S., Janarthanan, S. (2012). Practical Manual on Fermentation Technology Paperback edition. I K International Publishing House Pvt. Ltd.
3. Baltz, RH., Davies, JE., Demain, AL. Manual of industrial Microbiology and Biotechnology (3rd Edition). ASM publications. ASM press, Washington, DC.
4. Simpson R (2002). Proteins and proteomics: A laboratory manual. Cold Spring Harbor Laboratory Press. 926 pages.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	S	H	M	S
CO2	H	S	S	M	M
CO3	S	H	S	S	M
CO4	S	M	M	H	S
CO5	M	M	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme name: M.Sc. Biotechnology		
Course code:22PBT5IT		Internship Training		
Batch: 2022-2023	Semester -	Hours / Week -	Total Hours -	Grade

Course objective

- To provide an opportunity to work in industry/institute under the mentorship of an industrial personnel
- To develop key skill sets that are industry relevant for future placements
- To have a flavor of corporate life in an industry sector
- To built strength, sprit of team work and self confidence
- To prepare the students to comprehend industrial problem

Working Instructions

- The tutor of the respective class shall identify a list of industries/institutes at the beginning of the fourth semester and the same shall be approved by the HoD
- The tutor shall prepare a letter of request with the name of the student who will be placed in a particular industry and send the same or concurrence from the industry
- The class tutor shall ensure not more than four students allotted to a particular industry or institute
- The class tutor shall ensure that a daily log book provided to all the students while they leave for the internship during the summer vacation (The format of the log book will be available with the HoD)
- The tutor shall also ensure that the following documents are received from the students before they leave for the internship
    i. The letter of undertaking from the concerned student
    ii. A letter of undertaking from a parent/guardian indicating the willingness for permitting for his/her ward to the internship either in Coimbatore or other places
    iii. During the internship the student must be in contact with the tutor and shall send weekly report
    iv. After the internship is completed the log books have to be submitted to the tutor which has to be verified

The tutor shall arrange for an evaluation in consultation with the HoD and grades be allotted

Mark breakup for Evaluation

Component	Marks
Log book submission	15
Report	50
Attendance	15
Review & Evaluation	20
Total	**100**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT411		Core Paper 11- Pharmaceutical Biotechnology		
Batch 2022-2023	Semester IV	Hours / Week 5	Total Hours 65	Credits 4

Course Objectives

1. To expose the students to biopharmaceutical market
2. To give them the knowledge on drug development process.
3. To cover the latest developments in Pharmaceutical Biotechnology
4. To create an insight on drug interaction and clinical trials

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Apply the basic knowledge involved in drug preparation and the classical treatment processes
	CO2	Correlate the effects of drugs, bio-assay and interpretation
	CO3	take part in clinical research
	CO4	Have commendable research aptitude for drug designing
K5	CO5	Be appraised for job openings in the field of pharmaceuticals

Syllabus

Unit I **(13hours)**

Pharmacological profile of drugs: drug classification (ATC classification ,therapeutic and NSAID drug class). Pharmacokinetics and pharmacodynamic of drugs. Routes of drug administration. Factors modifying drug action. Treatment for poisoning. Basic principles of Pharmacy: Sources for drug preparation. Drug dosage forms. Dosage calculations.Critical evaluation of drug formulations .An introduction to pharmacoeconomics. Generics and its advantages Biogenerics and Biosimilars.

Unit II **(13hours)**

Knowledge of drug delivery systems **:**Sustained Release(SR) and Controlled release(CR)drug delivery systems -oral, parenteral ,dental, colon specific, ocular and transdermal drug delivery system. Rate Controlled Drug Delivery Systems: Modulated Drug Delivery Systems; Mechanically activated,

chemically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems, Feedback regulated Drug Delivery Systems.

Unit III **(13hours)**

Drug interaction : Basic insight into the anatomy of liver kidney and brain (BBB). Absorption and metabolism of drugs by liver and kidney.Detoxification mechanism by liver. Types of Drug-Receptor Interactions .Drug response on CNS and autonomous nervous system .Adverse drug effects. Genotoxicity screening. Drug resistance assessment and management of drug resistance.**MDR-Quorum sensing analogues**.* (Submission of a **Critical review on drug toxicity and testing)**

Unit IV **(13hours)**

New drug discovery process: purpose, main steps involved in new drug discovery process, timeline of each step, advantages and disadvantages. Drug discovery cycle : Drug isolation, identification, characterisation and formulation. Preclinical study: toxicity study of drugs (acute vs chronic toxicity).***Exposure to animal handling methods ***. Scope of Clinical Research.- Framing a PICOT question. Types of clinical trial- single blinding, double blinding, open access, randomized trial. Clinical Phases, Cohort analysis, Pharmacovigilance.Manufacturing and regulatory issues, Compliance/Adherence and acceptability of Product.

***(preparation and submission of a case study on drug trial research for evaluation by each student.)**

Unit V **(13hours)**

Production of biopharmaceuticals: Production of any **one** enzyme and therapeutic protein, cytokines, interferon, interleukins and vaccines. Production & applications of Probiotics. Good laboratory practice (GLP):- Basic principles of quality control (QA) and quality assurance (QC) Guidelines for QA and QC. Pharmacognosy: An introduction to Ayurveda, Unani and siddha medicine. **Importance of herbal medicine in INDIA. .A generalised view of herbs and Oils used in health and their extraction procedure*.**

(**case study on indigenous drug preparation in collaboration with AVP, Coimbatore**

****Denotes self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books:

1. Richard A Helms, (2006). Text Book of Therapeutics Drug and Disease Management, 8th Ed., LWW.
2. Sharma, H. L. (2013). Principles of pharmacology.Paras Medical Publisher. New Delhi.
3. Kayser, O., & Warzecha, H. (2012). Pharmaceutical biotechnology: Drug discovery and clinical applications. Wiley-Blackwell ; John Wiley [distributor], . Weinheim: Chichester.,
4. Vyas, S. P., & Dixit, V. K. (2008). Pharmaceutical biotechnology. CBS Publishers & Distributors. New Delhi:
5. Crommelin, D. J. A., Sindelar, R. D., Meibohm, B., & Springer International Publishing. (2019). Pharmaceutical biotechnology: Fundamentals and applications. Daan J.A. Crommelin, Robert D. Sindelar, Bernd Meibohm (editors) .Cham Springer

. **Reference Books:**

1. Hall, J. E. (2016). Guyton and Hall textbook of medical physiology., 13th Ed., Saunders. Philadelphia
2. Mahato, R. I., & Narang, A. S. (2018). Pharmaceutical dosage forms and drug delivery., 10th Edition. Boca Raton, FL : CRC Press, Taylor & Francis Group.
3. Tripathi, K. D., & Jaypee Brothers (Jaypeedigital). (2016). Essentials of Pharmacology for Dentistry. (Jaypee eBooks.) Jaypee Brothers Medical Publisher (P) Ltd.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	S	H	H	H
CO2	H	M	S	M	S
CO3	S	H	H	M	M
CO4	H	S	S	H	H
CO5	M	M	M	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc., Biotechnology		
Course code: 22PBT1E1		Major Elective I - Environmental Biotechnology		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	I	5	65	5

Course Objectives

1. To introduce the students to various regional and global concerns regarding the environment, including the natural challenges, various types of environmental pollutants and their effects.
2. To Study the changing environment, and the developments of diverse technologies to detect, address these concerns.
3. To prioritize specific examples and cases, and explain how chemical, biological sciences can be applied to identify and address issues of environmental concerns.

Course outcomes

After completion of the course, the students will be able to:

K1	CO1	Recognise the various global and regional environmental concerns due to natural causes
	CO2	Investigate some examples of different types of environmental pollution and their impacts
↕	CO3	Demonstrate an awareness of emerging concerns such as climate change, waste management or reductions in fossil fuels, and new technologies for addressing these.
	CO4	Explain Environmental Impact Assessment, Management and Auditing in India
K5	C05	Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration

Syllabus

Unit I

Water Pollution: (13hours)

Types and sources of water pollution. Wastewater Treatment: Primary, Secondary and Advanced treatment methods. Common effluent treatment plant. Impact on humans, plants and animals. Sampling techniques (Dissolved Oxygen (DO); Chemical Oxygen Demand (COD); Biological Oxygen Demand (BOD); Total Dissolved Solids (TDS); Total Suspended Solids (TSS).

Case Study I: Pollution cocktail in the Noyyal River Basin, Coimbatore and its impact on Ecosystem

Air Pollution:

Sources and types of Pollutants - Natural and anthropogenic sources, Primary and secondary pollutants transport and diffusion of pollutants, Effect and control devices for air pollution. Indian National Ambient Air Quality Standards. Impact of air pollutants on human health, plants and materials.

Case Study II: COVID 19 ‘s link in Air Pollution in Metro political cities in India

Unit II (13hours)

Soil Pollution, Thermal pollution, and Electronic waste (E-waste)

Physico-chemical and biological properties of soil (texture, structure, inorganic and organic components). Soil Pollution control. Industrial effluents and their interactions with soil components. Soil micro-organisms and their functions in degradation of pesticides and **synthetic fertilizers***.

Thermal pollution: Sources, Chemical and biological effects of thermal pollution, control Methods of thermal pollution .

Case Study III: Warming up to catastrophe- Climatic Change Pattern globally”

Electronic waste (E-waste): Sources types and constituents of E-wastes and its environmental consequences

Case Study IV: Environmental impacts caused to to Dumping of medical waste and meat waste in Pollachi from Kerala.

Unit III (13hours)

Radiation Pollution and Sampling

Radiation pollution: Biological impact and health hazards associated with radiation, Protection against ionizing isotopes and their applications in waste water and air pollution analysis and treatment; Radioactive waste disposal. **Fly ash:** sources, composition and utilisation. **Plastic waste:** sources, consequences and management.

Case Study V: Impact of electromagnetic radiation on Bird Diversity in Tamil Nadu

Unit IV Environmental monitoring (13hours)

Xenobiotic compounds-Degradation Mechanisms, Bioremediation – Microbial Bioremediation, Processes and Technologies. Biodegradation of Organic Pollutants, Factors affecting process of biodegradation; Phytoremediation: **Waste water treatment using aquatic plants***; Root zone treatment.

Unit V **(13hours)**

Environmental Assessment, Management and Legislation: Aims and objectives of Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS), EIA Guidelines. Impact Assessment Methodologies. Environmental Auditing – Types and Guidelines for Environmental Audit. Risk Assessment - Risk characterization and Risk management. Overview of Environmental Laws in India: The Ancient Monuments Preservation Act.

Denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Textbooks

1. K.V.S.G.Murali, K. (2015). Air Pollution and Control. Laxmi Publications Pvt Ltd, Kaninada, India.
2. Manahan, S. E. (2017). Environmental chemistry.7th edition, Boca Raton : Taylor & Francis.

References

1. Evans, G. G., & Furlong, J. (2013). Environmental biotechnology: Theory and application. Hoboken, N.J: Wiley.
2. Hung, Y.-T., & Wang, L. K. (2006). Advanced physicochemical treatment processes. Totowa, NJ: Humana Press.
3. Harrison, R. M., Hester, R. E., & Royal Society of Chemistry (Great Britain). (1995). Waste treatment and disposal. Cambridge: Royal Society of Chemistry.
4. Shrivastava, A. K. (2017). Environment impact assessment. APH Publishing Corporation, New Delhi
5. Thompson, S., Therivel, R., Oxford Polytechnic., & Oxford Polytechnic. (1992). Environmental auditing. Oxford: Oxford Polytechnic, School of Planning.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	H	M	H
CO2	S	M	H	M	H
CO3	M	H	H	H	M
CO4	M	H	M	M	H
CO5	M	H	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT1E1		Major Elective 1-Nano Biotechnology		
Batch 2022-2023	Semester I	Hours / Week 5	Total Hours 65	Credits 5

Course Objectives

1. To understand the influence of dimensionality of the object at nanoscale on their properties
2. To outline size and shape-controlled synthesis of nanomaterials and their applications
3. To familiarize themselves with nanotechnology potentialities
4. To introduce the various applications of nanotechnology

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO 1	Understand the fundamentals of nanotechnology
↑	CO 2	Give a general introduction to different classes of nanomaterials
	CO 3	Apply their knowledge on various synthesis methods of nanomaterials
↓	CO 4	Understand characterization techniques involved in nanotechnology
K5	CO 5	Apply nanotechnological principles in agri and medical fields

Syllabus

Unit I **(13 Hours)**

Fundamentals of Nanomaterials –Nanomaterials-Definition, Features and PropertiesClassifications (1D, 2D and 3D etc. Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc and types of nanomateirals- property change at the nanoscale- influence of size, shape and chemistry- comparison of bulk and nanoscale systems **-advantages and disadvantages of nanomaterials***

Unit II **(13 Hours)**

Types of nanomaterials: Carbon-based nano materials – fullerenes, buckyballs, carbon nanotubes and graphene, Metal based nano materials – Nanogold and Nano silver, Iron oxide based nano materials, Nanocomposites and nanopolymers, Nano capsules, Nano glasses and nano ceramics Biological nanomaterials. Quantum dots, wells and wires,

Unit III **(13 Hours)**

Synthesis of Nanomaterials- Top down bottom up approaches; Physical methods- Ball milling, Electrodeposition techniques, Spray pyrolysis and flame pyrolysis, DC/RF magnetron sputtering,

Molecular beam epitaxy (MBE); Chemical methods- Metal nanocrystals by reduction, Solvothermal synthesis and photochemical synthesis, Sonochemical routes and chemical vapor deposition (CVD), Metal oxide chemical vapor deposition (MOCVD) - **Green synthesis using microbes – viruses - algae – plants- Biomineralization***

Unit IV **(13 Hours)**

Fabrication and Characterization of Nanostructures: Nanofabrication- Photolithography and its limitation and electron beam lithography (EBL), Nanoimprinting and soft lithography patterning**,** Directional photo fluidization lithography (DPL) **Characterization**: Field emission scanning electron microscopy (FESEM) and environmental scanning electron microscopy (ESEM), High resolution transmission electron microscope (HRTEM), Scanning tunnelling microscope (STM). atomic force microscopy (AFM). Surface enhanced Raman spectroscopy (SERS). X-ray photoelectron spectroscopy (XPS)

Unit V **(13 Hours)**

Applications in Nanotechnology Solar energy conversion and catalysis, Molecular electronics, nanoelectronics and printed electronics, Polymers with a special architecture, liquid crystalline systems, Linear and nonlinear optical and electro-optical properties, Applications - nanomaterials for data storage, Photonics and plasmonic, Chemical and biosensors, Nanomedicine – Diagnosis, Drug Delivery, Nano drugs, Cancer Therapy, **Nanotoxicology challenges***

****denotes self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Pradeep, T. (2012). A Textbook of Nanoscience and Nanotechnology. Tata McGraw Hill Education Pvt. Ltd.
2. Nalwa, H. S. (2000). Handbook of nanostructured materials and nanotechnology: Volume 3. San Diego: Academic Press.
3. Nabok, A (2009). Organic and Inorganic Nanostructures. Artech House.

Reference Books

1. Dupas, C., Houdy, P., & Lahmani, M. (2007). Nanoscience: Nanotechnologies and Nanophysics. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg
2. Edelstein, A. S., & Cammarata, R. C. (2002). Nanomaterials: Synthesis, properties, and applications. Institute of Physics Pub. Bristol.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	M
CO2	H	M	H	H	H
CO3	H	H	H	H	H
CO4	S	H	H	H	H
CO5	H	H	M	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT1E1		Major Elective 1- Post Production System of Foods		
Batch 2022-2023	Semester I	Hours / Week 5	Total Hours 65	Credits 5

Course Objectives

1. To focus on producing a high-quality product, maintaining the nutrition value of the food, increasing the shelf life of the product and availability of the seasonal fruits and vegetables throughout the year.
2. To impart knowledge and skills to deal with the technicalities and diverse issues with the food processing technologies.
3. To introduce a flavour of indigenous products
4. To sensitize on various packaging systems

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	Comprehend the basic principles and methods of food processing, reservation and quality.
	CO2	Predict processing and to find a method of preservation in relation to food composition.
	CO3	Discuss and employ quality standards ethics of processed foods.
	CO4	Invent and develop novel food by utilizing local resources of vegetation.
	CO5	Be competent in using local resources for entrepreneurship options

Syllabus

UNIT I **(10 Hours)**

Introduction to post production system – Need for post production of foods- Agents causing food losses- insects, rodents, micro organisms. Food borne illness- bacteria, viruses, parasites, chemicals, biotoxins, outbreak- causes- and burden.Microorganisms required for food fermentations- starter cultures -curds, yoghurt, iddlies, bread

UNIT II **(12 Hours)**

Food laws, food standards and regulations – FSSAI, BSI , ISI, PFA, AGMARK, Milk and Milk Products Order, Fruit Products Order, Meat Products Order, Edible Oils Packaging Order, HACCP,

GMP, Codex Alimentarius, Processed food audits; GM foods- safety and acceptance, Food adulterants and its harmful effects, Detection of common adulterants in foods,Methods and procedure for sampling and testing- Pathogens test & spoilage indicators, chemical test – pesticides, antibiotics, heavy metals; Decision for acceptance/ rejection; Quality management system and ethics. ***Status of food industry in India****

UNIT III (15 Hours)

Food processing: Primary processing- Rice, wheat and pulse milling - traditional and commercial milling processes- brief description; Applications in traditional Indian foods

Secondary Processing- Milk – processing of sterilised milk, condensed milk, flavoured milk, toned milk, milk powder, khoa, icecream, butter, ghee, cheese – brief description; meat processing- salting, smoking, curing- brief description. ***Application of khoa, butter, ghee and meat in traditional Indian foods*.***

UNIT IV (15 Hours)

Egg Processing- Liquid eggs, dried and powdered eggs; Thermal processing- Canning of foods- brief description of steps, spoilage in canned foods-flat sour, toxic spoilage, hydrogen swell, metallic spoilage; Freeze drying of foods; Chemical preservatives- types and applications; food irradiation- doses, safety of irradiated foods. Convenience foods - Ready to Eat, Ready to Serve. ***Local food processing industries- Banana, Coconut and Corn based products in Coimbatore*.***

UNIT V (13 Hours)

Packaging- Introduction, Functions, Classification – unit pack, intermediate pack, bulk pack; Materials used for packing – glass containers, metal containers, caps and closures, composite containers, wooden crates, fibre board drums, plastics, retortable pouches, micro ovenable packages, vacuum packaging, shrink wrap packaging, nano packaging; Labeling- Requirements. Product Communication, nutrient labeling and claims; Shelf life prediction of foods in packages. ***Traditional packaging and storage of foods*.***

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Textbooks

1. Shakuntalamanay, V., and ShadaksharaSwamy, M.(1987). Foods: Facts and Principles.New Age International Pub. (P) Limited.
2. Srilakshmi, B.(2007). Food Science.New Age International Pub (P) Limited.
3. Eckles, E., Comb, M., and Macy, CM. (1972). Technology of Indian Milk products. Tata McGraw Hill.
4. Khade, V. (1999). Text Book on Foods Storage and Preservation.Kalyani Publ.

References

1. Goldberg, I. (1994). Functional foods. Chapman & Hall.
2. Lopez, GF., and Conovas,BGV.(2003). Food Science and Food Biotechnology. CRC Publ.
3. Byong, LH. (1996). Fundamentals of food Biotechnology. VCH Publ.
4. Sukumar D.(2001). Outline of Dairy technology, (1st edition). Oxford University Press.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	H	M
CO2	S	M	H	M	H
CO3	M	H	M	M	M
CO4	H	L	M	M	M
CO5	L	L	M	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT1E1		Major Elective 1- Plant therapeutics and phytoproducts		
Batch 2022-2023	Semester I	Hours / Week 5	Total Hours 65	Credits 5

Course Objectives

1. To understand the basics and applications of natural products
2. To comprehend the various phytomolecules in plant systems
3. To analyze and improve the standards and formulation of natural products in pharmaceutical industry
4. To study the role of natural products as nutraceuticals

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1 ↑	CO1	Discuss the extraction methods of several natural products
	CO2	Illustrate the screening, isolation and characterization of phytocompounds
↓	CO3	Examine the mode of action of natural products in pharmaceutical and cosmetic industry
	CO4	Deploy the advanced methods for formulating drugs from natural origin
K5	CO5	Comprehend the regulatory aspects in plant therapeutics

Syllabus

UNIT-I (12 Hours)

Sources of crude drug: Plant, marine and other biological organisms. Methods of extractions: Infusion, decoction, maceration, percolation, hot continuous extraction, successive solvent extraction, supercritical fluid extraction, steam distillation, counter-current extraction, ultrasound extraction (Sonication) and solid phase extraction. **Parameters for selection of suitable extraction process***

UNIT-II (18 Hours)

Preliminary phytochemical screening: Alkaloids – Identification, classification and bioactive properties; Saponins – Extraction, isolation, structure determination and bioactive properties; Flavonoids – Identification, classification and isolation and pharmacological properties; Cardenolides and bufadienolides, Tannins and other polyphenols, Cynogenetic glycosides – Detection and isolation;

Anthraquinones, Coumarins and Lignans – Properties, classification and isolation; Amino acids and tripeptides – Properties, isolation, and characterisation.

UNIT-III **(13 Hours)**

Essential oil: Extraction – Hydrodistillation (Clevenger) and steam distillation; Sesquiterpene: Properties, isolation and its application in pharmaceutical and cosmetic industry; Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil. Herbal cosmetics: Importance of herbals as shampoos (soapnut), conditioners and hair darkeners, (amla, henna, hibiscus, tea); skin care (aloe, turmeric, lemon peel, vetiver); Colouring and Flavouring agents from plants.

UNIT-IV **(10 Hours)**

Nutraceuticals and Health Foods: Classification of Nutraceuticals, Health foods: Source, Chemical constituents, uses, actions and commercial preparations of following health foods: Alfalfa, Bran, Angelica, Chamomile, Corn oil, Fenugreek, Feverfew, **Garlic**, Ginseng, Ginkgo, Honey, Hops, Safflower oil, **Soyabean Oil,Turmeric**; Concept and examples of Adaptogens.

UNIT-V **(12 Hours)**

Important therapeutic classes and its associated natural products: antimicrobial, antidiabetic, hepatoprotective, immmunomodulators and anti-cancer; Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeia guidelines - Extractive values, ash values, determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations; **Role of CCAD (Computer Aided drug Discovery) in natural drug preparation.***

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Rensheng Xu *et al*., (2010). Introduction to Natural Products Chemistry. (1st Edition). CRC Press. Taylor and Francis Group, NW.

2. Bramachari, G. (2015). Bioactive Natural products - Chemistry and Biology. Wiley-VCH Verlag GmbH & Co.DOI:10.1002/9783527684403
3. Colegate, MS and Molyneux, MR. (2008). Bioactive Natural Products. (2nd Edition). CRC Press, Taylor and Francis Group, NW.
4. Krishnaswamy, NR. (1999). Chemistry of Natural Products: A Unified Approach, University Press (India) Ltd., Orient Longman Limited, Hyderabad.

Reference Books

1. Agrawal, SS. (2007). Herbal drug technology. (1st Edition). Universities press.
2. Kashi, AR. (2013). Industrial Pharmacognosy. (1st Edition). Universities press.
3. Varghese, KM. (1998). Indian Herbal Pharmacopoiea. Medical Books Distributors & Publishers.
4. Tandon, N., Saraswathy, A., Kumar, SKN and Shakila, R. (2012). Quality Standards of Indian Medicinal Plants.ICMR, New Delhi.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	L	L
CO2	S	M	L	L	M
CO3	M	M	M	M	L
CO4	H	L	L	M	L
CO5	M	L	M	H	S

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT2E2		Major Elective II -Research Methodology		
Batch 2022-2023	Semester II	Hours / Week 5	Total Hours 65	Credits 4

Course Objectives

1. To identify the overall process of designing a research study from its inception to its report.
2. To distinguish a purpose statement, a research question or hypothesis, and a research objective.
3. To describe and express the role and importance of research in basic and applied sciences
4. To Design an action plan of research and acquire skills of writing a research manuscript

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Evaluate literature, form a variety of sources, pertinent to the research objectives.
↕	CO2	Identify and justify the basic components of the research framework, relevant to the tackled research problem
	CO3	Raise awareness of crucial aspect of the nature of Knowledge and the value of scientific method
	CO4	Appreciate the components of scholarly writing and evaluate its quality
K5	CO5	Perform a standard and outcome based research in niche areas

Syllabus

Unit I **(13 Hours)**

Research Methodology- Characteristics, Research and Scientific method, Types of research- Descriptive vs Analytical, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research, Research Questions, Research Process, Research Design- Features, Inductive, Deductive and Development of models Developing a Research Plan – Exploration, Description, Diagnosis, Experimentation, **Determining Experimental and Sample Designs.***

Unit II **(13 Hours)**

Literature review- Review concepts and theories, Its Relevance and Importance in Directing Research, Analysis of Literature Review – Primary and Secondary Sources, Web sources –critical Literature Review, Citations –Types of Citations, Bibliography and End Matters, Editing and Proof Reading,

Research Problem, Identification and Formulating the Research Problem, Action Plan, Design and Pilot Study Undertaking a Research Project; Hypothesis – framing and designing hypothesis for research problem.

Unit III **(13 Hours)**

Data Collection- Methods, Sampling- Types and techniques, Sample error, Sources of Data- Primary, Secondary and Tertiary Sources, Types of Data - Categorical, nominal & Ordinal, Methods of Collecting Data : Observation, field investigations, Direct studies – Reports, Records or Experimental observations, Sampling methods – Data Processing and Analysis strategies- Graphical representation – Descriptive Analysis – Inferential Analysis- Correlation analysis – Least square method - Data Analysis using statistical package; Generalization and Interpretation – Modeling.

Unit IV **(13 Hours)**

Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports - Illustrations and tables, Importance of Effective Communication, Writing papers and posters- Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, h-index, i-10 index; Format of thesis writing. Writing a Research grant Proposal- Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – **Budget and Justification – References***

Unit V **(13 Hours)**

Paper critiquing- the Purpose and the Methodology of Paper Critiquing, Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Penalty for plagiarism, Ethical Issues — Ethical Committees, Reproduction of published material, Reproducibility and accountability, Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/ Mendeley, **Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism*.**

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books:

1. Gopalan, R. (2005).Thesis Writing. India: Vijay Nicole Imprints Private Limited,
2. Gurumani, N. (2010) Research Methodology for Biological Sciences. India MJ Publishers,.
3. Kothari C R. (2009). Research Methodology, Methods and Techniques. India: Wishwa Prakashan

Reference Books:

1. Chawla, Deepak & Sondhi, Neena (2011). Research methodology: Concepts and cases, Vikas, Publishing House Pvt. Ltd. Delhi.
2. Pawar, B.S. (2009). Theory building for hypothesis specification in organizational studies, Response Books, New Delhi.
3. Neuman, W.L. (2008). Social research methods: Qualitative and quantitative approaches, Pearson Education.
4. Wallinman, N. (2006). Your Research Project: A step-by-step guide for the first-time researcher. London: Sage Publications.
5. Leedy, P. D. (1980). Practical Research: Planning and design. Washington: Mc Millan Publishing Co., Inc.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	L	L
CO2	H	M	M	M	M
CO3	M	M	M	H	L
CO4	H	M	L	M	L
CO5	M	H	M	H	S

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT2E2		Major Elective II- IPR, Biosafety and Bioethics		
Batch 2022-2023	Semester II	Hours / Week 5	Total Hours 65	Credits 4

Course Objectives

1. To disseminate fundamentals of Intellectual Property Rights to students
2. To impart the importance of IPR laws and to encourage students in the novel creation to meet the biotechnological demands.
3. To educate students about the principles and conflicts in bioethics
4. To perceive the various IPR convention and their utilities in biotechnology innovation.
5. To employ the basics of biosafety measures to maintain the biological integrity between the ecology and human health.

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Apply skills of critical thinking, reading, understanding, explaining and applying IP-related statutes and IP-related cases
↕	CO2	Analyse ethical and professional issues which arise in the intellectual property law context
	CO3	Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyze the social impact of intellectual property law and policy
K5	CO4	Facilitate the students to explore career options in IPR
	CO5	Be competent in evaluation of safety and ethical standards in biology

Syllabus

Unit I **(13 Hours)**

Intellectual Property: Concepts, Kinds of Intellectual Property: Patents, Copyrights©, Designs, Trademarks™, Trade Secret (TS), Geographical Indication, Need for Private Rights versus Public Interests Advantages and Disadvantages of IPR, Criticisms of Intellectual Property Rights Politics of

Intellectual Property Rights Third World Criticisms Marxist Criticisms, International Regime Relating to IPR TRIPS and other Treaties (WIPO,WTO, GATTS).

Unit II **(13 Hours)**

Patents- Concepts, Novelty, Utility, Inventiveness/Non-obviousness, Patentable subject matter, Patentability criteria, non-patentable inventions Patent filing procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Rights of patentee Procedure for granting a patent and obtaining patents Grounds for opposition Working of Patents, Compulsory License Acquisition, Surrender, Revocation, restoration Transfer of patent rights, **Precautions while patenting–disclosure/non-disclosure***

Unit III **(13 Hours)**

Patent Infringement and Litigation - International Patent Law - Double Patenting, Patent Searching - Patent Cooperation Treaty - New developments in Patent Law. Financial assistance for patenting-introduction to existing schemes, Examples of Patents in Biotechnology- From US: Transgenic animal, Polymerase Chain reaction (PCR), HIV Protease inhibitor, Examples from India: Patenting in drugs, Herbal remedies;

Case studies in IPR- Neem, Turmeric, Basmati, *Bt* Brinjal, *Bt* Cotton.

Unit IV **(13 Hours)**

Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding, biotechnology in international relations, globalization and development divide. Introduction to bioethics: Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology,

Group Discussion: bioethics vs business ethics.

Unit V **(13 Hours)**

Biosafety issues in biotechnology-historical background; Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels- Specific Microorganisms; Infectious Agents and Infected Animals, Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and

communication; **Overview of National Regulations and relevant International Agreements including Cartegana Protocol.***

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books:

1. IPR, Bio safety and Bioethics by Deepa Goel and Shomini Parasha
2. Intellectual property rights by Dr. Reddy

Reference Books:

1. Vaughn, L. (2020). Bioethics: Principles, issues, and cases. New York, N.Y: Oxford University Press.
2. Krishna, V. S. (2011). Bioethics and Biosafety in Biotechnology. New Delhi: New Age International Ltd.
3. Sibley. (2007). Law and Strategy of biotechnological patents Butterworth publication. ISBN: 075069440, 9780750694445.
4. Ganguli (2001) Intellectual property rights- -Tat Mc Grawhill. ISBN-10: 0074638602,
5. Wattal. (1997). Intellectual Property Right-Oxford Publication HouseISBN:0195905024

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	H	S
CO2	S	H	H	H	M
CO3	S	H	S	S	S
CO4	H	M	M	H	S
CO5	M	M	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT2E2		Major Elective II-Marine and Algal Biotechnology		
Batch 2022-2023	Semester II	Hours / Week 5	Total Hours 65	Credits 4

Course Objectives

1. To familiarize the students on marine natural products and its bioactive compounds
2. To provide insights on algal production and its importance.
3. To explain the applications of marine and algae in an environment and medicines.
4. To introduce various methods of applications of aquaculture

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	Explain about the production of bioactive compounds and marine natural product.
	CO2	Investigate the application of Genetic Engineering in the marine science
	CO3	Describe importance of aquaculture Biotechnology
	C04	Explain about algal cultivation and its importance
	CO5	Employ methods of resource mobilization and usage for product production

Syllabus

Unit 1 **(10 Hours)**

Marine natural products: Agar agar, Alginate carrageenan, Chitin, Chitosan. Marine lipids, marine flavourants, lectins, heparin, carotenoids. metagenomic strategies for natural product discovery

Unit II **(10 Hours)**

Marine Pharmacology: Identification of bioactive compounds containing marine organisms – Extraction of bioactive compounds. Screening, standardization of marine drugs. potential pharmacological uses of phyco-toxins Need and potentialities of marine drugs.

Unit III **(15 Hours)**

Bioremediation and Biofouling: Marine pollutants – Bioremediation – CMO in bioremediation – Aquaculture effluent treatment – Biofouling organisms and their control, Biosensors for monitoring marine contaminants

Unit IV **(15 Hours)**

Aquaculture Biotechnology: Application of Genetic Engineering – Production of transgenic fish – disease diagnosis, Freeze resistant fish – **Cryopreservation techniques*** – Broodstock management and larval raring – Feed technology – Prebiotics & probiotics. Green fluorescent protein (GFP) & red fluorescent protein (RFP) characteristics and their applications

Unit V **(15 Hours)**

Algal production : Culture media, Large-scale cultivation of algae, Harvesting and Drying.Single cell protein – Chlorella. Use of algae in agriculture, space research and medicine. **Role of algae in nanobiotechnology***

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Textbooks

1. Se-Kwon Kim (2019), Essentials of Marine Biotechnology, Springer Publications
2. Pomponi, SA. (1999). The Potential for the Marine Biotechnology Industry. In Trends and Future Challenges for U.S. National Ocean and Coastal Policy. DIANE Publishing: Delaware, USA. 143 pages.
3. Bilgrami K.S and Saha L.C (2012). A textbook of Algae. CBS Publishers and Distributors Pvt Ltd. Delhi.

References

1. De Jesus-Ayson, EG. (2011). Trends in Aquaculture and Fisheries Biotechnology: Current Applications in the Philippines. In Selected Reviews in Biotechnology: Livestock, Forestry, and Fisheries. ISAAA and BCP: Philippines. 246.
2. Marine Biology- Lalli C.M. and T.R. Parsons., (2006). 2nd Edition. Biological Oceanograpahy - An Introduction, Elsevier, 314.
3. Sporne (2012). 2nd Edition, Bryophytes- Hutchinsan & Co.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	S	H
CO2	S	H	H	M	H
CO3	S	H	H	H	H
CO4	M	M	M	H	M
CO5	M	H	H	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PB2TE2		Major Elective II – Total Quality Control and Management		
Batch 2022-2023	Semester II	Hours / Week 5	Total Hours 65	Credits 4

Course Objective

1. To facilitate the understanding of Quality Management principles and process.
2. To understand the different components in management, customer - supplier relationship and services.
3. To learn the elements of quality systems and quality auditing.

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	To overview the basic knowledge of total quality management principles and concepts of Current Biotech Industries.
	CO2	To predict the customer orientated quality and leadership and continuous improvement process and supplier selection and management.
	CO3	To discuss six sigma concept methodology and application and the TQM tools.
	CO4	To invent and develop novel design of quality systems of ISO auditing in the field of Biotechnology.
	CO5	Apply TQM principles in biotechnology research and industry

Syllabus

UNIT I **(13Hours)**

Introduction: Need for quality – Evolution of quality – Definition of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II **(13Hours)**

*TQM Principles:*Quality statements – Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Continuous process improvement – PDCA cycle, 5s, Kaizen- Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III **(13Hours)**

***TQM tools & techniques* I:**The seven traditional tools of quality – New management tools – Six-sigma:

Concepts, methodology, applications to manufacturing.

UNIT IV **(13Hours)**

Benchmarking: Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V **(13Hours)**

Quality systems: Need for ISO 9000 and Other Quality Systems, ISO 9000 : 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing. ***Environmental Management System: QS 9000, ISO 14000 – Concept, Requirements and Benefits*.*** Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP) in Pharmaceutical Industries, Guidelines on Application in Food and Drink Industry

**** denotes Self study***

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Textbooks

1. Dale H. Besterfiled, et al., (1999) Total Quality Management, Pearson Education Asia. (Indian reprint 2002).

References

1. Suganthi, L., & Samuel, A. A. (2006). Total quality management. New Delhi: Prentice-Hall of India.
2. Evans, J. R., & Lindsay, W. M. (2012). The management and control of quality. Andover: Cengage.
3. Feigenbaum, A. V. (1991). Total quality control. New York [etc.: McGraw-Hill.
4. Oakland, J. S. (2014). Total quality management: Text with cases. London.
5. Sreenivasan, N. S., & Narayana, V. (2005). Managing quality: Concepts and tasks. New Delhi [u.a.: New Age International.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	S
CO2	S	H	H	H	M
CO3	S	H	S	S	S
CO4	M	M	M	H	S
CO5	M	M	M	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 22PBT3X1		Extra Departmental Course – Business ventures in Biosciences		
Batch 2022-2023	Semester III	Hours / Week 2	Total Hours 30	Credits 4

Course Objectives

1. Provides a more refined procedural road map for non-bioscience students who are interested in starting their own companies in bio sectors
2. To strengthen students' skills to commence their biotechnology company from its earliest stages to self-sustainable model
3. Provide students with a broad coverage of key areas of modern biotechnology and a basic understanding of business and finance issues.
4. Coupling of entrepreneurship with scientific innovation.

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Evaluate ideas and innovations that could be viable for a business
↑	CO2	Decipher and comprehend the ever changing scenario of Biotechnology industry
	CO3	Possess skills including idea evaluation, elevator pitching, intellectual property strategies, feasibility analysis, market assessments, regulatory approval, funding cycles, business planning, team formation, and financial planning
↓	CO4	Possess personal motivations in choosing potential next steps for commercialization
K5	CO5	Establish and sustain a bio business enterprise

Syllabus

Unit I **(6 Hours)**

Introduction to Biotechnology Start ups/industries, Mechanics of forming a company

Commercialization Knowledge Survey (CKS) : review and knowledge survey of biotechnology industry, entrepreneurship, intrepreneurship, and Lean Launchpad methodology (LLP)

Case Study: Identifying a local need based on availability of resources and raw materials from Coimbatore District

Unit II **(6 Hours)**

Qualities and skills of an entrepreneur -Resources required for a business -Project formulation, evaluation and feasibility analysis -Idea generation -Market research -Project selection -Project evaluation using appropriate industry standards -Business planning -Importance, purpose and efficiency of a plan -Business acquisition, franchising and outsourcing -Legal, ethical and environmental considerations of the entrepreneurial venture.

Group Activity: Students shall bring out a business plan/model for a biological product made from local resources like products from a vegetable/food processing industry etc..

Unit III **(6 Hours)**

Different models of biotechnology start ups., Overview of business regulation by the government -Inspection, Licensing -Patent, **trademark*** and intellectual property rights registration and accreditations

Activity: Prepare a report for filing a design patent for an industrial product. Prepare a draft for filing patent for an indigenously made product

Unit IV **(6 Hours)**

Financial considerations of entrepreneurship Funding for the business proposal − Government and non-government opportunities for funds and resources. − Franchising opportunities Product pricing and profit generation − Tools of analysis of costing, cost control and budgeting Accounting procedures and financial statements. Investing resources into the business Corporate Social Responsibility

Unit V **(6Hours)**

Marketing and Marketing Management process -Concepts of marketing -Channels of distribution -Market Research and Marketing strategies -Market segmentation, targeting and positioning -Novel and innovative product /service development -Brand development and promotion Concepts of Human Resource Management -Recruitment and selection -Training and development -Performance appraisal -Personnel action, retention and productivity improvement -Overview of Labour management and relations. -**Supply Chain Management***

Activity: Draft a complete business brief.

***Denotes self study**

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text books:

1. Tripathi, PC., and Reddy, PN. (2010). Principles of Management. (6th Edition). Tata McGraw Hill.
2. Khanka, SS. (2018). Entrepreneurship Development hand & Co. S Chand & Co.
3. Puri, RS., and Viswanathan, A. (2009). Practical Approach to IPR. IK Intl. Ltd.
4. Cornish, WR. (1999). Cases and Materials on Intellectual Property. (3rd Edition). McWell.

References:

1. Jeffrey A. Timmons., Zacharakis, A., and Spinelli, S. (2004) Cynthia Robbins-Roth: From Alchemy to IPO: The Business of Biotechnology. Business Plans That Work: A Guide for Small Business. (2nd Edition). McGraw Hill.
2. John A. Tracy. (2009). How to Read a Financial Report: Wringing Vital Signs out of the Numbers. John Wiley & Sons, Hoboken, NJ.
3. Shimasaki, C. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Elsevier Inc.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	S
CO2	M	M	s	H	S
CO3	L	L	S	S	S
CO4	L	L	M	H	H
CO5	M	L	S	H	S

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc., Biotechnology		
Course code: 22PBT3N1		Non Major Elective (on-line) - Aptitude and reasoning I		
Batch 2022-2023	Semester III	Hours / Week 2	Total Hours 27	Credits 4

Course Objectives

1. To introduce the concept of reasoning ability, research aptitude, and general awareness to the students.
2. To develop divergent thinking and motivate the students to participate in various competitive examinations
3. To prepare the students to face the challenges of the competitive exams
4. To train students by advancing, verbal and quantitative skills

Course outcomes

After completion of the course, the students will be able to:

K1	CO1	The ability to analyse a logical problem and to identify the appropriate resolving technique.
↕	CO2	The ability to use current skills, and tools necessary for Aptitude glitches.
	CO3	Students are asked to remember concepts in a short way.
	CO4	The ability to recognize the need for continuing professional development.
K5	C05	Increase in analytical nature to apply the scientific knowledge to arrive at the solution to the given scientific problem

Syllabus

Unit I **(5 hours)**

Data Interpretation and Graphical Analysis: Mean, Median, Mode, Measures of Dispersion, Graphical Analysis: Bar Graph, Line Graph, **Pie-Chart***, Tabulation.

Unit II **(5 hours)**

General Reasoning : Analytical Reasoning, , Classification, Alphabet Series, Analogies, Number Series, Arrangements ,Statements, **Data Sufficiency***, Graphical Analysis, Data Analysis

Unit III **(5 hours)**

Logical Reasoning : Syllogisms, Directions, Symbols and Notations, Similarities and Differences, Blood Relationships, Non-verbal Reasoning, Visual Ability, Coding-Decoding.

Unit IV **(6 hours)**

Numerical Ability: Number and Simplification, LCM and HCF, Average, Sequence and Series, Surds and Indices, Logarithms, Time Speed and Distance, Time and Work, Permutations and Combinations, Probability,

Unit V **(6 hours)**

Quadratic Equations, Percentage, Profit and Loss, Simple Interest, Compound Interest, Ratio, Proportion and Variation, Partnership, Alligation, and Mixture, Geometry, Mensuration, Trigonometry, etc.

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Textbooks

1. Nagesha, A., Kumar, P., & Hossain, Q. J. (2019). NTA CSIR UGC NET/SET (JRF & Lectureship) Life sciences. Arihant Publications (India) Limited. New Delhi:
2. Nagesh, A., Prashant, K., & Hossain, Q. J. (2012). UGC CSIR NET/SET (JRF & LS) Life Sciences. Arihant Publications.New Delhi:

References

1. Aggarwal, R. S. (2001). Quantitative aptitude: For competetive examinations (Fully solved). S. Chand & Co. New Delhi:
2. Chaudhary, B., Choudhary, K., & Chaudhary, A. (2011). CSIR-Net Life Sciences. Sure Success Series. New Age International Ltd. New Delhi:

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	S	M	H
CO2	M	H	S	M	H
CO3	M	L	S	H	H
CO4	M	M	S	M	H
CO5	M	L	S	H	H

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc., Biotechnology		
Course code: 22PBT3N2		Non Major Elective (on-line) – Cancer Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2022-2023	IV	2	30	4

Course Objectives

1. To introduce the overview and causes of cancer
2. To develop chance to learn molecular mechanism and cellular events in cancer progression
3. To understand the diagnostic procedure and treatment of cancer

Course outcomes

After completion of the course, the students will be able to:

K1	CO1	Develop the knowledge of causative agents of cancer
↕	CO2	Integrate the cellular events and signaling mechanism for cancer progression
	CO3	Comprehend the molecular basis for cancer
	CO4	Discuss the advanced diagnostics tools to detect the early onset of cancer
K5	C05	Invent and apply alternative strategies to treat cancer

Syllabus

Unit 1 **(5 hours)**

Overview of Cancer: Cancer incidence and mortality; Origin of neoplastic cells; Cancer as cellular disease; Types of Cancer: Benign Tumors Vs. Malignant Tumors, Common Symptoms, Causes of Cancer: Chemical Carcinogenesis; Irradiation Carcinogenesis; **Oxygen Free Radicals***, Aging and Cancer

Unit 2 **(7 hours)**

Cell Cycle Regulation and Cell Signaling in Cancer: Growth Characteristics of Malignant Cells; Cell Cycle Regulation; Evasion of Apoptosis (Programmed Cell Death); Growth Factors; Signal Transduction Mechanisms-G protein linked receptors, The phosphoinositide 3-kinase pathway, mTOR, Tyrosine kinase pathways, JAK-STAT pathway, Estrogen receptor pathway, Hypoxia-inducible factor, Tumor necrosis factor receptor signaling, Tumor growth factor-β signal transduction, Heat shock protein mediated events

Unit 3 **(6 hours)**

Molecular Genetics of Cancer: Molecular Basis of Cancer-DNA Methylation and Cancer; Loss of Heterozygosity; Telomeres and Telomerase; Oncogenes, Tumor Suppressor Genes: pRb and p53, DNA

Tumor Viruses - V40 and Polyoma, Papilloma Viruses E6 and E7, Adenoviruses E1A and E1B, Hepatitis B Virus and Herpes Viruses.

Unit 4 **(6 hours)**

Cancer diagnosis: Screening methods; conventional and new visualization Techniques - Histopathology, X-ray, CT-Scan, MRI, PET; Molecular Screening and early detection - Cytogenetics, molecular cytogenetics and array based techniques;Cancer markers: promises and challenges, genomic and proteomic technologies in targeting cancer

Unit 5 **(6 hours)**

Cancer therapeutics: Chemotherapy, Surgery and Radiation Therapy; Mechanism, FDA approved Anticancer drugs and **FDA approval procedures***, Cancer immunotherapy, Therapeutic Screening: Role of cell lines, chemically induced models, knockout mouse model, Xenograft models, patient-derived xenografts (PDXs), Futuristic cancer therapeutics approaches

denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Book

1. Robert A. Weinberg (2017). The biology of cancer. 2nd Edition. W.W. Norton & Company, US

References:

1. Cancer Biology, Raymond W. Ruddon, 2007, 4th edition, Oxford University Press
2. Molecular Biology of Cancer by F. Macdonald, C.H.J. Ford, and A.G. Casson; Garland Science / Bios Scientific Publishers
3. Molecular Biology of Human Cancers by Wolfgang Arthur Schulz Springer
4. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics 2nd Ed. By Lauren Pecorino. Oxford University Press.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	H	H
CO2	S	M	M	L	M
CO3	H	L	M	L	L
CO4	H	S	M	L	L
CO5	H	S	L	M	M

S – Strong **H – High** **M – Medium** **L – Low**

Programme code: 08		Programme title: M.Sc., Biotechnology		
Course code: 22PBT3N2		Non Major Elective (on-line) – Nutraceuticals		
Batch 2022-2023	Semester IV	Hours / Week 2	Total Hours 30	Credits 4

Course Objectives

1. To explain the nutraceutical concepts and classification and their role in human health
2. To understand the plant and animal origin and explain the health benefits of functional foods
3. To explain the importance of nutraceuticals in disease prevention

Course outcomes

After completion of the course, the students will be able to:

K1 ↕ K5	CO1	Develop the knowledge on relation of nutraceutical Science with other sciences
	CO2	Identify the different sources of nutraceuticals, their extraction methods, and their metabolism
	CO3	Discuss the concepts and extraction of marine and algal nutraceuticals
	CO4	Discover various food products that are used as nutraceuticals in making functional foods
	C05	Relate the role of various nutraceuticals in combating major health problems such as diabetes, obesity, cardiovascular diseases, cancer, and osteoporosis

Syllabus

Unit I **(5hours)**

Introduction to Nutraceuticals: The concept and classification of nutraceuticals, dietary supplements, fortified foods, functional foods, scope involved in the industry- **Indian and global scenario***. Relation of nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition.

Unit II **(5hours)**

Nutraceuticals of plant and animal origin: Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids. Extraction and purification, applications with specific examples with reference to skin, hair, eye, bone, muscle and General health. Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine,

chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment.

Unit III **(5hours)**

Microbial and Algal nutraceuticals: Concept of prebiotics and probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, Symbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment.

Unit IV **(5hours)**

Biotechnology in Phytonutraceuticals: Role of medicinal and aromatic plants in nutraceutical industry – propagation - conventional and tissue culture, cultivation, post harvest technology and strategies for crop improvement, development of high yielding lines and yield enhancement, plant genomics and metabolomics. Concept of nutrigenomics

Unit V **(5hours)**

Nutraceuticals in disease prevention: Nutraceuticals for- cardiovascular health, HIV and cancer risk reduction, bone and joint health, diabetes, hypertension, hypercholesterolemia, immune system, oxidative stress, cognitive function, **anti-aging***, maternal and infant health, gut health, reproductive health.

Denotes self study

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text books

1. Bagchi D, Preuss HG, Swaroop A (2015) Nutraceuticals and Functional Foods in Human Health and Disease Prevention, CRC Press.
2. Paul Insel , Don Ross, Kimberley McMahon, Melissa Bernstein 4rth edition. 2012. Discovering Nutrition. Jones and Bartlett Publishers, Inc;

References

1. Mine Y, Li-Chan E, and Jiang B (2010) Bioactive Proteins and Peptides as Functional Foods and Nutraceuticals, Blackwell Publishing Ltd.

2. Hurst WF (2010) Methods of analysis for functional foods and nutraceuticals. Taylor & Francis Group, CRC Press.
3. Catherine Sanderson and Mark Zelman. 2015. EssentIal Health, 1st EdItIon.G-W publIshers

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	L	M
CO2	H	M	M	M	L
CO3	M	L	L	M	M
CO4	S	S	M	L	L
CO5	H	S	M	M	M

S – Strong **H – High** **M – Medium** **L – Low**

Programme Code: 08	M.Sc Biotechnology		
Course Code: 22PGI4N2	Non-Major Elective Paper : Information Security		
Batch 2022-2023	Hours/Week 4	Total Hours 60	Credits 4

Course Objectives

1. Students will identify the core concepts of Information security.
2. To examine the concepts of Information Security.
3. To design and implement the security features for IT and Industrial sectors.

Course Outcomes (CO)

K1	CO1	To Learn the principles and fundamentals of information security.
K2	CO2	To Demonstrate the knowledge of Information security concepts
K3	CO3	To Understand about Information Security Architecture.
K4	CO4	To Analyze the various streams of security in IT and Industrial sector.
K5	CO5	To know about Cyber Laws and Regulations.

UNIT I **(12 Hours)**

Information Security basics: Definition of Information Security - History of Information Security - Characteristics of Information Security - Components of Information Security - Security System Development Life Cycle (SDLC).

Information Security for technical administrators: Server Security – Network security- Social Media Security.

UNIT II **(12 Hours)**

Cryptography: Basic concepts - plain text - Cipher text - Encryption Principles - CRYPT Analysis - Cryptographic Algorithms - Cryptographic Tools – Authentication -Biometrics* - passwords - Access Control Devices - Physical Security - Security and Personnel.

Language-based Security: Analysis of code for security errors, Safe language and sandboxing techniques.

UNIT III **(12 Hours)**

Firewalls, Viruses & Worms & Digital Rights Management : Viruses and Worms-Worms - Digital Rights Management – Firewalls - Application and Circuit Proxies - Stateful Inspection - Design Principles of Firewalls.

Logical Design: Access Control Devices- Physical Security-Security and Personnel - NIST Models- VISA International Security Model- Design of Security Architecture-Planning for Continuity.

UNIT IV **(12 Hours)**

Hacking : Introduction – Hacker Hierarchy – Password cracking – Phishing - Network Hacking - Wireless Hacking - Windows Hacking - Web Hacking*- Ethical Hacking.

Security Investigation: Need for Security- Business Needs-Threats- Attacks- IP Addressing and Routing - Social Media

UNIT V **(12 Hours)**

Cyber Laws : What is Cyber Law? - Need for Cyber laws - Common Cyber Crimes and Applicable Legal Provisions: A Snapshot - Cyber Law (IT Law) in India – The Information Technology Act of India 2000 - Cyber Law and Punishments in India - Cyber Crime Prevention guide to users – Regulatory Authorities.

***Self study questions for examination may be taken from the self-study portions also.**

Teaching Methods:

Chalk and Talk, Power point presentation, Seminar, Brainstorming, Assignment, Google Classroom.

Text Book:

Information Security –Textbook prepared by KONGUNADU ARTS AND SCIENCE COLLEGE, Coimbatore -29, 2022.

Reference Books:

1 Charles P Pfleeger and Shai Lawrence Pfleeger, **"Security in Computing",** Fourth & Third Edition, Prentice Hall, 2007 & 2011.

2 Ross J. Anderson and Ross Anderson, "Security Engineering: A guide to building Dependable Distributed System", Wiley,2009.

3 Thomas R. Peltier, Justin Peltier and John Bleckley, "Information Security Fundamentals",2nd Edition, Prentice Hall 1996.

4 Gettier, Urs E. Information Security: Strategies for Understanding and Reducing Risks John Wiley & Sons, 2011.

5 "Principles of information security". Michael Whiteman and Herbert J. Mattord,2012.

6 Information security -Marie wright and John kakalik,2007.

7 Information security Fundamentals- Thomas R. Peltier, Justin Peltier and John Blackley-2005.

8 Information Security theory and practical PHI publication, Dhiren R. Patel-2008.

9 Debby Russell and Sr.G.T. Gangemi," computer Security Basics,2nd edition, O'Reilly Media,2006.

MAPPING

PSO/ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	S	S
CO2	M	H	H	S	H
CO3	H	S	S	M	S
CO4	H	M	H	S	H
CO5	H	S	H	S	H

Programme code: 08		**Programme name:** M. Sc. Biotechnology		
Course code: 22PBT4Z1		Project and Viva voce		
Batch: 2022-2023	**Semester** IV	**Hours / Week** 23	**Total Hours** 95	**Credits** 8

Course objectives

- To inculcate strong sense of research attitude
- To plan hypothesis design and execute experiments
- To analyse and interpret the results
- To present the research in a standard dissertation format

Work Instructions

- Each student will be allotted to the teaching faculty in a Department based on random lot
- The topic of the project work will be finalised by the respective guide either solely or in consultation with an industrial personnel provided a memorandum of understanding exists
- The student must ensure that at least a minimum of 75% wet lab experiments must be done in Biotechnology or related fields. The remaining can be applications of Bioinformatics tools
- If the student is placed in the industry for project, he/she shall submit the progress of the project fortnightly to the respective guide either as a hard or soft copy
- Monitoring of the progression of the project will be done by the respective guides on a continuous basis
- Every student will subject himself or herself to a mid-review on project progression on a date fixed by the Department. This review presentation is mandatory
- The student shall submit the dissertation in the format prescribed by the Department by the end of the fourth semester or a date intimated by the authorities
- The guide and the student shall ensure maximum integrity and shall not go astray in any form
- The dissertation will be subjected to the end semester examination and will be jointly evaluated by internal and external examiner
- Plagiarism in any form shall not be entertained in the dissertation and if found shall invite necessary disciplinary action on grounds of malpractice

Evaluation scheme for project and viva voce examination

Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3	Project Report	60	80
K4	Viva voce	20	
K5			

Project mark breakup

Knowledge Level	Section
K3 ↕ K5	Project Report: Content – 20 Presentation – 20 R&D – 10 Review – 10
	Viva Voce: Layout of presentation – 5 Clarity – 5 Defense – 10

Programme code: 08	Programme title: M.Sc. Biotechnology		
Course code : 22PBT0J1	JOC 1 – Food Safety and HACCP		
Batch 2022-2023	Hours / Week 2	Total Hours 30	Credits 2

Course Objectives

1. To make students understand the basics of food
2. To give a detailed idea about the food safety
3. To analyze the techniques and validate the samples
4. To provide ideas on the technologies of HACCP and application

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Remember the scientific terms by repeated learning
↑	CO2	Understand the concepts with help of videos displayed during class Hours
↓ K5	CO3	Choose the correct method and solve the problem by applying the specific techniques
	CO4	Distinguish even small variations by simple analysis
	C05	Know about the food standard laws and principles of hazards assessment

Syllabus

UNIT I **(6 hours)**

Food chemistry and Nutrition: Importance of food. Scope of food chemistry. Introduction to different food groups: classification and importance.. Carbohydrates-chemical reactions, functional properties of sugars and polysaccharides in foods, chemical make-up, properties, nutritional and industrial importance. Food as substrate for microorganisms: Hydrogen ion concentration (pH), Moisture requirement, Water activity, Oxidation-Reduction potential, Nutrient content, Inhibitory substances and Biological Structure

UNIT II **(6 hours)**

Food contamination and Food spoilage: General principles of food spoilage, Causes, Factors affecting kind and number of microorganism. Chemical changes caused by microorganisms. Spoilage of Meat and Meat products, Egg and Egg products, Fish and Marine products, Cereal and

Cereal products, Fruits and Vegetables. Food Preservation: Physical, Chemical and Biological methods of food preservation. Food borne diseases and their control: Food Infection and Intoxication Fermented foods Traditional fermented foods of India and other Asian countries, Fermented foods based on milk, meat and vegetables, Fermented beverages. Food Quality- Methods of quality, assessment of food materials-fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products. Sanitation and hygiene, GMP, GLP, Statistical quality control. Food laws and standard, PFA, AGMARK, BRC, KSHER.

UNIT III **(6 hours)**

Analytical techniques and Validation. Good Laboratory Practices (GLP), Standard Operating Procedure (SOP), study performance and reporting. Screening and Enumeration of spoilage for microorganisms. Detection of pathogens in food, Rapid detection technique for microorganisms, Carbohydrates Analysis, Protein Analysis, Lipid Analysis, Enzyme Analysis. Modern Food Analysis, Sampling and Data Analysis, Buffers and Titratable Acidity. Sampling and specification of raw materials and finished products, Concept of Codex Alimentarious/USFDA/ISO 9000 series, rules and regulations for waste disposals. Food adulteration and food safety, Mycotoxin and Aflatoxins.

UNIT IV **(6 hours)**

Food Laws and Standards in India a. Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, b. Agricultural Produce Act, 1937 (Grading and Marketing) c. Export (Quality Control & Inspection), Act, 1963 and Rules d. Bureau of Indian Standards relevant to food safety e. Legal Metrology Act f. International Food Control Systems/ Laws, Regulations and Standards/ Guidelines with regard to Food Safety: CODEX (SPS/TBT), OIE, IPPC Planning Organization and set up of Food Analyst Laboratory including NABL/ ISO/IEC17025:2005 a. Accreditation systems and their general requirements b. Measurement of uncertainty - Handling of testing and calibration materials - Testing and calibration methods - Validation of methods c. Reporting and interpretation of results - Data and document control in accreditation process / accredited laboratory

UNIT V **(6 hours)**

HACCP - Introduction, Education and Training, Developing a HACCP Plan, Assemble the HACCP team, the food and its distribution, the intended use and consumers of the food. The seven principles - Conduct a hazard analysis (Principle 1), Determine critical control points (CCPs) (Principle 2),

Establish critical limits (Principle 3), Establish monitoring procedures (Principle 4), Establish corrective actions (Principle 5), Establish verification procedures (Principle 6), Establish record-keeping and documentation procedures (Principle 7), Sensory evaluation-introduction, panel screening, Sensory and instrumental analysis in quality control, IPR and Patents, ISO system – 9001, 14001, 17025 and 22000. Non Conformance Report (NCR).

References:

1. The training manual for Food Safety Regulators. Vol.II- Food Safety regulations and food safety management. (2011) Food safety and Standards Authority of India. New Delhi .
2. Food Microbiology Adams M. A and Moss M. O.Third edition.(2008) ISBN978-0- 85404- 284-5 .
3. Vanderheijden. 1999. International Food safety hand book: Science, International Regulation and control Food Science & Technology).
4. Frazier WC & Westhof DC; Food Microbiology, 3rd Ed., Tata McGraw Hill.
5. Doyle PM et al; Food Microbiology – Fundamentals & Frontiers, 2nd Ed., ASM Press.
6. Pitt J & Hocking. (1985); Fungi & Food spoilage, Academic Press. 5. Sandeep Sareeen; Food Preservation, Sarops & Soni, New Delhi.
7. Food Analysis: Third Edition, S. Suzanne Nielsen. (2003). Official Methods of Analysis. Association of Official Analytical Chemists, 15th ed. (1990). Food Analysis: Theory and Practice. Pomeranz and Meloan, 3rd. ed., (1994).
8. Food Packaging Materials: Testing & Quality Assurance Hardcover – Import, 2017 by Preeti Singh , Ali Abas Wani , Horst-Christian Langowski.
9. Pomeraz, Y. and MeLoari, C.E. (2008) Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.
10. Bryan, F.L. (2007) Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva.
11. Mortimre, S., and Wallace, C., (2005) HACCP: A practical approach, 2nd Ed, Aspen Publicatio

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	H	H
CO2	H	H	H	H	S
CO3	S	H	H	H	H
CO4	H	H	H	H	H

S – Strong **H** – High **M** – Medium **L** – Low

Programme code: 08	Programme title: M. Sc. Biotechnology		
Course code : 22PBT0J2	JOC 2 – Natural Farming, Biofertilizers and Biopesticides		
Batch 2022-2023	Hours / Week 2	Total Hours 30	Credits 2

Course Objectives

1. To understand the concepts of unique model that relies on farmlands rejuvenation
2. To learn the various cost production to nearly zero and return to a green revolution farming
3. To interpret and understand the mechanism and activity of microbes in soil
4. To develop pesticides to control pests by nontoxic mechanism

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	Explaining natural farming to draw chemical free agriculture and to promote traditional Indian Practises
↑	CO2	Understand the usage of cyanobacteria and Azolla in wetland for crop improvement.
K5	CO3	Understand the role of microbes in crop improvement.
	CO4	Analyse the mechanism of solubilisation by phosphobacteria.
↓	CO5	Know about the benefits of using biopesticides to prevent environmental pollution.

Syllabus

UNIT I **(6 Hours)**

Natural Farming: Pure Organic Farming – Definition, Concepts and Benefits. Integrated Farming system – Combination of Organic and Inorganic. Mixed Farming. Zero Budget Natural Farming.

UNIT II **(6 Hours)**

Bacterial biofertilizers: General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Isolation, characteristics, types, inoculum production and field application - *Rhizobium*, *Azotobacter*, *Azospirillum* and *Frankia*.

UNIT III **(6 Hours)**

Algal and Fungal bio-fertilizers: Cyanobacteria, Azolla, Anabaena **-** Isolation, characteristics, types, taxonomy, occurrence and distribution, colonization of VAM, inoculum production and field application of Fungal. Biofertilizers: Mycorrhizae – ecto and endomycorrhiza.

UNIT IV **(6 Hours)**

Phosphate Solubilizers: Phosphate solubilizing microbes – Isolation, characterization, mechanism of phosphate solubilization,mass inoculum production, field application

UNIT V **(6 Hours)**

Biopesticides: History and concept, Definition, Classification, Concept, scope, production and field application - *Bacillus thuringiensis, Trichoderma viride* and Viruses; Biosafety. Advantages of biopesticides over synthetic pesticides, Biostimulants, PGPR and BSFL.

Teaching Methods

Power point presentation/ Google Class Rooms/Smart Class Rooms /Seminar /Quiz /Discussion / Assignment/ Demonstration/ video presentation /Podcast /materials from NDLI/class blended learning/ flipped class

Text Books

1. Bansal and Mamta. Basics of Organic Farming, CBS Publication, 2017
2. Kannaiyan, S. Biotechnology of Biofertilizers, CHIPS, Texas. 2003.
3. Mahendra K. Rai. Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York, 2005.
4. Reddy, S.M. *et al.*, Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers, 2002.
5. Saleem, F. and A. R. Shakoori. Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG, 2012.

Reference Books

1. Deshmukh, A. M., P. P. Dixit and R. M. Khobragade. Handbook of Biofertilizersand Biopesticides. Oxford Book Co., Jaipur, India, 2007.
2. Anirudddh Kumar, Indian Agriculture: Agrarian Crisis, Organic Farming, Conventional Farming & Precision Farming, Shandilya Publications, 2017

3. Giri, B., Ram Prasad, Qiang-Sheng Wu and AjitVarma. Biofertilizers andSustainable Agriculture, Springer Nature Switzerland, 2019.
4. Aggarwal, S.K. Advanced Environmental Biotechnology, APH publication, 2005.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	H
CO2	M	H	S	S	H
CO3	H	M	S	S	S
CO4	M	M	S	S	S
CO5	H	H	M	M	S

S – Strong **H** – High **M** – Medium **L** – Low

Programme code: 08	Programme title: M. Sc. Biotechnology
Course code : 22PBT0D1	ALC. 1 – Forensic Biotechnology
Batch 2022-2023	Credits 2

Course Objectives

1. To emphasize the importance of scientific methods in crime detection.
2. To emphasize the importance of scientific methods in crime detection.
3. To be able to use and apply modern tools, techniques and skills in forensic investigations.
4. To highlight the importance of forensic science for perseverance of the society.

Course Outcomes (CO)

After completion of the course, the students will be able to:

K1	CO1	The student will be able to describe the fundamental principles and functions of forensic science and its significance to human society.
↕	CO2	The student will acquire the skills involving the tools and techniques required for detection of critical assessment
	CO3	Rationalise the significance of biological and serological evidence
	CO4	Explain how forensic entomology assists in death investigations
K5	CO5	The student will be able to demonstrate an integrative approach to environmental issues with a focus on sustainability

Syllabus

UNIT I:

Forensic Science: Definition of Forensic Science, The Role of the Forensic Laboratory, History and Development of Forensic Science in India & Abroad, Pioneers in Forensic Science, Multidisciplinary nature, Forensic Technology solving crimes with advanced technology, Forensic intelligence and Interviews.

UNIT II:

Forensic in Crime Scene: Police and Forensic Science: Relationship between police and forensic expert, Role of Police at the Crime scene, scientific help at crime scene, handling of various types of crime scenes by police, forensic teaching of police personals, forensic case documentation by Police, Ethics in Forensic Science.

UNIT III:

DNA Profiling: Introduction, History of DNA Typing, molecular biology of DNA, variations, polymorphism, DNA Extraction-Organic and Inorganic extraction, Commercial kits DNA typing systems- RFLP analysis, PCR amplifications, sequence polymorphism. Analysis of SNP, YSTR, Mitochondrial DNA -Evaluation of results.

UNIT IV:

Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping, missing person's identity- civil immigration, veterinary, wildlife and agriculture cases, legal perspectives- legal standards for admissibility of DNA profiling, status of development of DNA profiling in India and abroad. New and future technology- DNA chips.

UNIT V:

Recent Trends in Forensic Science- Geo-forensics Global Positioning System; Basic principles and applications, Forensic Entomology: Introduction, Insects of forensic importance, Insects on Carrion, Microbial Forensics : Types and identification of Bacteria and Viruses in Forensic Science, Microbial profiles as identification tools.

Text Books

1. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques, CRC Press.
2. Virginia A. Lynch (2011) and Janet Barber Duval: Forensic Nursing Science.

References

1. Advanced Crime Scene Photography (2010) by Christopher D Duncan
2. Encyclopedia of Forensic Science, Wiley (2010)

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	H
CO2	H	H	H	H	S
CO3	S	S	S	M	H
CO4	H	H	H	H	M

S – Strong **H** – High **M** – Medium **L** – Low

Programme code: 08	Programme title: M. Sc. Biotechnology
Course code : 22PBT0D2	ALC. 2 – Stem Cell and Neuroscience
Batch 2022-2023	Credits 2

Course Objectives

1. To familiarize the students with stem cell technology and basics of neuroscience
2. To discuss various chemical and biological neural signals and its types.
3. To explain the importance of artificial intelligence in neural network
4. To familiarize the use of stem cells in the treatment of genetic and human diseases

Course Outcomes (CO)

On completion of the course, students will be able to

K1 ↕ K5	CO1	Relate various stem cells and their characteristic features
	CO2	Explain neuronal signaling pathways and neurotransmitters in action potential
	CO3	Investigate the role of Artificial intelligence in neural network.
	CO4	Investigate the applications of stem cell and neuroscience in the treatment of various diseases
	CO5	Use stem cells in design of therapeutic regimes

Syllabus

UNIT I

Introduction to stemcell Biology**:**Properties, proliferation, Identification, characterization and differentiation; overview of different stemcell types (embryonic, adult, and induced pluripotent stem cell), adult stemcell from amniotic fluid and cord blood; Ethical and legal issues of stem cell.

UNIT II

Stemcell culture and Aging:Growth factor and serum free culture of stem cells, Feeder free culture, Trophoblast stem cells – Identification and lineage specificity, Role of Yamanaka factor in iPSC; aging theory; cell cycle; senescence of stem cell; Role of stemcell in aging; regeneration of adult stem cell.

UNIT III

Neuron: Neural membrane, classification, nerve fibre, neural growth, nervous system, Blood Brain Barrier, Cerebrospinal fluid, Neuronal signaling- ion channel, recording neural signal, propogation of

action potential

UNIT IV

Synapse and Neurotransmitters**:**Synapse, Electrical synapse transmission, Synaptic transmitter release, Myoneural junction, neurotransmitters – synthesis, storage, release and functions – acetyl choline, catecholamine, histamine, serotonin, nitric oxide. Role of Artificial intelligence in neural network.

UNIT V

Applications:Current stencell therapy for type 1 diabetes, cancer. Clinical outcomes of stem cell therapy, pluripotent stem cell in cell replacement therapy.Neurodegenerative disrders – Hearing and Memory, Parkinson's disorder, Alziemer's disorder.

Textbooks

1. Deb, KD., and Totey, SM. (2017). Stem cell basics and Applications. Tata McGraw Hill Pvt.Ltd.

2. Kiessling, AA. (2006). Human Embryonic stem cells. Jones and Barlett Publications.

3. Kandel, E., Schwarts, J., Jessell, T., Siegelbaum, S. (2013). Principles of Neurosciences (5th Ed). McGraw hill Medicals.

4. Kuldhip S Sindhu. (2018). Frontiers in Pluripotent stem cells research and therapeutic potentials. Bench to Bedside.References

References

1. Quesenberry, PJ., Stein, GS, Wiley, ED. (2001). Stem Cell Biology and Gene therapy. Springer.

2. Bear, MF., Connors,BW., Paradiso, MA. (2015). Neuroscience: Exploring the Brain (4th Edition). Wolters Kluwer.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	H	H
CO2	H	H	H	H	S
CO3	S	H	H	H	H
CO4	H	H	H	H	H

S – Strong **H** – High **M** – Medium **L** – Low