



## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Cellular Metabolism
<b>Course Code</b>	BT 105 (T)

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Knowledge about basics of biomolecules			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To impart knowledge on structural, functional and dynamic aspects of biological components. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> To comprehend the understanding of the metabolic pathways involving the four major metabolic compounds: <b>(BL2-Understand)</b></p> <p><b>CO3-</b> To estimate the relation of biological material to living matter and elaborate the structure and functions of different biomolecules. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> To analyze the various biomolecules in biological samples <b>(BL4-Analyze)</b></p> <p><b>CO5-</b> To evaluate the applications of biomolecules in various fields <b>(BL5-Evaluate)</b></p>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Basic Concepts of Intermediary metabolism, Carbohydrate metabolism: Glycolysis, Kreb's Cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeogenesis, glyoxalate pathway, Cori cycle. Metabolic disorders	Tutorials, Collaborative Demonstrations, Project methods Experiments,	7
2	Biosynthesis and degradation of fatty acids, Biosynthesis of lipids, Degradation of lipids, Regulation of lipid metabolism. Formation of ketone bodies Ketosis. Metabolic disorders	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	7
3	Transamination, Oxidative deamination, decarboxylation, Biosynthesis of amino acids, Degradation of amino acids, Regulation of amino acids metabolism. Nitrogen Metabolism - Assimilation of inorganic Nitrogen sources; Urea cycle	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, ABL Experiments,	7
4	Biosynthesis and degradation of purine nucleotides, Biosynthesis and Degradation of Pyrimidine nucleotide, regulation of purine and pyrimidine metabolism.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	10
5	Photosynthetic microorganisms, photosynthetic pigments, and generation of reducing power by cyclic and non-cyclic photophosphorylation, Electron transport chain in photosynthetic bacteria. Carbon dioxide fixation pathways. Respiration : Components of electron transport chain, free energy changes and electron transport, oxidative phosphorylation, ATP synthase and theories of ATP formation.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	Estimation of Blood Glucose by Coupled Enzyme Assay	Experiments	BL4-Analyze	3
II	Sugar Fermentation by Microorganisms	PBL	BL3-Apply	3 DAYS
III	Demonstration of Starch Digestion by Salivary Amylase	Simulation	BL2-Understand	3
IV	Isolation and Fractionation of Egg Lipids by TLC and their Estimation	PBL	BL5-Evaluate	6

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	28
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation

## Part E

<b>Books</b>	David L. Nelson, Michael M. Cox, W. H. Freeman;Lehninger Principles of Biochemistry, Fifth Edition, , 2008, th Edition
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7545035/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7545035/</a>
<b>References Books</b>	G.Zubay Biochemistry 3 rd Edition Stryer Biochemistry 9 th Edition DVoet and JG. Voet , J Wiley and Sons. Biochemistry 5 th Edition David Plummer Practical Biochemistry Volume 3  Company.S;Philadelphia, Stipanuk.PA. (4th edition) (2019) Biochemical, physiological, and molecular aspects of human nutrition. Second Edition, Murray, R., Mayes, P., Rodwell, V., Granner, D (2006) Harper's illustrated biochemistry. 26th edition, McGraw-Hill Companies, Columbus, OH.
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/104105139">https://nptel.ac.in/courses/104105139</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/104105139">https://nptel.ac.in/courses/104105139</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	2	-	-	-	2	-	-	1	-	1
CO2	2	3	2	2	2	1	-	-	-	2	-	-	1	-	3
CO3	3	1	1	2	1	-	-	-	-	-	-	-	3	2	3
CO4	3	2	1	1	1	-	-	-	-	2	-	-	2	3	2
CO5	2	1	1	2	1	-	-	-	-	2	-	-	2	2	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Biophysics and Biochemistry
<b>Course Code</b>	BT-101[T]

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Embedded theory and lab							
<b>Course Category</b>	Disciplinary Major							
<b>Pre-Requisite/s</b>	Biophysics and Biochemistry is an interdisciplinary research field that is rapidly developing and expanding. The objective is to ensure that students acquire essential knowledge of modern biochemistry and molecular biophysics, including the principles of biological phenomena.			<b>Co-Requisite/s</b>	To impart knowledge on structural, functional, and dynamic aspects of biological components			
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To remember the structure of various biomolecules like carbohydrates, fats, amino acids, etc.(<b>BL2-Understand</b>)</p> <p><b>CO2-</b> To comprehend the biological material; and its relation to living matter and elaborate the structure and functions of different biomolecules(<b>BL4-Analyze</b>)</p> <p><b>CO3-</b> To understand the importance of biophysical chemistry and its applications.(<b>BL2-Understand</b>)</p> <p><b>CO4-</b> To provide experimental basis and to enable students to analyze the various biomolecules in food samples.(<b>BL3-Apply</b>)</p> <p><b>CO5-</b> To evaluate the applications of biomolecules in various fields such as research and industries(<b>BL5-Evaluate</b>)</p>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✓ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education) SDG8(Decent work and economic growth)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Basic Biochemistry: Types of solutions, Buffer and buffering capacity, concept of pH and pKa., Acids, base, ionization of weak acids and bases zwitter ions; Henderson-Hasselbatch equation. Principle of thermodynamics, Concept of free energy, entropy, High energy biomolecules, and their significance, Bonds in the biological system.	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Carbohydrates: Introduction, Classification, Structure, Properties and biological role of sugars. Basic structure and functions of monosaccharides and Oligosaccharides, optical isomerism, important derivatives of monosaccharide, Structure, and functions of polysaccharides, Mucopolysaccharides, Proteoglycans, Glycoproteins, Cell wall. Vitamins: Introduction, Classification, and functions of vitamins and their coenzyme activity	Tutorials, Demonstrations, Project methods, Hands on experience, Experiments,	8
3	Lipids: Classification, nomenclature, and structure of fatty acids. Classification, structure, and biological functions of lipids. Structure and function of Biomembranes: Micelles, Liposomes and their application. Hormones: Types (animal hormone and plant hormones) and biological roles	utorials, Demonstrations, Project methods, Hands on experience, Experiments,	8
4	Amino acid: Structure, Classification, and functions of amino acid; essential and nonessential amino acids, common rare and non- protein amino acids. Properties and Chemical reactions of amino acids, biologically active peptides Proteins: Classification, Properties and biological functions of proteins, coagulation and denaturation of proteins, Ramachandran plot. Conformation and structure of proteins are primary, secondary, tertiary, and quaternary.	utorials, Demonstrations, Project methods, Hands on experience, Experiments,	8

5	Nucleic acids: Structure and functions of purines, pyrimidines, nucleosides, nucleotides Structure, properties and biological role of DNA. Various types of DNA, Melting of DNA, Denaturation, and annealing of DNA. Structure and biological role of different types of RNA, Ribozymes: structure and functions.	tutorials, Demonstrations, Project methods, Hands on experience, Experiments,	8
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## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Qualitative analysis of carbohydrates	Experiments	BL3-Apply	3
2	Qualitative analysis of lipids and fats	Experiments	BL3-Apply	3
3	Qualitative analysis of proteins	Experiments	BL3-Apply	3
4	Quantitative estimation of carbohydrates	Experiments	BL3-Apply	3
5	Quantitative estimation of proteins	Experiments	BL3-Apply	3
6	Determination of acid value in the given fat sample	PBL	BL3-Apply	3
7	Determination of esterification value of given fat sample	PBL	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	40	20	60	

## Part E

<b>Books</b>	Lehninger's Principle of Biochemistry: Nelson, L.D. and M. M Cox, Macmillan, Worth Publication Inc.
<b>Articles</b>	<a href="https://www.nature.com/subjects/biochemistry">https://www.nature.com/subjects/biochemistry</a>
<b>References Books</b>	Voetand JG.Voet, JWileyand Sons. Biochemistry 6th Edition
<b>MOOC Courses</b>	<a href="https://onlinecourses.nptel.ac.in/noc24_bt12/preview">https://onlinecourses.nptel.ac.in/noc24_bt12/preview</a> <a href="https://onlinecourses.nptel.ac.in/noc24_bt14/preview">https://onlinecourses.nptel.ac.in/noc24_bt14/preview</a>
<b>Videos</b>	<a href="https://onlinecourses.nptel.ac.in/noc24_bt12/preview">https://onlinecourses.nptel.ac.in/noc24_bt12/preview</a> <a href="https://onlinecourses.nptel.ac.in/noc24_bt14/preview">https://onlinecourses.nptel.ac.in/noc24_bt14/preview</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	3	3	1	2	-	-	-	-	-	1	3	-
CO2	1	3	2	1	-	-	1	-	-	-	-	-	2	3	1
CO3	1	2	1	1	1	2	2	-	-	-	-	-	-	1	1
CO4	1	2	1	1	3	2	1	-	-	-	-	-	2	1	2
CO5	1	2	3	1	1	2	3	-	-	-	-	-	2	1	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	General Microbiology and Microbial Genetics
<b>Course Code</b>	BT-102[T]

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Embedded theory and lab							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Microbiology is the study of life forms too small to be seen with the naked eye, including Viruses, Bacteria, Archaea, and Protists. The paper emphasizes on study of distribution, morphology, physiology and nutrition of microorganisms in addition to skills in aseptic procedures, isolation and identification and their classification. This course also takes account of study on gene transfer mechanisms and a detailed insight into mutations and their analysis.			<b>Co-Requisite/s</b>		Microbial classification and methods of gene transfer		
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To remember the basic concepts and view of professional and scientific communication approaches for microbiology and biotechnology settings. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> To understand the gene transfer mechanisms and a detailed insight into mutations and their analysis. <b>(BL2-Understand)</b></p> <p><b>CO3-</b> To describe comprehensive understanding of sterilization processes and media preparation pipelines. <b>(BL2-Understand)</b></p> <p><b>CO4-</b> To provide experimental basis, and to enable students to analyze the basic concepts of microbial evolution, phylogeny, nutritional aspects and elements of microbial genetics. <b>(BL3-Apply)</b></p> <p><b>CO5-</b> To evaluate the genetic analysis and gene transfer mechanisms of microbes <b>(BL5-Evaluate)</b></p> <p><b>CO6-</b> To apply Appraise the current regulatory, quality control, and legal frameworks that impact biotechnology and ethical behaviors that foster positive and productive interactions in diverse microbiology and biotechnology settings. <b>(BL3-Apply)</b></p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>		SDG4(Quality education) SDG8(Decent work and economic growth)			



## Part B

Modules	Contents	Pedagogy	Hours
1	History and scope of microbiology, modern development of microbiology, Classification of microorganism: Haeckel's; three kingdom concept, Whittaker; five kingdom concept. Introduction and general characteristic of bacteria, fungi. Algae and virus.	Tutorials, Demonstrations, videos, case studies ,	8
2	Concept of Sterilization - Definition of sterilization, methods of sterilization; dry and moist heat, pasteurization, tyndalization; radiation, filtration, disinfection, sanitization. Stains and staining techniques -Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining.	Tutorials, Demonstrations, videos, case studies ,	8
3	Culture media: Type of media and their uses, pure culture techniques. Microbial growth: growth curve, measurement of growth and factor affecting the growth, Microbial nutrition: Nutritional classification of microorganism. Cultivation of microorganism: aerobic and anaerobic culture and preservation of microbial culture. Oxygen toxicity: Study	Tutorials, Demonstrations, videos, case studies ,	8
4	Gene transfer mechanisms: transformation, transduction, conjugation and transfection, Mechanism and applications, genetic analysis of microbes- bacteria and yeast. Plasmids: characteristics and their uses in genetic analysis/as cloning vectors, replication of selected plasmids. Transposable genetic elements: transposons, types of transposons and their uses.	Tutorials, Demonstrations, videos, case studies ,	8
5	Genetic analysis of bacteria: Importance and uses of Mutation analysis. Inheritance in bacteria, types of mutations, spontaneous and induced mutagenesis. Isolating mutants, selecting mutants, mutant enrichment. Reversions versus suppression. Complementation test	Tutorials, Demonstrations, videos, case studies ,	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Grams staining	Experiments	BL2-Understand	3
2	Negative & capsular staining	Experiments	BL2-Understand	3
3	serial dilution	Experiments	BL3-Apply	3
4	Pour plate method	Experiments	BL3-Apply	3
5	sterlization technique	Experiments	BL3-Apply	3
6	isolation of microorganisms from soil sample	Experiments	BL4-Analyze	3
7	To prepare sigmoid growth curve for bacterial growth	PBL	BL4-Analyze	1 week

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	40	20	60	

## Part E

<b>Books</b>	Fundamental Bacterial Genetics by Nancy Trun and Janine Trempey, 1st edition; Blackwell Science Publishers; 2004. 2. Modern Microbial Genetics by U.N. Streips and R.E. Yasbin, 2nd edition; Wiley Publishers; 2002. 3. Microbial Genetics by Stanly R. Maloy, John E. Cronan, Jr. and David Freifelder, 2nd edition; Narosa
<b>Articles</b>	<a href="https://www.nature.com/subjects/microbiology">https://www.nature.com/subjects/microbiology</a>
<b>References Books</b>	Stanier, R.Y. Adelberg, E.EA. and Ingraham, J.L. (1984). General Microbiology, IVth Eds., Mac. Millan Press. 5. Pelczar, M.J. Chan, E.C.S. and Krieg, N.R. (1986). Microbiology, Vth Eds., Mc. Graw Hill.
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103015">https://nptel.ac.in/courses/102103015</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103015">https://nptel.ac.in/courses/102103015</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	2	-	-	-	-	-	1	1	3
CO2	1	2	2	-	-	-	1	-	-	-	-	-	2	-	-
CO3	1	2	2	-	-	-	3	-	-	-	-	-	2	-	-
CO4	2	1	2	-	-	-	2	-	-	-	-	-	2	-	-
CO5	1	2	2	-	-	-	1	-	-	-	-	-	-	3	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Cell Biology
<b>Course Code</b>	BT-103[T]

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Embedded theory and lab							
<b>Course Category</b>	Foundation core							
<b>Pre-Requisite/s</b>	Knowledge of basics of biology			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> Students will remember the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles(<b>BL1-Remember</b>)</p> <p><b>CO2-</b> Students will understand how these cellular components are used to generate and utilize energy in cells(<b>BL2-Understand</b>)</p> <p><b>CO3-</b> Students will recognize the cellular components underlying mitotic cell division(<b>BL2-Understand</b>)</p> <p><b>CO4-</b> Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.(<b>BL3-Apply</b>)</p> <p><b>CO5-</b> : Students will create a model by using cell biology basics(<b>BL5-Evaluate</b>)</p>							
<b>Coures Elements</b>	Skill Development ✗ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Membrane components, structure and asymmetric arrangement of lipid and proteins Membrane model: Fluid mosaic model of random diffusion of membrane components; Flip-flop and Lateral diffusion of membrane components (lipids and proteins) Transport across membrane: principles of membrane transport, carrier proteins and active membrane transport, lipid bilayer and membrane protein diffusion, osmosis, ion channel, membrane pumps Membrane potential: electrical properties of membrane, ionic basis of membrane excitability	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Compartmentalization and protein sorting of cell organelles: Mechanism of Transport of proteins into Endoplasmic Reticulum (ER) and Regulation Transport of Proteins into Mitochondria and Chloroplast Transport of proteins into and out of Nucleus. Vesicular transport: types of vesicle and mechanism of vesicle transport (Cop II, Cop I and Clathrin coated) and significance.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	9
3	Structure and functions of Cytoskeletal filaments (Microtubule, Actin filaments and Intermediate filaments, Mechanism and role of actin and myosin in muscle contraction Molecular mechanism of cell-cell adhesion: Cadherins and Adherins. Intra cellular communication through Cell Junctions: gap junction, Tight junction, Occluding Junctions, Anchoring Junctions and Communicating Junctions. Extracellular matrix (ECM) of animals: Organization, Receptor Proteins and Functions. Cell- matrix junctions: Types and functions	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, ABL Experiments,	9
4	Cell signaling; Gaseous messengers (NO and CO); Receptor mediated cell signaling – Types of receptor and function, G protein coupled receptors - heterotrimeric G proteins and its effectors (second messengers like cAMP, DAG, Ca <sup>2+</sup> ); calcium as signal molecules. Neurotransmission and its mechanism Apoptosis and cell death its mechanism and therapeutic interventions of uncontrolled cell growth, Oncogenes, Tumor suppressor genes, Rb gene and p53. virus-induced	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8

	cancer, metastasis, interaction of cancer cells with normal cells		
5	Cell cycle control, cell cycle checkpoint. Basic concepts of development, potency, commitment, specification, induction, competence, determination and differentiation, genomic equivalence and cytoplasmic determinants: imprinting mutants and transgenics analysis of development Gametogenesis, fertilization and early development Animal Development: Oogenesis. Fertilization, Embryonic Cleavage, Division, blastulation, Gastrulation and Morphogenesis	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	9

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Mushroom cultivation	Industrial Visit	BL6-Create	8

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation

## Part E

<b>Books</b>	Alberts et al.: Molecular Biology of the cell (3rded.)
<b>Articles</b>	<a href="https://www.mdpi.com/2073-4409/13/10/805">https://www.mdpi.com/2073-4409/13/10/805</a>
<b>References Books</b>	Damall, J., Lodis, H., and Baltimore, D., 1990. Molecular and Cell Gerald Karp Cell and Molecular Biology: Concepts and experiments 3rd Ed.,.2002 G.M. Cooper The Cell : A Molecular Approach  Lodish et al.: Molecular Cell Biology (4thed.) Scott F. Gilbert: Developmental Biology (5thed.) Zubay, Parson & Vance: Principles of Biochemistry Joshua Zimmerberg, Membrane Biophysics. Current Biology Vol 16 No 8 R272, <a href="https://www.cell.com/current-biology/pdf/S0960-9822(06)01347-9.pdf">https://www.cell.com/current-biology/pdf/S0960-9822(06)01347-9.pdf</a>
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103012">https://nptel.ac.in/courses/102103012</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103012">https://nptel.ac.in/courses/102103012</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	2	3	2	2	2	2	-	-	-	2	-	-	1	-	3
CO3	3	1	1	2	1	-	-	-	-	-	-	-	3	2	3
CO4	3	2	1	1	1	-	-	-	-	2	-	-	2	3	2
CO5	2	1	1	2	1	-	-	-	-	2	-	-	2	2	3
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Bioanalytical Techniques
<b>Course Code</b>	BT-104[T]

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	To be familiar with the basic instruments present in the laboratory and their working principles.			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To remember and understand and learn the basic microscopic &amp; centrifugation techniques (<b>BL1-Remember</b>)</p> <p><b>CO2-</b> To understand the separation of components using various techniques like chromatography, electrophoresis, centrifugation etc(<b>BL2-Understand</b>)</p> <p><b>CO3-</b> To utilize the separation techniques in order to distinguish the different types of molecules present in the sample.(<b>BL3-Apply</b>)</p> <p><b>CO4-</b> To evaluate, identify and compare the molecules on the basis of bioanalytical techniques.(<b>BL4-Analyze</b>)</p> <p><b>CO5-</b> To purify the specific protein/molecules/compound for its further utilization in food, dairy, chemical and beverage industries(<b>BL5-Evaluate</b>)</p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✓ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				



## Part B

Modules	Contents	Pedagogy	Hours
I	Microscopy: Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, difference between TEM and SEM Centrifugation: Basic principle, Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, types of centrifugations, instrumentation and applications. <u>Types of rotors</u>	Lecture methods, group discussions, 3D animated videos, ABL, PBL, Experiments.	10
II	Chromatography: Principle, types, instrumentation and applications: <u>Paper, TLC</u> , Column, Affinity chromatography, Ion exchange chromatography, HPLC . Electrophoresis: Principle, types and applications, Isoelectric-focusing, 2D gel electrophoresis	Lecture methods, group discussions, 3D animated videos, ABL, PBL, Experiments.	10
III	Spectroscopy: Basic principles, instrumentation and applications of UV-visible spectrophotometry, IR Spectrophotometry, Atomic absorption spectroscopy: Flame emission spectroscopy. Polarimetry: Principle, instrumentation and applications	Lecture methods, group discussions, 3D animated videos, ABL, PBL, Experiments.	9
IV	ESR: Principle, instrumentation and applications, NMR Principle, and applications, <del>circular dichroism (CD) Principle, and applications</del> , GC Mass: Basic principle, instrumentation and applications, Mass spectroscopy.	Lecture methods, group discussions, 3D animated videos, ABL, PBL, Experiments.	8
V	X Ray crystallography: Principle and application. Autoradiography: Principles, and applications. Flow cytometry: <u>Principle and applications.</u>	Lecture methods, group discussions, 3D animated videos, ABL, PBL, Experiments.	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	Qualitative analysis of various plant pigments using thin layer chromatography	PBL	BL4-Analyze	5
II	To plot bacterial growth curves using U.V.Visible spectroscopy	PBL	BL4-Analyze	6 days

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
0	0	0	0	0	0

## Part E

<b>Books</b>	Wilson.K;Principles and Techniques of Biochemistry and Molecular Biology;7th Edition; (2010) Sheehan .D;Physical Biochemistry: Principles and Applications 2nd Edition, John Wiley & Sons (2009)
<b>Articles</b>	<a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spectrophotometry">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spectrophotometry</a> <a href="https://www.mdpi.com/journal/chromatography">https://www.mdpi.com/journal/chromatography</a>
<b>References Books</b>	Rodney F. Boyer,Hall.P.P;;Biochemistry Laboratory: Modern Theory and Techniques, ; 2nd Edition (2010). Talluri.S;Bioanalytical Techniques;I.K. International Publishing House Pvt. Ltd. (2012) Dua .S and Garg.N,Biochemical methods of analysis: Theory and applications. Alpha Science Intl Ltd; 1st Edition (2010)
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103044">https://nptel.ac.in/courses/102103044</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103044">https://nptel.ac.in/courses/102103044</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	-	-	-	-	-	-	1	2	1
CO2	1	1	-	3	2	1	-	-	-	-	-	-	2	1	-
CO3	1	2	2	2	2	-	1	-	-	-	-	1	1	2	2
CO4	3	2	2	2	1	2	1	-	-	-	-	-	2	1	2
CO5	1	3	1	1	2	1	-	-	-	-	-	-	2	-	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Lab
<b>Course Code</b>	BT-106[P]

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C
					0	0	3	3
<b>Course Type</b>	Lab only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Biophysics and Biochemistry and Microbiology is an interdisciplinary research field that is rapidly developing and expanding.			<b>Co-Requisite/s</b>	Ensure that students acquire essential knowledge of modern biochemistry and molecular biophysics, and Microbiology including the principles of biological phenomena. To impart knowledge on structural, functional and dynamic aspects of biological components.			
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To provide experimental basis, and to enable students to analyze the various biomolecules in food samples.(<b>BL1-Remember</b>)</p> <p><b>CO2-</b> To evaluate the applications of biomolecules in various fields such as research and industries(<b>BL2-Understand</b>)</p> <p><b>CO3-</b> To provide experimental basis, and to enable students to analyze the basic concepts of microbial evolution, phylogeny, nutritional aspects and elements of microbial genetics. (<b>BL2-Understand</b>)</p> <p><b>CO4-</b> To evaluate the genetic analysis and gene transfer mechanisms of microbes.(<b>BL3-Apply</b>)</p> <p><b>CO5-</b> To apply Appraise the current regulatory, quality control, and legal frameworks that impact biotechnology and ethical behaviors that foster positive and productive interactions in diverse microbiology and biotechnology settings.(<b>BL3-Apply</b>)</p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗	<b>SDG (Goals)</b>	SDG4(Quality education)					

## Part B

Modules	Contents	Pedagogy	Hours
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## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Qualitative analysis of carbohydrates	Experiments	BL3-Apply	3
2	Qualitative analysis of lipids and fats	Experiments	BL3-Apply	3
3	Qualitative and Quantitative estimation of carbohydrates and analysis of proteins	Experiments	BL3-Apply	3
4	Quantitative estimation of proteins	Experiments	BL3-Apply	3
5	Determination of acid value in the given fat sample	Experiments	BL3-Apply	3
6	Determination of esterification value of given fat sample	PBL	BL4-Analyze	6
7	Introduction of Laboratory equipment, cleaning of Glassware, Autoclaving	Experiments	BL3-Apply	3
8	Introduction to balancing and pipetting	Experiments	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	50	60	30	40	

## Part E

<b>Books</b>	<p>Fundamental Bacterial Genetics by Nancy Trun and Janine Trempey, 1st edition; Blackwell Science Publishers; 2004.</p> <p>Modern Microbial Genetics by U.N. Streips and R.E. Yasbin, 2 nd edition; Wiley Publishers; 2002.</p> <p>Microbial Genetics by Stanly R. Maloy, John E. Cronan, Jr. and David Freifelder, 2nd edition; Narosa</p> <p>Stanier, R.Y. Adelberg, E.EA. and Ingraham, J.L. (1984). General Microbiology, IVth Eds., Mac. Millan Press.</p> <p>Pelczar, M.J. Chan, E.C.S. and Krieg, N.R. (1986). Microbiology, Vth Eds., Mc. Graw Hill.</p>
<b>Articles</b>	<p><a href="https://www.nature.com/subjects/biochemistry">https://www.nature.com/subjects/biochemistry</a></p> <p><a href="https://www.nature.com/subjects/microbiology">https://www.nature.com/subjects/microbiology</a></p>
<b>References Books</b>	<p>Lehninger's Principle of Biochemistry: Nelson, L.D. and M. M Cox, Macmillan, Worth Publication Inc.</p> <p>Biochemistry: Stryer, L., W.H. Freeman and Co. NY</p> <p>Biochemistry: Voet and Voet, John Wiley and Sons.</p> <p>Biochemistry: Jeoffery Zubay, WMC. Brown Publ.</p> <p>Biochemistry: West, B. Todd, M. Mason, R.V. Bruggen and MacMillan.</p>
<b>MOOC Courses</b>	<p><a href="https://nptel.ac.in/courses/105107173">https://nptel.ac.in/courses/105107173</a></p> <p><a href="https://nptel.ac.in/courses/118106019">https://nptel.ac.in/courses/118106019</a></p> <p><a href="https://nptel.ac.in/courses/102103015">https://nptel.ac.in/courses/102103015</a></p>
<b>Videos</b>	<p><a href="https://nptel.ac.in/courses/105107173">https://nptel.ac.in/courses/105107173</a></p> <p><a href="https://nptel.ac.in/courses/118106019">https://nptel.ac.in/courses/118106019</a></p> <p><a href="https://nptel.ac.in/courses/102103015">https://nptel.ac.in/courses/102103015</a></p>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	-	2	2	-	-	-	-	-	1	1	-
CO2	2	2	3	2	1	-	2	-	-	-	-	-	1	2	2
CO3	1	1	1	2	3	2	3	-	-	-	-	-	-	2	1
CO4	2	1	1	-	3	1	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	1	1	-	-	-	-	-	-	3	1	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Lab
<b>Course Code</b>	BT-107[P]

#### Part A

Year	1st	Semester	1st	Credits	L	T	P	C	
					0	0	3	3	
<b>Course Type</b>	Lab only								
<b>Course Category</b>	Discipline Core								
<b>Pre-Requisite/s</b>	Student must be acquainted by the basic knowledge of cell biology, molecular biology and bioinstrumentation			<b>Co-Requisite/s</b>					
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> Students will recognize the cellular components underlying mitotic cell division(<b>BL3-Apply</b>)</p> <p><b>CO2-</b> Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function(<b>BL4-Analyze</b>)</p> <p><b>CO3-</b> Students will create a model by using cell biology basics(<b>BL6-Create</b>)</p> <p><b>CO4-</b> To utilize the separation techniques in order to distinguish the different types of molecules present in the sample.(<b>BL3-Apply</b>)</p> <p><b>CO5-</b> To evaluate, identify and compare the molecules on the basis of bioanalytical techniques.(<b>BL4-Analyze</b>)</p> <p><b>CO6-</b> To purify the specific protein/molecules/compound for its further utilization in food, dairy, chemical and beverage industries(<b>BL6-Create</b>)</p>								
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)					

#### Part B

Modules	Contents	Pedagogy	Hours
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## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	Introduction to chromosome preparation: Pre-treatment, Fixation, Staining, Squash and Smear preparation. Preparation of permanent slides	Experiments	BL2-Understand	3
X	To plot bacterial growth curves using U.V.Visible spectroscopy	PBL	BL4-Analyze	6 days
III	Study of mitotic chromosome: Metaphase chromosome preparation, free hand drawing under high power objective.	Experiments	BL2-Understand	3
IV	The determine osmolarity in RBCs.	Experiments	BL5-Evaluate	3
V	The fractionation of rat Liver	Experiments	BL4-Analyze	5
VI	Estimation of chlorophyll content in spinach leaves.	Experiments	BL4-Analyze	3
VII	To separate casein from milk using centrifugation	Experiments	BL3-Apply	3
VII	To separate plant pigments using paper chromatography	Experiments	BL4-Analyze	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	50	60	30	40	



## Part E

<b>Books</b>	Lehninger's Principle of Biochemistry: Nelson, L.D. and M. M Cox, Macmillan, WorthPublication Inc.
<b>Articles</b>	<a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spectrophotometry">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spectrophotometry</a> <a href="https://www.mdpi.com/journal/chromatography">https://www.mdpi.com/journal/chromatography</a>
<b>References Books</b>	Wilson and Walker;Principles and Techniques of Biochemistry and Molecular Biology Gerald Karp;Cell and Molecular Biology: Concepts and experiments  Sheehan .D;Physical Biochemistry: Principles and Applications 2nd Edition, John Wiley &Sons (2009)
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103044">https://nptel.ac.in/courses/102103044</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103044">https://nptel.ac.in/courses/102103044</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	2	-	-	-	-	-	-	-	2	1
CO2	1	2	2	2	2	2	1	-	-	-	-	-	1	2	2
CO3	1	3	-	1	3	-	1	-	-	-	-	-	2	1	2
CO4	1	-	2	1	1	1	-	-	-	-	-	-	2	1	-
CO5	2	1	2	2	3	-	-	-	-	-	-	-	1	3	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-





## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Enzyme Technology
<b>Course Code</b>	BT 202 (T)

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Disciplinary Major							
<b>Pre-Requisite/s</b>	To acquire fundamental knowledge on enzymes and their importance in biological reactions.			<b>Co-Requisite/s</b>	To analyse methods for production, purification, characterization and immobilization of enzymes			
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To acquire fundamental knowledge on enzymes and their importance in biological reactions( <b>BL1-Remember</b> ) <b>CO2-</b> To understand and ability to difference between a chemical catalyst and bio catalyst. ( <b>BL2-Understand</b> ) <b>CO3-</b> to apply the role of enzymes in clinical diagnosis and industries. ( <b>BL2-Understand</b> ) <b>CO4-</b> analyze methods for production, purification, characterization and immobilization of enzymes( <b>BL2-Understand</b> ) <b>CO5-</b> To evaluate the current and future trends of applying enzyme technology( <b>BL3-Apply</b> ) <b>CO6-</b> To develop biotechnological products for the commercialization purpose. ( <b>BL4-Analyze</b> )							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✓ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✓ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Historical aspects, Classification and Nomenclature, Enzyme commission system of Classification; EC Number, Mechanism of enzyme action and specificity, Mechanism of enzyme catalysis and their type	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Enzyme activity: Effects of substrate, temperature, pH and pressure on enzyme activity. Steady state kinetics: Estimation of rate of enzyme catalyzed reaction. Relationship between initial velocity and substrate concentration	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
3	Enzyme assay: Continuous and Sampling techniques coupled kinetic assays; turn over number and specific activity. Enzyme Inhibition: Competitive, Un-competitive and noncompetitive inhibition effect to inhibitors on enzyme kinetics	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	9
4	Enzyme Immobilization: Methods of immobilization of the enzyme. Properties of immobilized enzymes. Advantages and disadvantages of immobilized enzymes. Enzyme Purification techniques: Isolation, purification and, Large-scale production of enzymes.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
5	Uses of enzyme in Industries; textiles, leather and food. Therapeutics uses of enzyme. Uses of Enzymes in diagnostics. Enzymes as Biosensors.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	To quantitative analysis of protease	Experiments	BL3-Apply	3
2	To quantitative and quantitative analysis of protease	Experiments	BL3-Apply	3
3	To quantitative analysis of Urease	Experiments	BL3-Apply	3
4	To quantitative and quantitative analysis of Urease	Experiments	BL3-Apply	3
5	Determination of Km and Vmax of Urease	Experiments	BL4-Analyze	3
6	Determination half life of enzyme	PBL	BL4-Analyze	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
0	0	0	0	0	

## Part E

<b>Books</b>	David L. Nelson & Michael M. Cox-Lehninger Principles of Biochemistry-3rd Edition
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3962110/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3962110/</a>
<b>References Books</b>	Palmer T and P L Bonner-Enzymes: Biochemistry Biotechnology, Clinical Chemistry-2nd Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103097">https://nptel.ac.in/courses/102103097</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103097">https://nptel.ac.in/courses/102103097</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	3	1	3	2	1	1	1	3	3	1	3	2
CO2	2	1	2	2	1	3	3	1	1	1	3	1	2	2	3
CO3	2	3	1	1	3	3	2	1	3	3	1	2	3	1	2
CO4	2	3	2	3	3	1	1	1	2	1	1	2	1	1	2
CO5	3	1	3	2	1	3	3	1	1	1	1	2	2	1	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Molecular Biology
<b>Course Code</b>	BT 203(T)

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Basic knowledge of macromolecules and micro molecules			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To observe and understand the types of DNA and its replication among prokaryotes &amp; eukaryotes. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> To understand the transcription process in prokaryotes and eukaryotes. <b>(BL2-Understand)</b></p> <p><b>CO3-</b> To compare and distinguish the functions of various enzymes involves in transcription process of prokaryotes as well as eukaryotes. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> To describe and summarize the RNA modifications in eukaryotes. <b>(BL4-Analyze)</b></p> <p><b>CO5-</b> To study and conclude the genetic behavior based on the genetic code in a particular organism. <b>(BL5-Evaluate)</b></p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Chemical structure and base composition of nucleic acids, A, B and Z- DNA, Factors and forces stabilizing nucleic acid structure, super coiled DNA, properties of DNA, Denaturation Kinetics. DNA replication: Replication initiation, elongation and termination in prokaryotes and eukaryotes, Types of DNA replications; Theta Shaped, Rolling circle. DNA damage and DNA repair, SOS repair.	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	9
2	Prokaryotic transcription; RNA polymerase, transcription unit, promoters: constitutive and inducible, initiation, Types of termination-(rho dependent and factor independent). Eukaryotic transcription: Eukaryotic transcription unit, structure and design of Promoters for RNA polymerase I, II and III, mechanism of transcription and its regulation, Basal transcription factors. RNA interference.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
3	Post-transcriptional modifications: 5' cap formation, 3'-end processing, polyadenylation Organization and structure-function of ribonucleoprotein: Spliceosome. Splicing, Processing of hnRNA, Processing of rRNA and Processing of tRNA.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	9
4	Genetic code and their properties, Deciphering the genetic codes, wobble hypothesis, difference between genetic codon and codon Prokaryotic and eukaryotic translation: the translation machinery, adaptor molecules, mechanism of initiation, elongation and termination	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
5	Regulation of gene expression in prokaryotes: Operon concept; lac, trp and ara operons, Regulation of gene expression in eukaryotes: hormonal. Molecular markers RAPD, AFLP, SSLP markers, STS, Satellites DNA, RFLP maps, linkage analysis, Application of molecular Markers in forensic and disease prognosis. PCR and its variants	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	9

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	Isolation of DNA from the different plant sample	PBL	BL3-Apply	4
II	DNA isolation from various sample	PBL		6

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	30	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	0				

## Part E

<b>Books</b>	David Frei Felder Molecular Biology 4 th Edition
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9573682/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9573682/</a>
<b>References Books</b>	Watson, Baker & Bell Molecular Biology of Gene 7 th Edition Albert Molecular Biology of the Cell 5 th Edition Lewin and Benjamin Genes 12th Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103341">https://nptel.ac.in/courses/102103341</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103341">https://nptel.ac.in/courses/102103341</a>



## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	2	-	-	1	-	1
CO2	2	3	2	2	2	2	-	-	-	2	-	-	1	-	3
CO3	3	1	1	2	1	-	-	-	-	-	-	-	3	2	3
CO4	3	2	1	1	1	-	-	-	-	2	-	-	2	3	2
CO5	2	1	1	1	1	-	-	-	-	2	-	-	2	3	3
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Immunotechnology
<b>Course Code</b>	BT 204 (T)

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
						3	0	1
<b>Course Type</b>	Embedded theory and lab							
<b>Course Category</b>	Disciplinary Major							
<b>Pre-Requisite/s</b>	Understand basic and advanced concepts of Immunology and body's defense system.			<b>Co-Requisite/s</b>	This course will introduce to the applied aspects of immunology in disease detection and diagnosis			
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To remember the structure of various Immunological Barriers of the body ( <b>BL1-Remember</b> ) <b>CO2-</b> To understand the Different cells & proteins involved in Immune system( <b>BL2-Understand</b> ) <b>CO3-</b> To understand the connection of immune system failure & disorders( <b>BL2-Understand</b> ) <b>CO4-</b> To apply the use of Proteins & receptors in antibody formation( <b>BL3-Apply</b> ) <b>CO5-</b> To evaluate the applications of Antigens & Antibodies in Diagnostic & Medical Research( <b>BL5-Evaluate</b> )							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✓ Environment ✗		<b>SDG (Goals)</b>	SDG3(Good health and well-being)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Introduction to the immune system, innate and adaptive immune response, Lymphatic tissues and migration of immune cells .Physiological and anatomical barriers in immune system.Cells and organs of the immune system, Hematopoietic development and mediators of the process and regulation . Humoral and cell mediated immune response.	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Inflammation: sign & Symptoms, cell involved in inflammation, leucocyte extravasation, TOLL receptors :types and mechanism of action. Antigens and Immunogens its properties, Super antigens Adjuvants, haptanes.epitopes . active and passive immunity, Structure, classification and functions of Antibody, CDRS and there function., Organization and expression of Immunoglobulin genes and Class switching.Mechanism of antibody diversity	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	7
3	Major histocompatibility complex (MHC), Types of MHC and Display of antigenic peptide, Role of MHC in antigen processing and presentation. Complement system: component, activation pathway , complement deficiency diseases.Activation, maturation and differentiation of B and T cells, B cell receptor complex, T cell receptor complex	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments ABL	8
4	CTLs: activation and mechanism of action, NK cells and target cell destruction, Cytokines : Properties, mode of action, cytokine families and JAK-STAT pathway, Hypersensitivity: type 1,2,3,4, Immunodeficiency: primary and secondary, Autoimmunity: Organ specific and systemic diseases	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	7

5	Antigen antibody interaction: precipitation, agglutination reaction, RIA, ELISA, Western blotting, Immunofluorescence, CFT. Monoclonal antibody and Polyclonal antibodies: Hybridoma Technology and their applications, Antibody engineering. Immunization: active and passive immunization, types of vaccines and their production strategy.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
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## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Anatomical view of mammalian thymus and various immune organs	Experiments	BL2-Understand	3
2	Precipitation reaction.	Experiments	BL2-Understand	3
3	Haemoglobin detection by given Blood Sample	Experiments	BL3-Apply	3
4	Double immunodiffusion	Experiments	BL3-Apply	3
5	Radial immuno diffusion	Experiments	BL4-Analyze	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	09
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	50	60	30	40	20

## Part E

<b>Books</b>	Kuby Immunology by T. Kindst, R.A. Goldsby and B.A. Osborne 2. Essential Immunology by Ivan Roitt
<b>Articles</b>	<a href="https://medcraveonline.com/MOJI/cytokines-and-their-role-in-health-and-disease-a-brief-overview.html">https://medcraveonline.com/MOJI/cytokines-and-their-role-in-health-and-disease-a-brief-overview.html</a>
<b>References Books</b>	Immunology understanding the immune system by Klaus D. Elgert 4. Immunology by I. Roit J. Brostoff and D. Male
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102105083">https://nptel.ac.in/courses/102105083</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102105083">https://nptel.ac.in/courses/102105083</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	3	1	3	1	2	3	1	2	3	1	1	2
CO2	1	1	2	1	3	2	3	2	3	1	2	3	1	2	3
CO3	1	2	2	3	4	3	3	1	3	1	2	2	1	2	1
CO4	2	2	1	2	2	2	2	3	2	2	1	1	2	2	1
CO5	2	3	3	1	1	3	1	3	1	3	3	1	3	1	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Open Elective 1 : Bioinformatics
<b>Course Code</b>	BT 205 (T)

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Embedded theory and lab							
<b>Course Category</b>	Discipline Specific Elective							
<b>Pre-Requisite/s</b>	Should be familiar with the basics of bioinformatics, its databases and search tools, types of sequence alignment, comparative modeling, evolutionary prediction of sequences and basics of drug designing			<b>Co-Requisite/s</b>	Basic concepts of computational tools, their applications and their uses in industry and research along with basic understanding of proteomics and genomics and genomics			
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> The course prepares the student to understand the basic concepts of Bioinformatics, its applications and future prospects. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> The subject Bioinformatics is designed for post graduate students of biotechnology for understanding of basic concepts of each and every division of Bioinformatics along with its applications in other fields <b>(BL2-Understand)</b></p> <p><b>CO3-</b> The course aims to provide experimental basis, and to enable students to acquire a specialized knowledge and understanding. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> The course aims to provide basis of analyzing the applications of Bioinformatics in various fields of research and industries. <b>(BL3-Apply)</b></p>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education) SDG8(Decent work and economic growth)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Overview of Bioinformatics, bioinformatics as multidisciplinary domain, divisions, scope and future prospects of bioinformatics, Sequence Formats: NCBI, EBI, SWISS PROT, PDB, EMBL Sequence Databases: NCBI, EBI, SWISSPROT, DDJB, PDB	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Pairwise sequence alignment, types, significance and applications, Sequence alignment tools; BLAST, FASTA, Types and versions of BLAST and FASTA, Matrices for sequence alignment	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
3	Multiple sequence alignment methods and softwares, phylogenetic analysis: Methods of phylogenetic prediction Tree building methods, .Algorithms for phylogenetic analysis, Markov models; Concept of HMMS	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, ABL Experiments,	8
4	Insilico comparative modeling, Methods of Insilico comparative modeling, fold recognition, Ab initio methods for structure prediction, Use of genome analysis programs, primer designing tools, theory of profiles and their use in sequence analysis, computer aided drug designing: Basic principles and applications.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
5	DNA Microarray, proteomics, 2D-Electrophoresis for total cellular protein, Advantages and disadvantages of DNA and protein microarrays, Total expression vs functional proteomics, oligosaccharide microarrays for glycomics, Pharmaco genomics, introduction to metabolomics, Proteomics applications.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Accession of protein sequences from SWISSPROT.	Experiments	BL3-Apply	3
2	Pairwise alignment and analysis of DNA sequences using BLASTn software	Experiments	BL3-Apply	3
3	Pairwise alignment and analysis of protein sequences using BLASTp software	Experiments	BL3-Apply	3
4	Pairwise alignment and analysis of protein sequences using FASTA software.	Experiments	BL3-Apply	3
5	Alignment of DNA/protein sequences using dot matrix.	Experiments	BL3-Apply	3
6	Multiple sequence alignment and analysis of protein sequences using CLUSTALW software.	Experiments	BL3-Apply	3
7	Phylogenetic prediction of protein sequences using TREETOP/T-COFFEE software.	Experiments	BL3-Apply	3
8	Secondary structure prediction of protein sequences using 3d-PSSM software.	Experiments	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
0	0	0	0	0	

## Part E

<b>Books</b>	Bioinformatics: D.W. Mount, Cold Spring Harbour Laboratories Ltd.
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/</a>
<b>References Books</b>	Introduction to bioinformatics by Cynthia Gibas
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102106065">https://nptel.ac.in/courses/102106065</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102106065">https://nptel.ac.in/courses/102106065</a>



## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	2	-	-	-	-	-	-	-	1	2	-
CO2	1	2	-	-	-	3	-	-	-	-	-	-	1	2	-
CO3	1	2	-	1	-	-	-	-	-	-	-	-	1	2	-
CO4	1	2	-	-	-	-	1	-	-	-	-	-	1	2	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	LAB COURSE III
<b>Course Code</b>	BT 206

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
					0	0	3	3
<b>Course Type</b>	Lab only							
<b>Course Category</b>	Foundation core							
<b>Pre-Requisite/s</b>	Knowledge about biochemicals			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To impart knowledge on structural, functional and dynamic aspects of biological components( <b>BL1-Remember</b> ) <b>CO2-</b> To understand ability to difference between a chemical catalyst and biocatalyst( <b>BL2-Understand</b> ) <b>CO3-</b> To apply the role of enzymes in clinical diagnosis and industries( <b>BL3-Apply</b> ) <b>CO4-</b> To analyze the various biomolecules in biological samples( <b>BL4-Analyze</b> ) <b>CO5-</b> To evaluate the applications of biomolecules in various fields( <b>BL5-Evaluate</b> )							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Qualitative analysis of carbohydrates		2
2	Qualitative analysis of lipids and fats	Experiment	3
3	Qualitative analysis of proteins	Experiment	3
4	Quantitative estimation of carbohydrates	Experiment	3
5	Quantitative estimation of proteins	Experiment	3
6	Determination of acid value in the given fat sample	Experiment	3
7	Determination of esterification value of given fat sample	Experiment	3
8			

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	Antibiotic sensitivity test against microorganism	Experiments	BL4-Analyze	2 days
II	Biochemical characterization of the given sample	PBL	BL4-Analyze	1 week
III	Adulteration test of various samples	Case Study	BL5-Evaluate	1 week

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	50				
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	50	60	30	40	

## Part E

<b>Books</b>	
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7545035/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7545035/</a>
<b>References Books</b>	David Plummer Practical Biochemistry Volume 3 Imer T and P L Bonner Enzymes: Biochemistry, Biotechnology, Clinical Chemistry 3rd Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103097">https://nptel.ac.in/courses/102103097</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103097">https://nptel.ac.in/courses/102103097</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	2	-	-	1	-	1
CO2	2	3	2	-	2	2	-	-	-	2	-	-	1	-	3
CO3	3	1	1	-	1	-	-	-	-	-	-	-	3	-	3
CO4	3	2	1	-	1	-	-	-	-	2	-	-	2	-	2
CO5	2	1	1	-	1	-	-	-	-	2	-	-	2	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	LAB COURSE IV
<b>Course Code</b>	BT 207

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
					0	0	3	3
<b>Course Type</b>	Lab only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Knowledge about biomolecules and immunity			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To observe and understand the types of DNA and its replication among prokaryotes &amp; eukaryotes. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> To understand the Different cells &amp; proteins involved in Immune system <b>(BL2-Understand)</b></p> <p><b>CO3-</b> To compare and distinguish the functions of various enzymes involves in transcription process of prokaryotes as well as eukaryotes. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> To apply the use of Proteins &amp; receptors in antibody formation <b>(BL3-Apply)</b></p> <p><b>CO5-</b> To evaluate the applications of Antigens &amp; Antibodies in Diagnostic &amp; Medical Research <b>(BL5-Evaluate)</b></p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education) SDG8(Decent work and economic growth)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Quantitative estimation of DNA.	Experiment	3
2	Quantitative estimation of RNA	Experiment	3
3	Quantification of Protein spectrophotometrically	Experiment	3
4	Separation and estimation of DNA by Agarose gel electrophoresis	Experiment	3
5	Preparation of stock and buffer solutions/calculation for PAGE	Experiment	3
6	Protein profile using NATIVE Polyacrylamide gel Electrophoresis	Experiment	3
7	Protein profiling using SDS-PAGE	Experiment	3
8	DNA amplification by PCR	Experiment	3

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	DNA isolation from onion	Experiments	BL4-Analyze	2
II	Protein analysis of different samples	PBL	BL4-Analyze	6
III	To perform ELISA test	PBL	BL4-Analyze	15 DAYS

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
0	0	0	0	0	0
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	50	60	30	40	

## Part E

<b>Books</b>	
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/</a> <a href="https://medcraveonline.com/MOJI/cytokines-and-their-role-in-health-and-disease-a-brief-overview.html">https://medcraveonline.com/MOJI/cytokines-and-their-role-in-health-and-disease-a-brief-overview.html</a>
<b>References Books</b>	Ivam M Roitt Roits Essentials Immunology 12th Edition David Frei Felder Molecular Biology 4 th Edition Lewin and Benjamin Genes 12th Edition Abdul K Abbas Cellular & Molecular Immunology 10th Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102106065">https://nptel.ac.in/courses/102106065</a> <a href="https://nptel.ac.in/courses/102105083">https://nptel.ac.in/courses/102105083</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102106065">https://nptel.ac.in/courses/102106065</a> <a href="https://nptel.ac.in/courses/102105083">https://nptel.ac.in/courses/102105083</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	2	-	-	-	2	-	-	1	-	1
CO2	2	3	2	2	2	1	-	-	-	2	-	-	1	-	3
CO3	3	1	1	2	1	-	-	-	-	-	-	-	3	2	2
CO4	3	2	1	1	1	-	-	-	-	2	-	-	2	3	2
CO5	2	2	1	1	1	-	-	-	-	2	-	-	2	2	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Applied Biotechnology & Microbiology
<b>Course Code</b>	BT-201[T]

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Student must be acquainted with the basic knowledge of biotechnological and microbiological applications			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To understand professional and scientific communication approaches for microbiology and biotechnology settings. <b>(BL2-Understand)</b></p> <p><b>CO2-</b> Demonstrate comprehensive understanding of organizational processes and product development pipelines <b>(BL2-Understand)</b></p> <p><b>CO3-</b> Distinguish among diverse methods and technologies and their applications in microbiology and biotechnology <b>(BL3-Apply)</b></p> <p><b>CO4-</b> Appraise the current regulatory, quality control, and legal frameworks that impact biotechnology and ethical behaviors that foster positive and productive interactions in diverse microbiology and biotechnology settings. <b>(BL4-Analyze)</b></p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education) SDG8(Decent work and economic growth)				



## Part B

Modules	Contents	Pedagogy	Hours
I	Functional Genomics and Proteomics -- Approaches to analyze differential expression of genes; Gene tagging; Gene trapping; Gene silencing; Knockout mutants; Approaches to proteome analysis; Dynamic modulation of protein structure and function	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
II	Molecular biology tools for Environmental management, rDNA technology in waste treatment, Genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Biosensors development to monitor pollution	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
III	Bioremediation: In situ and ex-situ techniques, advantages of bioremediation. Phytoremediation: Phytoremediation of xenobiotics and bioaccumulation of metals using plants. Biodegradation of petroleum constituents and associated heavy metal, case study with example	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, ABL Experiments,	8
IV	Nanotechnology in medicine Basics of nanotechnology, nanomaterials and nanoparticles, nanotools, Nanoparticles in cancer therapeutics, Nanodiagnostics. In vitro nanodiagnostics – nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics In vivo nanodiagnostics– gold nanoparticles, nanotubes, quantum dots– nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
V	Pharmacology & Drug development Introduction to Pharmacology Concept of Essential Drugs Routes of Drug Administration Introduction to Drug Discovery and Development. Hurdles in Drug Development Sources of Drugs Approaches to Drug Discovery Pharmacovigilance Factors affecting drug response	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Grams staining	Experiments	BL2-Understand	3
II	To understand the bioremediation process	PBL	BL2-Understand	3 days
III	Identification of plants showing phytoremediation	Experiments	BL3-Apply	1 week

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation

## Part E

<b>Books</b>	Prentice hall, International, Katzung, B.G;Basic and Clinical Pharmacology ;7th Edition Mehra.J.K;Drug interaction;Basic Bussiness Publ, Bombay
<b>Articles</b>	
<b>References Books</b>	Lippincott, Williams and Wilkins;Remington Pharmaceutical Sciences. Chattopadhyay K K "Microbial Genomics And Proteomics" by Niyaz Ahmed;Introduction to Nanoscience and Nanotechnology
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/105107173">https://nptel.ac.in/courses/105107173</a> <a href="https://nptel.ac.in/courses/118106019">https://nptel.ac.in/courses/118106019</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/105107173">https://nptel.ac.in/courses/105107173</a> <a href="https://nptel.ac.in/courses/118106019">https://nptel.ac.in/courses/118106019</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	2	1	-	-	-	-	-	2	2	1
CO2	1	1	2	2	-	1	-	-	-	-	1	-	1	3	2
CO3	1	2	2	2	1	1	1	-	-	-	-	-	1	1	2
CO4	3	2	1	1	2	1	-	-	-	-	-	-	1	1	1
CO5	1	2	-	2	2	3	-	-	-	-	-	-	2	3	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Stem cell biology
<b>Course Code</b>	BT-205 (T)

#### Part A

Year	1st	Semester	2nd	Credits	L	T	P	C
						4	0	0
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Knowledge about basics of cell			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To remember the basics of stem cell structure and properties.(<b>BL1-Remember</b>)</p> <p><b>CO2-</b> To understand the techniques involved in the culturing of functional stem cell.(<b>BL2-Understand</b>)</p> <p><b>CO3-</b> To apply the bioengineering and development of mammalian stem cells in the laboratory(<b>BL3-Apply</b>)</p> <p><b>CO4-</b> To interpret the various applications of stem cells in treating various diseases(<b>BL4-Analyze</b>)</p> <p><b>CO5-</b> To Justify the industrial approach to stem cells. Ethical and Legal issues: and Guidelines in conducting human stem cell research.(<b>BL5-Evaluate</b>)</p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Basic of biology of stem cells; Unique properties of stem cells. Types & sources of stem cells: embryonic, fetal, cord blood, placenta, adult, bone marrow: hematopoietic and Mesenchymal stem cells. Organ Derived Stem cells, Cancer stem cells, induced pluripotent stem cells, Stem cell banking.	Lecture method, demonstrations, experiment, ABL, PBL, case studies	8
2	Stem cell characterizations: Bone Marrow Mesenchymal Stem Cells, Hematopoietic Stem Cells isolation & characterizations, markers & their identification. Blood cell formation from Bone marrow stem cell.	Lecture method, demonstrations, experiment, ABL, PBL, case studies	8
3	Growth factor requirement and stem cell maintenance in in-vitro culture. Bone marrow transplantation versus Stem cell transplantation. Stem Cells and Cloning, Molecular basis of stem cell self-renewal, pluripotency, and differentiation, Metaplasia, and trans-differentiation	Lecture method, demonstrations, experiment, ABL, PBL, case studies	8
4	Role of signal transduction pathways in self-renewal and differentiation of stem cells. Cell cycle regulators in stem cells. Therapeutic application of stem cells: Current State and Future Perspectives, Neurodegenerative diseases, Spinal cord injury, Heart disease, Diabetes, Burns and Skin ulcers, Muscular Dystrophy.	Lecture method, demonstrations, experiment, ABL, PBL, case studies	8
5	Orthopedic applications, Stem cells, and gene therapy. An industrial approach to stem cells. Ethical and Legal Issues: ICMR DBT Guidelines in conducting human stem cell research	Lecture method, demonstrations, experiment, ABL, PBL, case studies	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	To study the basic features of stem cell	Experiments	BL2-Understand	2
2	Study of stem cells preserved under in vitro conditions	PBL	BL4-Analyze	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	0				

## Part E

<b>Books</b>	R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, 1. Handbook of Stem Cells, Two Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult&Fetal Stem Cells,2012, Academic Press. Volume, Volume 1-2: Volume 1- 2012, Academic Press. J.J.Mao, G.Vunjak-Nova kovicetal (Ed):“Transational ApproachesinTissue J.J.Mao, G.Vunjak-Nova kovicetal (Ed):“Transational ApproachesinTissue
<b>Articles</b>	<a href="https://www.mdpi.com/2306-5354/8/5/50">https://www.mdpi.com/2306-5354/8/5/50</a>
<b>References Books</b>	R.Lanza,J.Gearhartetal (Ed), Elsevier Academic press. Essentials of Stem Cell Biology, 1. . Elsevier Academic press. Engineering & Regenerative Medicine” 2008, Artech House. INC Publications. NaggyN. Habib,M.Y.Levicar, L.G. Jiao and N. Fisk: Stem Cell Repair andRegeneration.Volume-2,2007, Imperial College Press Volume 2, 2007, Imperial College Press
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102106035">https://nptel.ac.in/courses/102106035</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102106035">https://nptel.ac.in/courses/102106035</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	2	-	-	-	2	-	-	1	-	1
CO2	2	3	2	2	2	1	-	-	-	2	-	-	1	-	3
CO3	3	1	1	2	1	-	-	-	-	-	-	-	3	2	3
CO4	3	2	1	1	1	-	-	-	-	2	-	-	2	3	2
CO5	2	1	1	2	1	-	-	-	-	2	-	-	2	2	2
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-





## Syllabus-2023-2024

(SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Genetic Engineering
<b>Course Code</b>	BT 301 (T)

### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Embedded theory and lab							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	knowledge of DNA RNA structure and mutation types in DNA			<b>Co-Requisite/s</b>	Effects of Changes in DNA on cell and Protein formation and use of different proteins in Health and Medicine Industry			
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To remember the role of all the enzymes used in the DNA editing( <b>BL1-Remember</b> ) <b>CO2-</b> To understand the method of creating new molecules such as DNA & RNA( <b>BL2-Understand</b> ) <b>CO3-</b> To understand the importance Nucleic acid editing tools ( <b>BL2-Understand</b> ) <b>CO4-</b> To apply the understanding of creation of new DNA, RNA & Protein and its use in different Fields.( <b>BL3-Apply</b> ) <b>CO5-</b> To evaluate the applications of in various fields such as research, Agriculture, Pharmaceutical industries( <b>BL5-Evaluate</b> )							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✓		<b>SDG (Goals)</b>	SDG4(Quality education) SDG8(Decent work and economic growth)				

## Part B

Modules	Contents	Pedagogy	Hours
1	Essential enzymes used in r-DNA technology, Types of Restriction enzymes and their mechanism, Restriction modification system. Cloning vectors- Plasmids, Cosmids, Phagmids, Phasmids, Artificial hromosomes (YAC and BAC), Shuttle vectors, Expression vectors, for E.coli, Hybrid Plasmid and phage vectors. Host organism used for expression system	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
2	Genetic transformation in plants:Agrobacterium mediated transformation in plants, crown gall and hairy root producing strains, structure and features of Ti and Ri plasmids, mechanisms of DNA transfer. Recalcitrance of monocot for Agrobacterium mediated transformation.Ti and Ri plasmid based vectors, Binary vectors, use of 35SCaMV and other promoters, selectable marker, Reporter genes. Methods of direct DNA transfer, particle bombardment, electroporation, Microinjection. Transfection, Alternative DNA transfer methods	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
3	Strategies for development of Tolerant/Resistant plants and their utility for productivity and performance: Herbicide resistance (Glyphosate, phosphinothricin, Sulfonylurea, Atrazine). Insect resistance: Bt Genes, Non-Bt like protease inhibitors, Alpha amylase inhibitor, Trypsin inhibitor; Genetically modifies plants: Examples, Advantages and disadvantages	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
4	Gene therapy: types of gene therapy, Strategies of gene delivery, Gene replacement/augmentation, gene therapy for cancer cells, Gene silencing. RNA interference; Si RNA and mi RNA.. DNA fingerprinting and its applications.Human genome project: Objective and goals. Protein engineering : examples and application	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
5	Applications of r-DNA technology in health, agriculture, industrial sectors and pharmaceuticals. Molecular Farming: Pharming in animals and plants, Nutritional quality: golden rice,protein, vitamins. Archeogenetics: Introduction and application	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Preparation of stock and buffer solutions for DNA isolation	Experiments	BL2-Understand	3
2	Isolation of DNA from yeast cells.	Experiments	BL3-Apply	3
3	Isolation of DNA from Plant cell.	Experiments	BL3-Apply	3
4	Isolation of plasmid DNA	Experiments	BL3-Apply	3
5	Agarose gel electrophoresis of Genomic DNA	Experiments	BL5-Evaluate	3
6	Quantification of DNA by spectrophotometer(260/280nm)	PBL	BL2-Understand	6
7	Isolation of RNA from Yeast cell	PBL	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	0	40	20	60	30



## Part E

<b>Books</b>	TA Brown Gene cloning 4th Edition
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3078015/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3078015/</a>
<b>References Books</b>	Waston J.D. Molecular Biology of the Gene: 4th Edition Primrose and Twyman Principles of Gene Manipulation and Genomics 8th Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103074">https://nptel.ac.in/courses/102103074</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103074">https://nptel.ac.in/courses/102103074</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	-	2	1	-	-	-	-	1	1	3
CO2	1	2	2	-	-	-	2	1	-	-	-	-	2	1	2
CO3	2	3	2	-	-	-	1	2	-	-	-	-	2	1	2
CO4	2	3	1	-	-	-	2	2	-	-	-	-	3	2	2
CO5	3	1	3	-	-	-	3	3	-	-	-	-	3	2	3
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Plant Biotechnology
<b>Course Code</b>	BT 302(T)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Should be acquainted with the basic knowledge of plants, tissue culture techniques, molecular biology and genetics			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To understand and recall the basic terms, techniques, historical landmarks of plant tissue culture( <b>BL1-Remember</b> ) <b>CO2-</b> To understand the establishment of callus and suspension cultures( <b>BL2-Understand</b> ) <b>CO3-</b> To observe and differentiate the behavior of various explants towards the different types of nutrient media( <b>BL3-Apply</b> ) <b>CO4-</b> To standardize the techniques and nutrient media for the growth and development of in vitro cultures using techniques like single cell culture, protoplast culture, anther culture, etc( <b>BL6-Create</b> ) <b>CO5-</b> To develop in vitro regenerated and transgenic plantlets using various tools and techniques of plant tissue culture. ( <b>BL5-Evaluate</b> )							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✓ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✓		<b>SDG (Goals)</b>	SDG3(Good health and well-being) SDG4(Quality education) SDG12(Responsible consumption and production) SDG15(Life on land)				

## Part B

Modules	Contents	Pedagogy	Hours
I	Objectives, roles and landmarks in plant tissue culture. Concepts and basic techniques in tissue culture. media (composition and preparation), <del>seed production techniques: release of new varieties</del> , Initiation and maintenance of callus and suspension cultures, cell synchronization, somatic embryogenesis.	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
II	Shoot tip culture for rapid clonal propagation and production of virus free Plants, Micropropagation: principle, technique, applications and abnormalities of micropropagated plants. Organogenesis and <u>its advantages</u>	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	9
III	Somaclonal variations and applications, <u>Haploid production</u> , Anther culture & their application Embryo culture /embryo rescue. Protoplast culture: isolation, fusion and culture, somatic hybridization, selection of hybrid cells and, regeneration of hybrid cell and cybrids. Synthetic seeds	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience,ABL Experiments, Video lectures	9
IV	Secondary metabolites and their production. Plant cloning vectors: Ti plasmid and direct gene transfer. Cryopreservation: techniques and application. Concept of Intellectual property right (IPR) and protection (IPP), patenting of biological material	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
V	<u>Seed production techniques: release of new varieties</u> , Transgenic crops: Pest and herbicide resistance. Insect resistance: BT genes, non-BT like protease inhibitors, lectins. <del>Plant breeder's right: UPOV 369,370, 372</del> . Genetically modified crops for resistance against biotic and abiotic stresses and improved nutritional quality	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	9

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
II	Establishment of Callus and suspension cultures	PBL	BL3-Apply	5
III	Establishment of in vitro regenerated plantlets and analyze their secondary metabolite production	PBL	BL5-Evaluate	7
III	in vitro regeneration of a commercially important plant	Internships	BL6-Create	3 months

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	0				

## Part E

<b>Books</b>	Smith.R; Plant Tissue Culture: Techniques and Experiments. Academic Press, 2012 Singh B.D. Plant Biotechnology, Kalyani Publishers, 2014.
<b>Articles</b>	<a href="https://www.mdpi.com/2223-7747/9/12/1733">https://www.mdpi.com/2223-7747/9/12/1733</a> <a href="https://www.nature.com/articles/nbt1100_1151">https://www.nature.com/articles/nbt1100_1151</a>
<b>References Books</b>	Bhojwani.S.S & Raazdan.M.K.Plant Tissue Culture Kole, C., Michler, C., Abbott, A.G., Hall, T.C. (Eds.) Transgenic Crop Plants: Volume 1: Principles and Development. Springer. 2010 Kole, C., Michler, C., Abbott, A.G., Hall, T.C. (Eds.) Transgenic Crop Plants: Volume 2: Utilization and Biosafety. Springer. 2010
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103016">https://nptel.ac.in/courses/102103016</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103016">https://nptel.ac.in/courses/102103016</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	2	1	-	-	-	-	-	-	1	2	2
CO2	1	-	2	3	1	-	-	-	-	-	-	-	2	1	3
CO3	1	2	1	3	-	2	1	-	-	-	1	-	-	2	1
CO4	2	2	3	1	1	2	1	-	-	-	-	-	2	3	2
CO5	1	1	1	-	2	1	-	-	-	-	1	-	1	3	1
CO6	1	2	1	2	3	-	-	-	-	-	-	-	-	2	1

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Animal Biotechnology
<b>Course Code</b>	BT 303 (T)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	The course prepares the student to understand the Animal Biotechnology: and how does it interact with living and non-living molecules.			<b>Co-Requisite/s</b>	The course aims to provide basis of analyzing the applications of Animal Biotechnology in various fields such as research and industries for the production of diff. therapeutic product and stem cell technology also use for treatment of different diseases			
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> The course prepares the student to understand the Animal Biotechnology: and how does it interact with living and non-living molecules <b>(BL1-Remember)</b></p> <p><b>CO2-</b> The subject Fundamental of Animal Biotechnology is designed to under graduate students of biotechnology for understanding of basic concepts of each and every part of Animal Biotechnology and their types. <b>(BL2-Understand)</b></p> <p><b>CO3-</b> The course aims to provide experimental basis, and to enable students to acquire a specialized knowledge and understanding. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> The course aims to provide basis of analyzing the applications of Animal Biotechnology in various fields such as research and industries for the production of diff. therapeutic product and stem cell technology also use for treatment of different diseases. <b>(BL4-Analyze)</b></p> <p><b>CO5-</b> To apply the understanding of Animal Biotechnology in evaluation in various Biological Samples and to evaluate the applications of Animal Biotechnology in various fields such as research and industries <b>(BL5-Evaluate)</b></p>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✓		<b>SDG (Goals)</b>	SDG4(Quality education)				

## Part B

Modules	Contents	Pedagogy	Hours
1	History and Scope of animal biotechnology: Design of animal tissue culture lab, Layout, Planning, construction, cell culture vessels. Nutritional requirement of cell and growth media selection of media, types of medium, cell culture medium. Basic aseptic techniques	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Design of experiments in tissue culture: Tissue culture technique, Primary cell culture and types, Chicken embryo culture, Fibroblast culture, Secondary culture, Suspension culture, Characteristics of cell in culture: contact inhibition, anchorage dependence and independence, Organ culture: methods, the behavior of organ ex-plants and the utility of organ culture. Growth study of the cell, cell proliferation, cell cycle, and mitosis in growing cells.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8
3	Cell lines: definition development of cell lines, characterization, and maintenance. Established cell lines, Characteristics, and cryopreservation. Freeze storing of cell and transport of culture. Cell cloning and selection, Transfection, and Transformation. Expression of the cloned protein in animal cells.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, ABL Experiments,	9
4	Cell culture Reactors: Scale-up in suspension, scale-up in monolayer, Different reactors used in Suspension, and monolayer culture. Commercial Scale Production of an animal cell, Stem cell, and the application of ATC in drug testing and toxicity of environmental pollutants in cell culture.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lectures	8
5	Mass Production: Mass Production of biologically important compounds. Harvesting of Products, Purification and Assay. Production of Human and Viral Vaccines. Production and Application of monoclonal antibody. Transgenic animals: Technique and application. Tissue engineering and its application	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
0	0	0	0	0	0

## Part E

<b>Books</b>	Freshney, Wiley-Liss,-Culture of Animal Cells-5 th Edition-2005
<b>Articles</b>	<a href="https://www.nature.com/subjects/animal-biotechnology#:~:text=Animal%20biotechnology%20is%20a%20branch,pharmaceutical%2C%20agricultural%20or%20industrial%20applications">https://www.nature.com/subjects/animal-biotechnology#:~:text=Animal%20biotechnology%20is%20a%20branch,pharmaceutical%2C%20agricultural%20or%20industrial%20applications</a>
<b>References Books</b>	G.Zubay -Animal Cell Culture Techniques-3 rd Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102104059">https://nptel.ac.in/courses/102104059</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102104059">https://nptel.ac.in/courses/102104059</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	3	1	3	3	1	1	1	3	1	-	-	-
CO2	2	3	3	2	1	3	1	2	2	3	3	1	-	-	-
CO3	3	3	1	1	3	3	3	2	1	1	3	2	-	-	-
CO4	2	1	2	1	3	1	1	3	2	2	3	1	-	-	-
CO5	3	3	2	2	1	3	3	1	1	1	1	2	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Agriculture Biotechnology and IPR
<b>Course Code</b>	BT 305 (T)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Student should have basic knowledge of botany and genetic engineering			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To define and contrast the terms agriculture and agricultural biotechnology( <b>BL1-Remember</b> ) <b>CO2-</b> To understand the techniques, skills, and modern engineering tools necessary for engineering practice in agriculture biotechnology( <b>BL2-Understand</b> ) <b>CO3-</b> To define the concept of utilizing plants for production of vaccines and production of biofertilizers( <b>BL2-Understand</b> ) <b>CO4-</b> To apply the knowledge of engineering principles of agriculture biotechnology to living entities for societal welfare( <b>BL3-Apply</b> ) <b>CO5-</b> The students will be able to develop the relationship between science and society and will be able to give justification for biotechnological manipulation of plants for human use( <b>BL4-Analyze</b> )							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✓ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✓ Environment ✓		<b>SDG (Goals)</b>	SDG3(Good health and well-being) SDG4(Quality education)				



## Part B

Modules	Contents	Pedagogy	Hours
I	Introduction To Agricultural Biotechnology: Origin of cultivated plants and plant indication, Introduction to Indian Agriculture heritage; Soil management and its relevance in Pre-modern India. Review of plant cell structure and function; Review of water uptake Introduction to plant nutrition; Mineral availability- uptake of minerals	Lecture method, demonstrations, field visit, ABL, Case studies, ABL.	8
II	Methods of breeding self-pollinated and vegetatively propagated plants; Seed Germination and Seedling Growth; Photoperiodism and its significance; Vernalization and hormonal control. Heterosis-Genetic and Molecular basis, Apomixis -Mechanism and significance in crop improvement	Lecture method, demonstrations, field visit, ABL, Case studies, ABL.	9
III	Post Harvest Biotechnology: Importance of post harvest physiology; Stages of growth; Maturity indices; Fruit ripening-changes during ripening; Post harvest losses-types; Technologies to control post harvest losses; Respiration and transpiration loss, methods to measure respiration and transpiration losses; Spoilage of fruit and vegetable, Microbial contaminants and post-harvest pathology	Lecture method, demonstrations, field visit, ABL, Case studies, ABL.	8
IV	Biotechnology In Organic Farming: Organic farming, principles and its scope in India; Role of Biotechnology in organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Molecular Farming And Nitrogen Fixation: Molecular farming for the production of industrial enzymes, biodegradable plastics, polyhydroxybutyrate, antibodies, edible vaccines; Metabolic engineering of plants for the production of fatty acids, industrial oils, flavonoids etc.,.	Lecture method, demonstrations, field visit, ABL, Case studies, ABL.	9
V	Introduction to Intellectual Property Rights Concept and Theories Kinds of Intellectual Property Rights Economic analysis of Intellectual Property Rights Need for Private Rights versus Public Interests Advantages and Disadvantages of IPR, International Regime Relating to IPR TRIPS and other Treaties (WIPO,WTO, GATTs)		8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	To analyze the soil samples of various locations to check its fertility.	PBL	BL4-Analyze	1 week
II	To study the mechanism and significance in crop improvement.	Industrial Visit	BL4-Analyze	8 hrs
III	To apply for the patent for a specific product, product development process or any idea	PBL	BL6-Create	15 days

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation

## Part E

<b>Books</b>	MS Swamynathan, Biotechnology in Agriculture, a Dialogue, 1981 Arun K. Sharma, Hand book of organic farming Agrobios, 2002
<b>Articles</b>	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8751662/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8751662/</a>
<b>References Books</b>	Arie Altman Paul Hasegawa, Plant Biotechnology and Agriculture, 2011 K. Lindsey and M.G.K. Jones, Plant biotechnology in Agriculture, 1989
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/126105014">https://nptel.ac.in/courses/126105014</a> <a href="https://nptel.ac.in/courses/126105337">https://nptel.ac.in/courses/126105337</a> <a href="https://nptel.ac.in/courses/109106128">https://nptel.ac.in/courses/109106128</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/126105014">https://nptel.ac.in/courses/126105014</a> <a href="https://nptel.ac.in/courses/126105337">https://nptel.ac.in/courses/126105337</a> <a href="https://nptel.ac.in/courses/109106128">https://nptel.ac.in/courses/109106128</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	-	-	-	-	-	1	2	3	2
CO2	1	-	2	3	-	3	2	-	-	-	-	-	1	2	2
CO3	1	3	1	3	1	1	1	1	-	-	-	-	-	1	2
CO4	2	1	2	2	1	-	2	-	-	-	-	-	2	2	1
CO5	2	3	1	2	2	2	1	-	-	-	-	-	3	2	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Research Methodology
<b>Course Code</b>	BT-305 (T)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					4	0	0	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Provides understanding of the basic concepts of research, their types and applications of Biostatistics in research and development.			<b>Co-Requisite/s</b>	Should have basic knowledge of data and its applications			
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> The course prepares the student to understand the basic concepts of Research Methodology, its applications in experimental design and future prospects. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> The subject Research Methodology is designed for post graduate students of Food Technology for describing the basic concepts of each and every division of the subject along with its applications in other fields. <b>(BL2-Understand)</b></p> <p><b>CO3-</b> The course aims to provide experimental basis, and to enable students to acquire a specialized knowledge and understanding of data and its applications in experimental verification. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> The course aims to provide basis of analyzing the applications of Research Methodology in various fields of research and industries <b>(BL3-Apply)</b></p> <p><b>CO5-</b> The course aims to provide basis of experimental design, computer applications and use of statistical tools in research and industries. <b>(BL3-Apply)</b></p>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG2(Zero hunger) SDG4(Quality education) SDG6(Clean water and sanitation) SDG8(Decent work and economic growth)				

#### Part B

Modules	Contents	Pedagogy	Hours
1	Introduction: Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Purposes - Research Design - Survey Research - Case Study Research. Research Reports, Introduction to SPSS	Class room teaching (chalk-board) Power Point Presentations Online Classes Interactive Videos	8
2	Data Collection: Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire - Sampling Merits and Demerits - Experiments - Kinds - Procedure; Control Observation	Class room teaching (chalk-board) Power Point Presentations Online Classes Interactive Videos	8
3	Introduction to Statistics - Probability Theories - Conditional Probability, Point and Interval Estimates of Means and Proportions; Hypothesis Tests, One Sample Test - Two Sample Tests / Chi-Square Test, t-test - Standard deviation	Class room teaching (chalk-board) Power Point Presentations Online Classes Interactive Videos	8
4	Statistical Applications: Analysis of Variance, Completely Randomized Design, Randomized Complete Block Design, Latin Square Design	Class room teaching (chalk-board) Power Point Presentations Online Classes Interactive Videos	8
5	Computer application: Use of computers for preparing and presenting Documents. Appropriate Statistical and other relevant packages, internet .Use of MS-Office, Library documentation and Scientific literature searching	Class room teaching (chalk-board) Power Point Presentations Online Classes Interactive Videos	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Steps in scientific research methodology	Case Study	BL2-Understand	3
2	Sampling process	Case Study	BL2-Understand	3
3	Developing Hypothesis	Case Study	BL2-Understand	3
4	Data collection	Case Study	BL2-Understand	3
5	ANOVA: CRD	Field work	BL3-Apply	3
6	RBD	Field work	BL3-Apply	3
7	Components of scientific research paper	Case Study	BL2-Understand	3
8	t-test	Case Study	BL3-Apply	3
9	Chi Square Test	Field work	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	20
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
0	0	0	0	0	0

## Part E

<b>Books</b>	Research methodology, C.R. Kothari, 6th Edition
<b>Articles</b>	<a href="https://nptel.ac.in/courses/127106227">https://nptel.ac.in/courses/127106227</a>
<b>References Books</b>	Methodology and techniques of Social Research, Wilkinson and Bhandarkar, 3rd Edition
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/121106007">https://nptel.ac.in/courses/121106007</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/121106007">https://nptel.ac.in/courses/121106007</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	2	-	-	-	-	-	-	2	-	2
CO2	1	2	3	2	3	2	-	-	-	-	-	-	1	2	3
CO3	1	2	2	2	2	2	-	-	-	-	-	-	2	2	1
CO4	1	2	2	1	2	-	-	-	-	-	-	-	2	2	1
CO5	1	2	2	1	2	1	-	-	-	-	-	-	2	1	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Bioprocess Engineering
<b>Course Code</b>	BT304 (T)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					3	0	1	4
<b>Course Type</b>	Theory only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Should be familiar with the basics of Bioprocess Engineering, techniques used for the production, purification and transport of metabolites, production of different metabolites with the help of microbes and their kinetics.			<b>Co-Requisite/s</b>	Should have the different fermentation processes, transport phenomenon and production of some important industrial metabolites			
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> The course prepares the student to understand the basic concepts of Bioprocess Engineering, its applications and future prospects. <b>(BL1-Remember)</b></p> <p><b>CO2-</b> The subject Bioprocess Engineering is designed for post graduate students of biotechnology for understanding of basic concepts of each and every division of the subject along with its applications in other fields. <b>(BL2-Understand)</b></p> <p><b>CO3-</b> The course aims to provide experimental basis, and to enable students to acquire a specialized knowledge and understanding. <b>(BL3-Apply)</b></p> <p><b>CO4-</b> The course aims to provide basis of analyzing the applications of Bioprocess Engineering in various fields of research and industries <b>(BL3-Apply)</b></p> <p><b>CO5-</b> The course aims to provide basis of design, production and purification of bioproducts produced through research and in industries. <b>(BL3-Apply)</b></p>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✓ Employability ✓ Professional Ethics X Gender X Human Values X Environment X		<b>SDG (Goals)</b>	SDG2(Zero hunger) SDG3(Good health and well-being) SDG4(Quality education) SDG8(Decent work and economic growth)				

#### Part B

Modules	Contents	Pedagogy	Hours
1	Units and dimensions: dimensional analysis, stoichiometric and composition relationship, Newton's law of viscosity and its measurement. Introduction to bioprocess technology Isolation and screening of Industrial microorganisms, Preservation and maintenance of industrial microorganisms	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
2	Kinetics of microbial growth, death and product synthesis; Air and media sterilization, Construction, design and types of bioreactor. Kinetics of batch, fed batch and continuous reactor. Automation for monitoring and control	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
3	Transport phenomenon in biochemical engineering: Mass transfer, heat transfer, rheology, Aeration and agitation. Product recovery processes, centrifugation, chromatography, extraction process, crystallization, drying and packaging. Quality assurance and safety consideration in DSP, Bioprocess Economics.	Tutorials, Collaborative, Demonstrations, Project methods Experiments,	8
4	Microbial production of Antibiotics (Penicillin and Streptomycin) and Enzymes (Amylase, Protease) with applications. Microbial Production of Vitamin (Vitamin B12), amino acids (Glutamic acid).	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments, Video lecture	8
5	Microbial production of Organic acids (Citric acid and Acetic Acid), solvents (Ethanol and acetone). Microbial production of food-SCP.	Tutorials, Collaborative, Demonstrations, Project methods, Hands on experience, Experiments,	8

## Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Isolation of industrially important microbes from soil by serial dilution method	Experiments	BL3-Apply	3
2	Isolation of industrially important microbes from water	Experiments	BL3-Apply	3
3	Isolation of industrially important microbes from air	Experiments	BL3-Apply	3
4	Microbial production of ethanol from orange juice using S. Cereviseae	Experiments	BL4-Analyze	3
5	Microbial production of ethanol from pineapple juice using S. Cereviseae	Experiments	BL3-Apply	3
6	Microbial production of ethanol from grape juice using S. Cereviseae	Experiments	BL3-Apply	3
7	Microbial production of citric acid using Aspergillus niger	Experiments	BL3-Apply	3
8	Microbial production of acetic acid	Experiments	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	60	18	40	20
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	40	40	12	60	30

## Part E

<b>Books</b>	Bioprocess Engg. Principles, P.M. Doran, Elsevier.
<b>Articles</b>	<a href="https://www.researchgate.net/topic/Bioprocess-Engineering">https://www.researchgate.net/topic/Bioprocess-Engineering</a>
<b>References Books</b>	Bioprocess Engg., Schular, Kargi
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102106022">https://nptel.ac.in/courses/102106022</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102106022">https://nptel.ac.in/courses/102106022</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	1	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO3	1	2	2	-	-	-	-	-	-	-	-	-	1	2	-
CO4	1	2	2	-	-	-	-	-	-	-	-	-	1	2	-
CO5	1	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Lab Course V
<b>Course Code</b>	BT306 (P)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					0	0	3	3
<b>Course Type</b>	Lab only							
<b>Course Category</b>	Discipline Core							
<b>Pre-Requisite/s</b>	Student must have basic knowledge of botany and plant physiology			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> To standardize the techniques and nutrient media for the growth and development of in vitro cultures using techniques like single cell culture, protoplast culture, anther culture, etc. <b>(BL3-Apply)</b> <b>CO2-</b> To develop in vitro regenerated and transgenic plantlets using various tools and techniques of plant tissue culture. <b>(BL4-Analyze)</b> <b>CO3-</b> To understand and develop new varieties of genetically modified crops in order to increase the production <b>(BL5-Evaluate)</b>							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG3(Good health and well-being) SDG4(Quality education) SDG13(Climate action) SDG15(Life on land)				

#### Part B

Modules	Contents	Pedagogy	Hours
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#### Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
I	Laboratory design and set up of plant tissue culture unit.	Experiments	BL2-Understand	2
X	Preparation of artificial seeds to overcome seed dormancy	PBL	BL6-Create	5
III	Sterilization of media and apparatus	Experiments	BL3-Apply	3
IV	Surface sterilization, sealing of culture, sources of contamination and their check measures.	Experiments	BL3-Apply	3
V	Callus induction, propagation and differentiation.	Experiments	BL4-Analyze	5
VI	Suspension culture	Experiments	BL4-Analyze	3
VII	Micrografting studies.	Experiments	BL5-Evaluate	3
VIII	Acclimatization of a in vitro raised plantlets	Experiments	BL6-Create	5

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	40				
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	50	40	20	60	

## Part E

<b>Books</b>	Smith.R; Plant Tissue Culture: Techniques and Experiments. Academic Press, 2012 Singh B.D. Plant Biotechnology, Kalyani Publishers, 2014.
<b>Articles</b>	<a href="https://www.mdpi.com/2223-7747/9/12/1733">https://www.mdpi.com/2223-7747/9/12/1733</a> <a href="https://www.nature.com/articles/nbt1100_1151">https://www.nature.com/articles/nbt1100_1151</a>
<b>References Books</b>	H.S. Chawla;An Introduction to Plant Biotechnology Kole, C., Michler, C., Abbott, A.G., Hall, T.C. (Eds.) Transgenic Crop Plants: Volume 2:Utilization and Biosafety. Springer. 2010 Kole, C., Michler, C., Abbott, A.G., Hall, T.C. (Eds.) Transgenic Crop Plants: Volume 1:Principles and Development. Springer. 2010
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102103016">https://nptel.ac.in/courses/102103016</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102103016">https://nptel.ac.in/courses/102103016</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	1	-	-	-	-	-	-	3	2	2
CO2	2	2	1	1	2	2	11	-	-	-	-	1	1	3	2
CO3	1	1	1	2	3	-	-	-	-	-	-	-	1	1	2
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Lab Course-VI
<b>Course Code</b>	BT307(P)

#### Part A

Year	2nd	Semester	3rd	Credits	L	T	P	C
					0	0	3	3
<b>Course Type</b>	Lab only							
<b>Course Category</b>	Disciplinary Major							
<b>Pre-Requisite/s</b>	The Bioprocess Engineering is designed to provide understanding of basic concepts of production techniques, their designing, applications, and perfectly blend with concepts of upstream and downstream process.				<b>Co-Requisite/s</b>	The student should have basic knowledge of design of experiments and the production of useful metabolites		
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> The course aims to provide basis of analyzing the applications of Bioprocess Engineering in various fields of research and industries.( <b>BL3-Apply</b> ) <b>CO2-</b> The course aims to provide basis of design, production and purification of bioproducts produced through research and in industries( <b>BL4-Analyze</b> )							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG4(Quality education)				

#### Part B

Modules	Contents	Pedagogy	Hours
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#### Part C

Modules	Title	Indicative-ABCA/PBL/ Experiments/Field work/ Internships	Bloom's Level	Hours
1	Isolation of industrially important microbes from the environment.	Experiments	BL3-Apply	3
2	Isolation of Industrially important microorganisms for microbial processes.	Experiments	BL3-Apply	3
3	Microbial production of alcohol using grape juice	Experiments	BL3-Apply	3
4	Microbial production of alcohol using orange juice	Experiments	BL3-Apply	3
5	Microbial production of alcohol using pineapple juice	Experiments	BL3-Apply	3
6	Microbial production of acetic acid	Experiments	BL3-Apply	3
7	Microbial production of alcohol using molasses	Experiments	BL3-Apply	3

## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	50				
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	0	40	20	60	30

## Part E

<b>Books</b>	Experiments in Microbiology, biotechnology, food microbiology, K. R. Aneja
<b>Articles</b>	<a href="https://www.researchgate.net/topic/Bioprocess-Engineering">https://www.researchgate.net/topic/Bioprocess-Engineering</a>
<b>References Books</b>	Bioprocess Engg. Principles, P.M. Doran, Elsevier.
<b>MOOC Courses</b>	<a href="https://nptel.ac.in/courses/102106022">https://nptel.ac.in/courses/102106022</a>
<b>Videos</b>	<a href="https://nptel.ac.in/courses/102106022">https://nptel.ac.in/courses/102106022</a>

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	1	2	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-





## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Research Project
<b>Course Code</b>	BT401

#### Part A

Year	2nd	Semester	4th	Credits	L	T	P	C
					0	0	14	14
<b>Course Type</b>	Project							
<b>Course Category</b>	Projects and Internship							
<b>Pre-Requisite/s</b>	Student must have basic knowledge of biotechnological laboratory skills			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<p><b>CO1-</b> To provide students with the fundamental tools and practical skills required to generate competent and highly qualified post graduates. <b>(BL2-Understand)</b></p> <p><b>CO2-</b> To acquaint the students with the principles of biosafety and ethical perspectives of biotechnological systems. <b>(BL2-Understand)</b></p> <p><b>CO3-</b> To develop students' ability to apply knowledge and skills to solve theoretical and practical problems in biology and biotechnology. <b>(BL5-Evaluate)</b></p> <p><b>CO4-</b> To provide students with the basis for the life-long self-learning in an attempt to keep up with the continuous quick changes in the field of biotechnology. <b>(BL3-Apply)</b></p> <p><b>CO5-</b> To equip students with the necessary critical theoretical background, develop the analytical, and basic research skills that will help students to pursue higher education in reputed institutes at both national and international levels <b>(BL4-Analyze)</b></p>							
<b>Coures Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✓ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG3(Good health and well-being) SDG4(Quality education) SDG8(Decent work and economic growth)				

#### Part B

Modules	Contents	Pedagogy	Hours
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## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	100				
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
200	0	200	100		

## Part E

<b>Books</b>	
<b>Articles</b>	
<b>References Books</b>	
<b>MOOC Courses</b>	
<b>Videos</b>	

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	1	1	-	1	-	-	-	-	-	-	2	2
CO2	1	1	2	1	2	2	1	-	-	-	-	-	2	3	1
CO3	1	2	2	2	2	2	2	-	-	-	-	-	1	2	2
CO4	1	2	1	1	2	2	2	-	-	-	-	-	1	1	1
CO5	3	-	1	1	-	-	2	-	-	-	-	-	1	3	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Syllabus-2023-2024

### (SOS)(MSc\_Biotechnology)

<b>Title of the Course</b>	Research Report and Presentation
<b>Course Code</b>	BT402

#### Part A

Year	2nd	Semester	4th	Credits	L	T	P	C
					0	0	4	4
<b>Course Type</b>	Project							
<b>Course Category</b>	Projects and Internship							
<b>Pre-Requisite/s</b>	Student must have basic knowledge of biotechnological laboratory skills.			<b>Co-Requisite/s</b>				
<b>Course Outcomes &amp; Bloom's Level</b>	<b>CO1-</b> Dissertation, Works As Skills Development In Students.( <b>BL3-Apply</b> ) <b>CO2-</b> Increases Their Mental Ability.( <b>BL4-Analyze</b> ) <b>CO3-</b> Express Their Opinion And Thoughts( <b>BL5-Evaluate</b> ) <b>CO4-</b> Enhancing Writing Skills And Knowledge.( <b>BL6-Create</b> )							
<b>Courses Elements</b>	Skill Development ✓ Entrepreneurship ✗ Employability ✗ Professional Ethics ✗ Gender ✗ Human Values ✗ Environment ✗		<b>SDG (Goals)</b>	SDG3(Good health and well-being) SDG4(Quality education)				

#### Part B

Modules	Contents	Pedagogy	Hours
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## Part D(Marks Distribution)

Theory					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
	50				
Practical					
Total Marks	Minimum Passing Marks	External Evaluation	Min. External Evaluation	Internal Evaluation	Min. Internal Evaluation
100	0	100	50		

## Part E

<b>Books</b>	
<b>Articles</b>	
<b>References Books</b>	
<b>MOOC Courses</b>	
<b>Videos</b>	

## Course Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	-	-	-	-	-	-	-	-	-	1	-	2
CO2	1	1	1	3	2	-	-	-	-	-	-	-	2	2	3
CO3	2	1	1	2	1	-	1	-	-	-	-	-	2	2	3
CO4	1	1	1	1	2	-	1	-	-	-	-	-	2	1	1
CO5	1	2	3	1	1	-	-	-	-	-	-	-	1	3	1
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

