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Program Structure
Program: (Biotechnology) Program
Code:SBR0404
Batch: 2021-onwards
Department of Life Sciences
School of Basic Science & Research

1. Standard Structure of the Program at University Level

Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**
4. **Seeking beyond boundaries**

Creative Campaign can be TEDs: This is guiding principle for promotion and wide circulation among various stakeholders.

Guidelines: Similar Mnemonics can be designed by schools.

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

Note: Detailed Mission Statements of University can be used for developing Mission Statements of Schools/ Departments.

Vision and Mission of the Department

Vision of the Department

To acquire and impart knowledge of biology and bio-techniques so as to build capacity for addressing current global challenges

Mission of the Department

1. **To train and transform students into thinking researchers/ professionals who are able to integrate theoretical knowledge and analytical skills in diverse areas of Biotechnology.**
2. **To make students and faculties updated with advance techniques and to introduce the students to dynamic environment of bioscience**
3. **To conduct cutting-edge interdisciplinary research.**
4. **To introduce various skill development courses thereby enhancing the employability and providing opportunities for industry-academia collaboration.**

Programme Educational Objectives (PEO)

Writing Programme Educational Objectives (PEO)

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PEO1: To createa foundation of various biological concepts and phenomena in the minds of students through theoretical and practical knowledge.

PEO2: Tokeep students upgraded with new discoveries in biological world and inculcate continuous learning and self-improvement so that students are motivated for higher studies and research.

PEO3: To teach the students various bio-techniques and application of these techniques for betterment of society and environment.

PEO4: Tomake students industry- or academia-ready by developing independent thinking, good communication and scientific skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.

PEO5: To make students understand interdisciplinary nature of research in biotechnology by assigning them different research projects/ case studies/ presentations.

Map PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1:	3	2	-	-
PEO2:	3	2	2	-
PEO3:	3	3	2	1
PEO4:	2	3	2	2
PEO5:	3	2	2	2

Map PEOs with Department Mission Statements:

PEO Statements	Department Mission 1	Department Mission 2	Department Mission 3	Department Mission 4
PEO1:	3	1	1	1
PEO2:	3	3	2	2
PEO3:	2	2	2	2
PEO4:	3	-	2	3
PEO5:	3	2	3	2

Program Outcomes (PO's)

PO1: Knowledge: Students will develop a sound understanding the biological systems and processes.

PO2: Skill Set Development: The student will be skilled in various biological techniques that will enhance the employability of the students.

PO3: Oral Communication and Scientific Writing: The students will be able to demonstrate good oral communication. Students will also be knowledgeable about writing technical (project report and reviews) content.

PO4: Environment and Sustainable Development: Student will be able to realize the effect of human malpractices on environment and the need and importance of sustainable development.

PO5: Ethics, Independent Thinking and Team Work: The students will develop professional ethics and also gain knowledge about various ethical issues associated with biotechnology. Students will learn to think and analyze a problem independently while at the same time realizing the importance of team work in carrying out successful research/ projects/ presentations.

Mapping of Program Outcome Vs Program Educational Objectives

Mapping	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	2	2	2
PO2	3	2	2	3	2
PO3	1	1	-	3	2
PO4	1	2	3	-	2
PO5	1	2	-	3	2

Program Structure

1. TITLE: Three Year UP Higher Education Program Structure for Biotechnology Discipline

2. DURATION OFTHECOURSE: 3 Years

3. YEAR OF IMPLIMENTATION

This syllabus will be implemented for the session academic year 2021-22onwards.

4. PREAMBLE

TotalCredits-150

Minimum credit required for multiple entry and exit:

Total credit of the 03 year UG Program for year wisemultipleentry and exit	01st Year	46
	02nd Year	96
	03rd Year	146

Total Number of Semesters – 06 (Two semesters per year)

Total Number of Theory Papers – 28

Total Number of Practical courses –20

Total Number of Minor Projects/Dissertations-

02Number of papers (theory) per semester – 04-

05Number of Laboratory courses per semester – 02-

04CommunityConnect: 01

Internship: 01

Year	Semester	Paper Title	Theory/Practical	Credits	Min. - Max. of the semester/year	(Min.-Max. Total Credits) After completion {Minimum Credits}[Max Duration in years]
1st	I	Fundamentals of Biochemistry	Theory	4		47 Certificate
		Introduction to Microbiology	Theory	4		
		Chemistry – I	Theory	4		
		Vocational Course	Practical	3		
		Food and Nutrition	Theory/Practical	2		
		Biochemistry Lab	Practical	2		
		Microbiology Lab	Practical	2		
		Chemistry Lab – I	Practical	2		
		Total Credits		**23**		
	II	Cell and Molecular Biology	Theory	4		
		Bioinstrumentation	Theory	4		
		Chemistry – II	Theory	4		
		Physics – I	Theory	4		
		Vocational Course	Practical	3		
		Health and Hygiene	Theory/Practical	2		
		Molecular Biology Lab	Practical	2		
		Bioinstrumentation Lab	Practical	2		
		Chemistry Lab – II	Practical	2		
		Total Credits		**27**		
2nd	III	Genetics	Theory	4		**47** Diploma in Biotechnology
		Immunology	Theory	2		
		Chemistry – III	Theory	4		
		Vocational	Practical	4		
		Physical Education and Yoga	Theory/Practical	2		
		Immunology Lab	Practical	3		
			Practical	2		
		Chemistry Lab – III	Practical	2		
		Total Credits		**23**		
	IV	Genetic Engineering	Theory	4		
		Metabolic Pathways	Theory	4		
		Chemistry – IV	Theory	4		
		Physics – II	Theory	4		
		Vocational	Practical	3		
		Human Values and Environmental Studies	Theory/Practical	2		
		Genetic Engineering Lab	Practical	2		
			Practical	2		
		Chemistry Lab – IV	Practical	2		
		Total Credits		**27**		
3rd	V	Dev Bio of Plants	Theory	4		50 Degree in Bachelor of Science
		Dev Bio of Animals	Theory	4		
		Industrial Biotechnology	Theory	4		
		Enzyme Technology	Theory	4		
		Analytic Ability and Digital Awareness	Theory/Practical	2		
		Industrial Biotechnology Lab	Practical	2		
		Enzyme Technology Lab	Practical	2		
		Community connect	Practical	2		
		Summer internship of term IV (Will be done after 4thSemester)	Practical	1		
		Total Credits		**25**		
		Plant Biotechnology	Theory	4		

	VI	Bioprocess Technology	Theory	4		
		Animal Biotechnology	Theory	4		
		Genomics	Theory	4		
		Communication Skills and Personality Development	Theory/Practical	2		
		Animal Biotechnology Lab	Practical	2		
		Plant Biotechnology Lab	Practical	2		
		Research Project	Practical	3		
		Total Credits		**25**		
4th	VII	Animal Behavior	Theory	4		56
		Biology of Reproduction	Theory	4		
		Medical Microbiology	Theory	4		
		Epidemiology & Biostatistics	Theory	4		
		Epidemiology & Biostatistics Lab	Practical	4		
		Research Project	Practical	6		
		Total Credits		**26**		
	VIII	Endocrinology	Theory	4		
		Bioprocess Technology	Theory	4		
		Cell Signaling & Cancer Biology	Theory	4		
		Research Methodology	Theory	4		
		Physics – III	Theory	4		
		Endocrinology Lab	Practical	4		
		Research Project	Practical	6		
		Total Credits		**30**		

Three years UG programme structure of Biotechnology chemistry as per UP Higher Education

		Subject I	**Subject II**	**Subject III**	**Subject IV**	**Vocational**	**Co-Curricular**	**Industrial Training/ Survey/ Project**			
		Major (Biotechnology)	**Major (Biotechnology)**	**Major (Chemistry/ Physics)**	**Minor/Elective**	**Minor**	**Minor**	**Major**	**Credits**		
		Credits	**Credits**	**Credits**	**Credits**	**Credits**	**Credits**	**Credits**			**{Minimum Credits}[Max Duration**
		4+2	**4+2**	**4+2**	**4**	**3**	**2**				**In years]**
Year	**Sem.**	**Own Faculty**	**Own Faculty**	**Any Faculty**	**OtherDepartment/Faculty**	**VocationalFaculty**	**Co-Curricular Course**	**Inter/IntraFacultyrelatedto Main Subjects**		**Total**	
	I	Fundamental of biochemistry	Introduction to	Chemistry/Physics		Nanobiotechnology					

1			Microbiology				Food, Nutrition And Hygiene		**23**	(50){46}[4] Certificate in Biotechnology Techniques
		Biochemistry Lab	Microbiology lab	Chemistry/Physics						
	II	Molecular Biology	Basic Microbiology	Organic Chemistry-I/ Bioinstrumentation	Statistics-I/ Food Science/Basics of Pharmaceuticals	Nanobiotechnology	Health and Hygiene		27	
		CellBiologyLab	Basic Microbiology Lab	Organic Chemistry Lab/ Bioinstrumentation Lab						
2	**III**	Genetics	MolecularBiology-I	Chemical Dynamics and Coordination Chemistry/Animal Biotechnology	Statistics-I/FoodScience/Basics ofPharmaceuticals	Nanobiotechnology	Physical Education		**27**	(100){96}[7] Diploma in molecular biology and instrumentation
		GeneticsLab	Molecular Biology Lab-I	PhysicalAnalysisLab/ AnimalBiotechnologyLab						
	IV	Enzymology	MolecularBiology-II	Analytical Techniques/ ChemistryinAction/Bioinformatics		Nanobiotechnology	Human values and Environmental Studies		23	
		Enzymologylab	Molecular Biology Lab-II	InsrumentalAnalysis/ ChemistryinActionLab/BioinformaticsLab						
		Intermediary Metabolism	HormonalBiochemistry					Communityconnect		

3	V	Immunology ImmunologyLab ResearchProject	Proteins ProteinsLab				Analytical Ability and Digital awareness	(2) +Summerinternshipofter mIV (1)	25	(150) {146} [10] Degree in Bachelor of Science In Biotechnology
	VI	Tools and techniques in Biochemistry GeneticEngineering Genetic EngineeringLab ResearchProject	Membrane Biochemistry and Bioenergetics Cellsignaling and CancerBiology AdvanceBiochemistry Lab				CommunicationSkills andPersonalityDevelopment	1(3)	25	

B.Sc.(H) Biotechnology

Course Structure Summary Sheet

Year	Semester	Course Code	Paper Title	Theory/Practical	Credits
1st	I		Fundamentals of Biochemistry	Theory	4
			Introduction to Microbiology	Theory	4
			Chemistry – I	Theory	4
			Vocational Course	Practical	3
			Food and Nutrition	Theory/Practical	2
			Biochemistry Lab	Practical	2
			Microbiology Lab	Practical	2
			Chemistry Lab – I	Practical	2
			Total Credits		**23**
	II		Cell and Molecular Biology	Theory	4
			Bioinstrumentation	Theory	4
			Chemistry – II	Theory	4
			Physics – I	Theory	4
			Vocational Course	Practical	3
			Health and Hygiene	Theory/Practical	2
			Molecular Biology Lab	Practical	2
			Bioinstrumentation Lab	Practical	2
			Chemistry Lab – II	Practical	2
			Total Credits		**27**
2nd	III		Genetics	Theory	4
			Immunology	Theory	2
			Chemistry – III	Theory	4
			Vocational	Practical	4
			Physical Education and Yoga	Theory/Practical	2
			Immunology Lab	Practical	3
				Practical	2
			Chemistry Lab – III	Practical	2
			Total Credits		**23**
	IV		Genetic Engineering	Theory	4
			Metabolic Pathways	Theory	4
			Chemistry – IV	Theory	4
			Physics – II	Theory	4
			Vocational	Practical	3
			Human Values and Environmental Studies	Theory/Practical	2
			Genetic Engineering Lab	Practical	2
				Practical	2
			Chemistry Lab – IV	Practical	2
			Total Credits		**27**
	V		Dev Bio of Plants	Theory	4
			Dev Bio of Animals	Theory	4
			Industrial Biotechnology	Theory	4
			Enzyme Technology	Theory	4
			Analytic Ability and Digital Awareness	Theory/Practical	2
			Industrial Biotechnology Lab	Practical	2
			Enzyme Technology Lab	Practical	2
			Community connect	Practical	2
			Summer internship of term IV (Will be	Practical	1

			done after 4thSemester)		
			Total Credits		**25**
3rd			Plant Biotechnology	Theory	4
			Bioprocess Technology	Theory	4
			Animal Biotechnology	Theory	4
	VI		Genomics	Theory	4
			Communication Skills and Personality Development	Theory/Practical	2
			Animal Biotechnology Lab	Practical	2
			Plant Biotechnology Lab	Practical	2
			Research Project	Practical	3
			Total Credits		**25**
4th	VII		Animal Behavior	Theory	4
			Biology of Reproduction	Theory	4
			Medical Microbiology	Theory	4
			Epidemiology & Biostatistics	Theory	4
			Epidemiology & Biostatistics Lab	Practical	4
			Research Project	Practical	6
			Total Credits		**26**
	VIII		Endocrinology	Theory	4
			Bioprocess Technology	Theory	4
			Cell Signaling & Cancer Biology	Theory	4
			Research Methodology	Theory	4
			Physics – III	Theory	4
			Endocrinology Lab	Practical	4
			Research Project	Practical	6
			Total Credits		**30**

Programme/Class: Certificate	**Year: First**	**Semester: First**
Subject: Biotechnology		
CourseCode:	**Course Title: Fundamentals of Biochemistry**	

Course outcomes:

The students at the completion of the course will be able to:

CO1**:**Understand the basic concepts of bioenergetics and its role in the and functioning of a cell.
CO2**:**Know about the proteins and various types of it.
CO3**:**Explain about various nucleic acid molecules and DNA structure typesthat exists in nature.
CO4**:**Understand the cell membranes and mode of transportation acrossthem.
CO5: Understand how cell functions when it receives a signal and how thecell cycle is regulated.
CO6: Apply his knowledge in understanding the cellular structure andcellular function.
CO7: Understanding of types of lipids and their synthesis
CO8: Understanding of types of carbohydrate and their synthesis

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**L-T-P:**4-0-0

Unit	Topic	TotalNo.of Lectures(60)
I	**Bioenergetics and thermodyanamics** • Principles of Bioenergetics, Bioenergetics andThermodynamics • Biological Oxidation-Reduction Reactions, Free EnergyCalculations, The Cell's Energy Currency-PhosphorylGroup Transfers and ATP • Free-Energy-Driven Transport across Membranes	7
II	**Protein structure** • Primary Secondary and Tertiary structure, Quaternary • Structures • Fibrous and globular proteins, Protein-assisted folding and • chaperones in protein folding, protein targetingthe physiological chemistry of oxygen binding bymyoglobin and hemoglobin, The regulatory compound, 2,3-bisphosphoglycerate (BPG)	7
III	**Nucleic Acids** • Structure and functions: Physical & chemical properties ofNucleic acids, Nucleosides & Nucleotides, purines & Pyrimidines • Biologically important nucleotides, Double helical model ofDNA structure forces responsible for A, B & Z – DNA, denaturation andrenaturation of DNA	6
IV	**Biological Membranes and Transport** • The Composition and Architecture of Membranes • Solute Transport across Membranes; transport of small • molecules, active and passive transport • Transport of macromolecules, Endocytosis, Phagocytosis, Pinocytosis	8

V	**Biosignaling and hormones** • Molecular Mechanisms of Signal Transduction, Gated IonChannels, Receptor Enzymes, G Protein-Coupled Receptors and Second Messengers • Regulation of transcription by steroid hormones, • Regulation of the Cell Cycle by Protein Kinases • Secretion and functions of hormones of thyroid, pituitary and gonads.	**8**
VI	**Synthesis and metabolism of Purines and Pyrimidines** • Denovo synthesis for purines and pyrimidines • Salvage pathway for purines and pyrimidines • Inhibitors of purines and pyrimidine	**8**
VII	**Lipids** • Classification, structure, properties and functions of fatty acids,. • Essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, • Prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides.	**8**
VIII	**Carbohydrate and vitamins** • Classification, structure, general properties and functions of Monosacharides,. • Different types of polysaccharides, homo and hetropolysacharides, steroids and sterols. • Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.	**8**

SuggestedReadings:

1. Nelson, D.L.,Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WHFreeman and Company, New York, USA.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).Biochemistry. VI Edition. W.H Freeman
3. Buchanan, B., Gruissem, W. and Jones, R. (2000)Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**1**

CO5	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**1**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Programme/Class: Certificate	**Year: first**	**Semester: first**
Subject: Biotechnology		
Course Code:	**Course Title: Introduction to Microbiology**	

Course outcomes:

The students at the completion of the course will be able to:

CO1: To study the history of microbiology and its basic concepts.
CO2: To understand the various classification of bacteria
CO3: To study how bacteria can be classified based on its morphology, cell structure
CO4: Understand the growth in bacteria and how to isolate bacterial species
CO5: Understanding the ways to control microbial growth
CO6: Basic understanding of viruses
CO7: To know of microbial diversity in extreme environments
CO8: To know the cell composition of microbial species

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Introduction to Microbiology** • History of Microbiology & contribution of Microbiologists • Spontaneous generation; Koch Postulates • Whittaker's 5 kingdom concept; Pasteurization.	**7**
II	**Classification of Bacteria** • Basis of microbial classification, molecular approaches in microbial classification, concept of microbial species; • Principle and classification of bacteria on the basis of Bergey's manual of Determinative bacteriology; Nutritional classification of Bacteria • Cyanobacteria and Prochlorons	**7**
III	**Morphology of Bacteria** • Morphology and fine structure of Bacteria; outer surface of bacteria; • Cell wall of Gram +ve and Gram –ve bacteria • Brief overview on Archaea; Cyanobacteria, PPLO	**6**
IV	**Growth and Sporulation in Bacteria** • Modes of cell division (Binary fission; budding and • Septum formation); Normal growth of bacteria; • Growth curve • Pure culture, Method of isolating pure culture • (Streak method, Pour-plate and spread plate technique); • Synchronous and asynchronous • Growth inhibitory substances (temperature, acidity, • alkalinity, water availability, oxygen)	**8**
V	**Control of Microbial Growth** • Microbes and Human welfare (medical and Chemical industry) • Microbes in food industry	**8**

	• Physical and chemical methods of control of Microorganisms	
VI	**Virus and its Control** • Ultra-structure of Virus • Life Cycle and its control • Life cycle of Bacteriophage	**8**
VII	**Microbial Diversity** • Microbial diversity and extremophiles: Microbial diversity, distribution ecological niche, abundance and density • Extremophiles – Psychrophiles, acidophiles, alkaliphiles, thermophiles, barophilesetc • non-culturable bacteria (Metagenomics). Methanogens, Methanotrophs and Methylotrophs	**8**
VIII	**Cell Composition** • Morphology and fine structure of Bacteria: Morphological types – size, shape and arrangements; • cell walls of archaea, Gram-negative, Gram-positive eubacteria, eukaryotes; L forms – cell wall synthesis, antigenic properties • Cell membranes – structure, composition and properties. Reserve materials, inorganic and organic inclusions.	**8**

SuggestedReadings:

1. Microbiology- Pelczar, M.J. Reid, R.D. and E.C.S.Chan, Tata McGraw Hill, New Delhi.1977 (4th Edition)
2. Prescott, Harley and Kelvin – Microbiology,2nd ed. TMH Publication
3. General Microbiology: Roger & Strainer et.al.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X

Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**2**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**2**	**1**	**3**	**1**
CO3	**3**	**2**	**3**	**2**	**1**	**3**	**1**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO5	**3**	**2**	**3**	**2**	**1**	**3**	**1**
CO6	**3**	**2**	**3**	**2**	**1**	**3**	**1**
CO7	**3**	**2**	**3**	**2**	**2**	**3**	**1**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class: Diploma	**Year-First**	**Semester-First**
Subject: Biotechnology		
Course Code: MSB 155	**Course title : Biochemistry Lab**	

Course Outcome

After finishing the course, the students will be able to

CO1: identify and distinguish between mono-, di-, and oligosaccharides present in different samples

CO2: able to perform enzyme kinetics

CO3: able to test activity of enzymes

CO4: able to test and analyse for nucleic acids

CO5: able to test and analyse for amino acids

CO6: able to test and analyse for proteins

CO7: able to test and analyse for Vitamins

CO8: able to test and analyse for Lipids

Credits: 2	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topic	**Total No. of Lectures (60)**
I	• Practical based on estimation of carbohydrates • Colorimetric estimation of carbohydratesQuantitative estimation of carbohydrate	8
II	• Practical related to estimation of starch • Enzyme kinetics of amylase	**8**
III	• Practical related to Practical related to study ofenzymes	**8**
IV	• Practical related to isolation and estimation ofnucleicAcids • Qualitative estimation of nucleic acids • Quantitative estimation of nucleic acids	**7**
V	• Practical related to estimation and separation of aminoacids • Amino acid separation by thin layer chromatograph • Amino acid separation by paper chromatography	**8**
VI	• Detection of proteins • Estimation of Proteins	**7**
VII	• Detection of Vitamins • Estimation of Vitamins	**7**
VIII	• Detection of Lipids • Estimation of Lipids	**7**

Suggested Readings

Sawhney S.K. and Singh R. **Introductory Practical Biochemistry.**

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**2**	**2**	**3**	**2**

CO8	**3**	**2**	**3**	**2**	**2**	**3**	**2**

Program/Class: Diploma		**Year-First**	**Semester-First**
Subject: Biotechnology			
Course Code: MMB153	**Course title: Microbiology Lab**		

Course Outcome
After finishing the course, the students will be able to
CO1: Isolation of pure colony
CO2: How to characterize bacteria on visible characteristics
CO3: learn gram staining
CO4: Acid fast technique principles
CO5: fermentation of carbohydrate by various bacterial species
CO6: importance of catalase
CO7: differential and cell staining
CO8: Assess bacterial growth curve

Credits: 2	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topic	**Total No. of Lectures (60)**
I	• Isolation of individual cells from mixed culture	
II	• Characterization based on shape and size of microbial colonies	
III	• Gram Stain Techniques	
IV	• Acid Fast Staining	
V	• Carbohydrate Fermentation Test	
VI	• Catalase test	
VII	• Differential and Cytological Staining	
VIII	• Bacterial Growth Curve	

Suggesting Readings
Practical manual of Biotechnology by Ritu Mahajan, Jitendar Sharma, RK Mahajan, Vayu Education of India

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**2**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Programme/Class: Certificate	**Year: First**	**Semester: Second**
Subject: Biotechnology		
Course Code:	**Course Title:** Cell and Molecular Biology	

Course outcomes:

The students at the completion of the course will be able to:

CO1: to understand about a cell and its evolution
CO2: Know about the detailed structure of a cell
CO3: How genetic information is stored in cells
CO4: To know about division of cells and its significance
CO5: To understand cell movements
CO6: To understand how genetic information flows through replication
CO7: To know RNA synthesis and regulation in prokaryotes
CO8: To understand regulation of gene expression

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Cell and Cell theory** • Cell as a basic unit of life, Cell theory, Cell size and • Shape • Prokaryotic and Eukaryotic cells • Different types of cells	**7**
II	**Ultra-structure of cells** • Plasma membrane, Ribosomes • Protein sorting and transportation; Endoplasmic • Reticulum, Golgi Apparatus, Lysosomes; • Bioenergetics and metabolism, Mitochondria, • Chloroplast, peroxisomes	**7**
III	**Nucleus and Chromosomes** • Ultra-structure of nucleus, nuclear membrane • Chromosome structure, Centromeres, Telomeres • Euchromatin and heterochromatin, Polytene and • lampbrush chromosomes	**6**
IV	**Cell cycle** • Growth cycle and cell division • Mitosis, Meiosis • Significance of cell division	**8**
V	**Cytoskeleton and Cell-to-cell interaction** • Concept about cytoskeleton, microtubules, • microfilaments, intermediary filaments • Structure of cilia and flagella and their movement; • Cell to cell interaction	**8**
VI	**DNA Replication** • Replication process in prokaryotes • Replication process in eukaryotes • Enzymes and accessory proteins in replication, Replication of ss-circular DNA	**8**

VII	**Prokaryotic Transcription** • Process of prokaryotic and eukaryotic transcription • Inducible and constitutive promoters, • Operators and regulators in prokaryotic transcription	**8**
VIII	**Transcription and Regulation of Gene Expression** • Translation machinery, Ribosome, degeneracy of codons and termination codons • Mechanism of initiation, elongation and termination • Operon system, Lac operon and Trp operon.	**8**

Suggested Readings:

1. Cooper G.M., and Hausman R.E., The Cell: A Molecular Approach, 5th Edition. Sinauer Associates (2009)
2. Karp G., Cell and Molecular Biology: Concepts and Experiments, 6th Edition. Wiley (2009)..

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5			X						
A			X		X				X
B			X		X				X
C			X		X				X
Unit 6									
A						X			X
B						X			X
C						X			X

Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**1**
CO7	**3**	**2**	**3**	**2**	**1**	**3**	**1**
CO8	**3**	**2**	**3**	**2**	**1**	**3**	**1**

Programme/Class: Certificate	**Year: First Year**	**Semester: Second**
Subject: Biotechnology		
Course Code:	**Course Title: Bioinstrumentation**	

Course outcomes:

The student at the completion of the course will be able to:

- CO1: To understand the concept and principle of microscopy
- CO2: To get a brief idea about common biotech lab instruments
- CO3: To discuss the principle of centrifugation and different types of centrifuges
- CO4: To understand the basic principle of chromatography and discuss different types of chromatographic techniques
- CO5: To discuss different types of electrophoresis and understand the principle of PCR and DNA sequencing
- CO6: To understand various radioisotopic techniques
- CO7: know about various biosensors and electrodes
- CO8: understand the principle of spectrospoic techniques

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Common Instruments Usage and principle** • pH meter, Weighing balances • Usage and applications of horizontal and vertical autoclave • Laminar air flow, incubator, oven and rotary shaker	**7**
II	**Microscopy** • Simple, phase contrast, bright and dark field microscopy • Confocal and super resolution microscopy • Fluorescence and Electron microscopy (TEM and SEM))	**7**
III	**Centrifugation** • Principle of centrifugation, different types of centrifuge and rotors, • Types of rotor: fixed angle and swinging bucket rotors, • Bench top and high-speed centrifuges • Preparative, differential and density gradient centrifugation, Analytical centrifugation	**6**

IV	**Chromatographic techniques** • Liquid, column, and affinity chromatography • Thin layer and gel-filtration chromatography • Ion exchange and hydrophobic chromatography	**8**
V	**Electrophoresis and PCR** • Electrophoresis - principles and working, Gel • Electrophoresis- Immunoelectrophoresis, isoelectric focusing, capillary • Electrophoresis, 2D electrophoresis, Pulse field electrophoresis, • Polymerase Chain Reaction (PCR), DNA sequencing • (Sanger's Dideoxy method)	**8**
VI	**Radioisotopic Techniques** • Principles and application of tracer techniques in biology, radioactive isotopes. • Half-life of isotopes, cerenkov radiation, liquid scintillation, GM counter. • Effect of radiation on biological system, radioactive labeling of biological macromolecules, autoradiography and radiation dosimetry	**8**
VII	**Biosensors and Electrodes** • Basic techniques, enzyme electrodes, organic salt electrodes, immuno electrodes, microbial biosensors • Reference electrodes, The pO2 electrodes, Membrane electrodes, Blood gas analysis, Transcutaneous pO2 and pCO2 transducers, Fiber optic chemical transducer, Ion specific electrodes, Ionic content of blood, ISFET for glucose, urea.	**8**
VIII	**Spectroscopy** • Spectroscopy – II and Thermal Analysis: Principles, Instrumentation & applications for flame emission / atomic absorption spectrophotometry and their comparative study; ICP (b) Mass spectrometry; Principles, Instrumentation and applications. Instrumentation and application of Differential scanning calorimetry and Thermogravimetry	**8**

Suggested Readings:

1. Alka Gupta. Instrumentation &BioanalyticalTechniques. Pragati Edition
2. Subramanian M A. Biophysics: Principles andTechniques. MJP Publishers Ltd.
3. Cottenil, R M S. Biophysics: An Introduction. JohnWiley& Sons Ltd, England, 2002.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	1	1	3	1
CO2	3	2	3	1	1	3	1
CO3	3	2	3	1	1	3	1
CO4	3	2	3	1	1	3	1
CO5	3	2	3	1	1	3	1
CO6	3	2	3	1	1	3	1
CO7	3	2	3	1	1	3	1
CO8	3	2	3	1	1	3	1

Program/Class: Diploma	**Year-First**	**Semester-Second**
Subject: Biotechnology		
Course Code: MMB156	**Course title: Molecular Biology Lab**	

Course Outcome

After finishing the course, the students will be able to

- Demonstrate safe laboratory practices and handle the equipment safely.
- Estimate the quality and quantity of nucleic acids.
- Amalgamation of tools for plasmid vectors and DNA uptake.
- Understand concept of ttransformation
- Perform insilicoanalysis for studying genome.
- Construct a phylogenetic tree
- To design primers and carry out amplification of DNA by PCR.
- To understand principle of PCR

Credits: 2	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topic	**Total No. of Lectures (60)**
I	• **Practical based on introduction to molecular biology lab** • Good lab practices in molecular biology laboratory. • Preparation of standard solutions for molecular biology experiments	**12**
II	• **Isolation of Nucleic acids and quantification** • Isolation of DNA from bacteria • Isolation of RNA from bacteria • Gel electrophoresis	**12**
III	• Practical related to preparation of plasmids and Transformations • Plasmid isolation	**12**

IV	• Preparation of competent cells • Transformation of plasmid into competent cells	**12**
V	• Practical related to in silico analysis of genome • Sequence similarity search with freely available tools •	**12**
VI	• Construction of phylogenetic tree • Identification of motifs and domain in sequences	
VII	• **Practical related to gene amplification** • Designing of primers for CDs and partial sequences	
VIII	• Performing PCR reactions	

Reading suggestions

Michael, R. G., Sambrook. J., "Molecular Cloning-A Laboratory Manual", 4th edition, Cold Spring Harbor Laboratory Press, 2012.

Davis, L. (2012). Basic methods in molecular biology. Elsevier.

Chard, T., Work, T. S., & Work, E. (1987). Laboratory techniques in biochemistry and molecular biology. Elsevier, Amsterdam.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class: Diploma	**Year-First**	**Semester-Second**
Subject: Biotechnology		
Course Code: MMB156	**Course title: Bioinstrumentation Lab**	

Course Outcome

After finishing the course, the students will be able to

- Operate autoclave, Laminar Air flow and Hot air oven and
- Sterilize glass and plastic wares.
- Understand how buffers are made
- Operate centrifuge and refrigerated centrifuge and separate cell components.
- Separate and visualize nucleic acids and proteins using gel electrophoresis.
- Operate spectrophotometer and perform absorbance assays.
- Separation of pigments, drugs, amino acids and hormones using chromatographic techniques.
- Operation and working of different instruments and bioanalytical Techniques

Credits: 2	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topic	**Total No. of Lectures (60)**
I	**Practical based on Sterilization** • To learn the working of an autoclave. • To learn the working of a laminar air flow. • To sterilize glassware using hot air oven.	**13**
II	**Practical related to centrifuge** • Using pH meter • Working and principle of incubator shaker • Working of refrigerated centrifuges	**13**

III	**Practical related to gel-electrophoresis** • Separation of DNA using PAGE • Separation of proteins using PAGE	**13**
IV	Practical related to spectrophotometer • Principle and working of a spectrophotometer • Measuring concentration of protein using spectrophotometer	**13**
V	**Practical related to chromatography** • Use of paper chromatography for separation of plant pigments	**8**

Suggesting Readings

1. Wilson K.and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge Press, 2010.
2. Cottenil R.M.S., "Biophysics: An Introduction", John Wiley and Sons, 2002.
3. Gupta A., "Instrumentation and Bioanalytical Techniques", Pragati Prakashan, 2009.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X

C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**2**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**2**	**2**	**3**	**2**

Programme/Class: Certificate	**Year: 2nd**	**Semester: 3rd**
Subject: Biotechnology		
Course Code:	**Course Title: Genetics**	

Course outcomes:

The students at the completion of the course will be able to:

- describe various Mendelian laws as well as exception to these laws
- explain the structure of DNA, chromosomes and aberrations in chromosomes
- analyze extranuclear inheritance and examples to understand cytoplasmic inheritance
- describe mutation, its consequences and types
- demonstrate the fine structure of gene and experiments that lead to the understanding of gene structure and function
- describe basic principles of genetics and gene mutations and mechanisms of inheritance and heredity

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Mendelism** • Brief overview of Mendel's work; Mendel's experimental • design, monohybrid and di-hybrid crosses; Mendel's Law of segregation & Law of independent assortment • Verification of segregates by back and test crosses; Allelic interactions: Concept of dominance, recessiveness • incomplete dominance, co-dominance, semi-dominance, • multiple alleles, pseudo-allele, essential and lethal genes. • Non allelic interactions: epistasis (dominant & recessive), • duplicate genes.	**7**
II	**Physical basis of Inheritance** • Chromosome theory of inheritance; Eukaryotic • Chromosome: Macromolecular Organization; packaging of DNA molecule into chromosomes • Chromosome banding pattern, Heterochromatin and • Euchromatin and its significance, karyotype; Chromosome types, primary and secondary constrictions; Centromere and Telomeres; Satellite -bodies • Variation in chromosome number Aneuploidy and • Euploidy; Variations in chromosomes structure - deletion, • duplication, inversion and translocation.	**7**
III	**Linkage and Crossing Over** • Concept of linkage and crossing over; Coupling and • repulsion hypothesis; Linkage in maize and Drosophila; • Linkage groups; Theories of linkage; Cis-Trans • arrangement • Crossing over and Genetic recombination • Extrachromosomal Inheritance: Maternal Inheritance: shell • coiling in Limnaea; Inheritance of Mitochondrial DNA and • Mitochondrial diseases in Human; Inheritance of • Chloroplast DNA and Cytoplasmic Male Sterility (CMS) incrop plants	**6**
IV	**Mutation** • Discovery of DNA as the genetic material • Definition and types of mutations, Molecular basis of • mutations • Ames test for mutagenic agents, screening procedures for • isolation of mutants	**8**

V	**Fine Structure of Gene** • Benzer and T4 rII locus, Complementation test; • Cistron, recon and muton • Beadle and Tatum's one gene one enzyme concept; One • gene one polypeptide concept	**8**
VI	**Genetics and Cancer** • Oncogenes- tumor inducing retroviruses and viral Oncogenes; Chromosome rearrangement and cancer; • tumor suppressor genes- cellular roles of tumor suppressor genes, pRB, p53, pAPC • Genetic pathways to cancer	**8**
VII	**Sex determination and Dosage compensation** • sex determination- in humans, Drosophila and other animals; • dosage compensation of X-linked genes– hyperactivation of X-linked gene in male Drosophila • inactivation of X-linked genes in female mammals	**8**
VIII	**Human Genetics** • karyotype and nomenclature of metaphase chromosome bands • chromosome anomalies and diseases- chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumor • genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits; human genome and mapping	**8**

Suggested Readings:

1. Hartl D.L. and Jones E.W, "Genetics: analysis of genesand genomes". Edition 5. Jones and Bartlett Publishers, 2000.
2. Gardner E.J., Simmons M.J., Snustad M.J., "Principlesof genetics". Edition 8. John Wiley & Sons (Asia) Pte.Ltd., 2007.
3. GriffithsJ.F., Wessler, S.R., Levonotin,R.C.,Gelbart,W.M.,Suzuki,es D.T.,MillerJ.H.,"An Introduction to Genetic Analysis".Edition 8.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**2**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**2**	**2**	**3**	**2**

Programme/Class: Certificate	**Year: 2nd year**	**Semester: 3rd**
Subject: Biotechnology		
Course Code:	**Course Title: Immunology**	

Course outcomes:

The students at the completion of the course will be able to:

- Understand immune system, immunity and immune response.
- Describe cells and organs of immune system.
- Illustrate about antigens, antibodies and their types & properties.
- Demonstrate the qualitative and quantitative analysis of antigens or antibodies for diagnostic purposes.
- Identify the role of molecules like MHC and cytokines in generation of immune response.
- Explore immunology as a basic tool for medical applications.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Cells and organs of immune system** • Primary and secondary lymphoid organs, their structure • and function • Cells of immune system; hematopoiesis and • Differentiation • Structure and role of B and T lymphocytes, NK cells, • macrophages, Dendritic cells, mast cells, eosinophil's, • basophils and neutrophils	**7**
II	**Immune Responses** • Innate and acquired immunity, humoral and cell mediated • immune response • Lines of defense and various barriers • Clonal nature of immune response, Primary and secondary immune response	**7**
III	**Antigen and Antibody** • Antigen and Immunogen, antigenicity vs • immunogenicity, properties of antigens • Antibody molecule, types and structure • Role in immune response, monoclonal antibody and • hybridoma technology	**6**
IV	**Antigen Antibody Interaction** • Antigen antibody interaction: Immunodiffusion • (Double and radial) • RIA & ELISA • Immunoelectrophoresis	**8**
V	**MHC and Cytokines** • MHC molecule and its types, structure and theirfunction • Cytokines and their role in immune response • Overview of hypersensitivity and autoimmunity	**8**
VI	**Effector Mechanism** • Signaling through immune system receptors- antigen receptor	**8**

	• structure and signaling pathways, • Other signaling pathways that contribute to lymphocyte • behavior • Regulation of immune response	
VII	**Immunity in health and disease** • introduction to infectious disease, innate immunity to • infection, adaptive immunity to infection. • immunodeficiency diseases- inherited immunodeficiency • diseases, acquired immune deficiency syndrome • evasion of the immune response by pathogens	**8**
VIII	**Autoimmunity** • Responses to self-antigens, transplant rejection- responses • to alloantigens; manipulation of immune responses, • Vaccines; evolution of immune system- evolution of innate immune system, • Evolution of adaptive immune system	**8**

SuggestedReadings:

1. Kuby Immunology,7th Edition-R.A. Goldsby, Thomas
2. Immunology-A short course,4th Edition-EliBenjamini, Richard Coico, Geoffrey Sunshine, (Wiley-Liss).
3. Fundamentals of Immunology, William paul
4. Immunology, By Roitt and others.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class: Diploma	Year- First	Semester-Second
Subject: Biotechnology		
Course Code: MMB156	**Course title: Immunology Lab**	

Course Outcome

After finishing the course, the students will be able to

- After successfully completion of this course students will be able to:
- Understand basic laboratory techniques of blood groups
- Estimate the haemoglobin of its own blood
- practical knowledge of antigen antibody interactions
- isolate lymphocytes for further deep analysis
- prepare suspension solutions of spleen and bone marrow

Credits: 2	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topic	**Total No. of Lectures (60)**
I	• To study permanent slides of immune tissues and organs • To find the blood group of own blood • To find the Rh factor of own blood group	**12**
II	• To estimate the amount of Hb present in human blood • To perform Rocket immunoelectrophoresis • To perform Separation of lymphocytes	**12**
III	• To perform Sandwich enzyme linked immunosorbant assay • To perform DoT ELISA • To perform Haemagglutination test	**12**
IV	• To perform Ouchlerlony's double immunodiffusion method. • To perform Radial Immunodiffusion • To perform RIA	**12**
V	• Preparation of single cell suspension of spleen. • Preparation of single cell suspension of bone marrow.	**12**

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Programme/Class: Certificate	**Year:**	**Semester:**
Subject: Biotechnology		
CourseCode:	**Course Title: Genetic Engineering**	

Course outcomes:

The student at the completion of the course will be able to:

- Identify various molecular tools for genetic engineering; host cells and right kind of enzymes to perform DNA digestion, ligation etc.
- Classify different kinds of cloning vectors and their uses.
- Analyze the use of Polymerase chain reaction in molecular
- cloning along and describe various DNA sequencing techniques.
- Explain different ways of cloning blunt ended DNA fragments and transfection as well as transformation methods.
- Recognize different types of gene libraries and apply different techniques of probing gene libraries.

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Molecular tools of genetic engineering** • Restriction enzymes Type I, II and III • DNA polymerase and RNA polymerase' reverse • Transcriptase • Modifying enzymes terminal deoxynucleotidyl • transferase, polynucleotide kinase, Phosphatases and • DNA ligase	**7**
II	**Cloning Vectors** • Introduction to cloning vectors; • Phage vectors; cosmid vectors; phagemid vectors; • Plasmid vectors BAC vectors and YAC vectors	**7**
III	**Nucleic Acid isolation and amplification** • Isolation of nucleic acid; PCR and its application • cDNA synthesis; RT-PCR • Nucleic acid sequencing	**6**
IV	**Cloning techniques** • Steps to cloning; Cloning after restriction digestion • blunt and cohesive end ligation; creation of • restriction sites by PCR • cloning using linkers and adapters; cloning after • homopolymer tailing; Strategies for cloning PCR • products – TA cloning	**8**
V	**Techniques of Genetic Engineering** • Library construction • DNA hybridization, colony hybridization and in-situ • hybridization • Screening methods; Blotting techniques (Southern, • Northern and Western blotting)	**8**

VI	**Recombinant products** • Recombinant products – human growth hormone (insulin • somatotropin) • Vaccines (hepatitis B virus vaccine, FMD vaccine), • interferons, tPA	**8**
VII	**Nucleic Acid Hybridization** • Nucleic acid hybridization: Principles and applications, • preparation of probes, principles of nucleic acid • hybridization, assays and micro-assays	**8**
VIII	**Tools for analyzing gene expression** • Reporter genes, Analysis of gene regulation, purification & detection tags, , • Analysis at the level of gene transcription – Northern blot, in situ hybridization, RNAse protection assay, RT-PCR • Analysis at the level of translation- Western blot, in situ hybridization, ELISA, protein gel electrophoresis	**8**

SuggestedReadings:

1. Molecular Biotechnology. Principles andApplications. 3rd Edition. Glick BR andPasternak JJ. ASM Press @2003. ISBN 1-55581-224-4.
2. Gene cloning and DNA Analysis- AnIntroduction. 6th Edition. Wiley-Blackwell.Brown TA @2010..

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Programme/Class: Certificate	**Year:**	**Semester:**
Subject: Biotechnology		
Course Code: MSB 159	**Course Title: Genetic Engineering Lab**	

Course outcomes:

The student at the completion of the course will be able to:

- Perform experiments on DNA isolation from biological resource and
- understanding different methods for DNA isolation
- Perform experiments on RNA isolation.
- Validation of isolated DNA and RNA content.
- Amplification of particular gene of interest by PCR method.
- Validation of amplified gene by electrophoresis method.
- Performing basic experiments of Genetic Engineering technique

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Credit-02	Core: Compulsory

Unit	Topic	Total No. of Lectures (60)
I	DNA isolation	12
II	RNA Isolation	12
III	Validation of isolated DNA and RNA	12
IV	Amplification of specific gene of interest by PCR method	12
V	Validation of amplified gene by electrophoresis method	12

Suggested Readings

1. Brown T.A, “Gene Cloning and DNA Analysis:An Introduction”, John Wiley & Sons, 2010.
2. Old R.W and Primrose S.B., “Principles of Gene Manipulation”, Blackwell Scientific Publication, 2002.
3. Dale W., von Schantz M. and Plant N., “From Genes to Genomes: Concepts and Applications of DNA Technology”, John Wiley, 2011.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Programme/Class: Certificate	**Year:**	**Semester:**
Subject: Biotechnology		
Course Code:	**Course Title: Metabolic Pathways**	

Course outcomes:

The students at the completion of the course will be able to:

- Evaluate metabolism of carbohydrates by different pathways
- Interpret the metabolism of different types of lipids
- Determine and differentiate between gluconeogenic and ketogenic amino acids
- Analyze and learn the electron transport chain
- Differentiate between de novo and salvage pathways for biosynthesis of purines and pyrimidines

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Glucose Metabolism** • Glycolysis • Glycogenolysis, Kreb's cycle and net energy yield • Pentose Phosphate pathway and its clinical significance	**7**
II	**Fat Metabolism** • Beta oxidation of fatty acids and energy yield • Cholesterol synthesis • Synthesis of fatty acids	**7**
III	**Amino Acid metabolism** • Introduction to gluconeogenic and ketogenic amino acids • Degradation of amino acids • Synthesis of amino acids, Urea Cycle	**6**
IV	**Electron transport Chain** • ATP synthase and proton transfer during electron transfer • Coupling of electron transport to oxidative phosphorylation • Inhibitors of electron transport	**8**
V	**Nucleotide Metabolism** • Biosynthesis of purines • Biosynthesis of pyrimidines • Structure of DNA and RNA	**8**
VI	**Introduction to enzymes** • Nature of enzymes – kinetics, reaction mechanism of chymotrypsin and lysozyme • purification and physico – chemical characterization, regulation of enzyme activity	**8**

VII	**Metabolic Disorders** • Metabolic basis of nutrition, metabolic basis of specialized tissue function, metabolic disorders, metabolic basis of diagnostics, metabolism and adaption with one example	**8**
VIII	**Regulation of Metabolism** • regulation of metabolism at molecular • cellular and organismic levels enzymes and receptors as drug targets.	**8**

Suggested Readings:

1. Stryer L., "Biochemistry", W. H. Freeman, 2010.
2. Jain JL., "Principles of Biochemistry", S. Chand Publications.

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

BSB210: Developmental Biology of Plants

Program/Class:	**Year-3rd**	**Semester:5 th**
Subject: Biotechnology		
Course Code: BSB210	**Course title: Developmental Biology of Plants**	

Course Outcomes

After the successful completion of this course students will be able to:

- Critically analyze the similarities and differences between plant and animal development.
- Decipher the molecular mechanism and regulation of embryo development in lower and higher plants.
- Cellular and molecular mechanism of development of male and female gametophytes, fertilization, self-incompatibility of fertilization and apomixes.
- Understand mechanistic details of root, stem and leaf development.
- Analyze the molecular mechanism of flower development.

Credit:4	**Core: compulsory**
Max. Marks: 25+75 Min.	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0

Unit	Topics	Total No. of Lectures (60)
I	**Overview of plant development** • Differences between plant and animal development, • Similarities between plant and animal development • Distinguished embryologists of the World and their work in brief	**7**
II	**Embryo and seed development** • Embryo development in the brown alga Fucus. • Role of light, Ca2+ and cell wall in Fucus development • Embryo development in angiosperms, • Different stages of embryo development, role of auxin in basal pole formation, Radial cell pattrn, role of scarerow and short root transcription factors**.** • Formation of root meristem**,** Formation of shoot meristem**,** • Endosperm development**,** Dormancy	**7**
III	**Development of male and female reproductive Structure** • Development of male gametophyte; Pollen grain, Tapetum. • Microsporophyte, Cytoplasmic male sterility • Development female gametophyte; Megasporogenesis, Gene expression during megasporogenesis, Fertllization, • The Molecular basis of self incompartibility, endosperm development,apomixes	**6**
IV	**Germination, Vivipary, Differential regulation of root and shoot meristem** • **Development of root; Cellular** organization in a developing root**;** Primary root development**;** Development of root hair**;** Secondary/adventious root development • **Development of Shoot;** Leaf primodium, Auxillary meristem**,** Tunica corpus**,** Rib meristem**,** • The fate of new meristems**,** Lateral meristem**,** Leaf development	08

V	**Development of Flowers,** • From vegetative to reproductive development**,** Reproductive structures in angiosperms • Floral meristem, Regulation of gene expression for floral development • Role of Leafy-like genes in the development of inflorescence, ABC Model of flower development.	08
VI	**Plant organ Culture** • Anther, Embryo & Meristem culture. • Organogenesis, somatic embryogenesis and artificial seeds. • Somatic Hybridization: Isolation, fusion and protoplast culture. Somoclonal Variation & cryopreservation	08
VII	**Metabolites from plants** • Biopolymer Production through transgenic plants • Fatty acid modification and oleosin technology • Chloroplast transformation, Molecular Pharming	08
Unit 8	**Gene editing and Bioethics** • Gene silencing, PTGS, RNai, Antisense technology, Applications. • Genome Editing tools- ZFNs, TALENs and CRISPR-Cas9 • Biosafety and bioethics in plant biotechnology	08
Mode of examination	Theory	

Weightage Distribution	CA	MTE	ETE	
	30%	20%	50%	

Suggested Readings

1. Plant Biology, Alison M. Smith et al., Garland Science, Taylor & Francis Group, 2010, ISBN 978-0-8153-4025-6
2. Developmental Biology, Tenth Edition. Scott F. Gilbert, editor. Sunderland, MA: Sinauer Associates, ISBN-13: 978-0878939787

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	Year-3rd	Semester:5th
Subject: Biotechnology		
Course Code: BSB211	**Course title: Developmental Biology of Animal**	

Course Outcomes

After studying this course, students will be able to

- Determine Process of Spermatogenesis in humans and its hormonal Control
- Summarize the Egg types and egg membranes in animals
- Describe the Cleavage types and role of yolk in cleavage
- Determine the Production of Antibiotics
- Analyze the Extra-embryonic membranes in humans
- Compare the Placenta: types; structure and function of placenta in humans

Credit:04	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Unit	Topics	Total No. of Lectures (60)
I	**Gametogenesis** • Process of Spermatogenesis in humans and its hormonalcontrol; Process of oogenesis in humans and its hormonal control • Ultrastructure of sperm and ovum- changes in sperm body during maturation • changes in ovum structure during maturation; layers of ovum and their function	**7**
II	**Female Reproductive Biology** • Types of menstrual cycles in mammals- Estrous cycle menstrual cycle in human females • The role of hormones in Menstruation • Egg types and egg membranes in animals	**7**
III	**Fertilization** • Physical events of fertilization- changes in sperm before ejaculation, female genital tract environment. • features of female reproductive tract that help in sperm motility • Molecular events of fertilization- changes in sperm before fertilization (capacitation), • Site of fertilization, mechanisms to prevent polyspermy, • sperm-egg fusion; Cleavage types and role of yolk in cleavage	**6**
IV	**Embryonic Development** • Formation of blastula (humans); Morphogenetic movements and process of gastrulation (humans). • Formation of epiblast and hypoblast, formation of primitive streak • Extra-embryonic membranes in humans Organogenesis: brain and eye (humans)- organizer and its role; • Notochord formation; formation of brain vesicles; steps in development of eye	8
V	**Embryonic Development- associated events** • Placenta: types; structure and function of placenta in humans • Introduction to in vitro fertilization • Concept of Potency; introduction to types of stem cells and embryonic stem cells	08
VI	Therapy of Animal Diseases • Recombinant cytokines and their use in the treatment of animal infections; • monoclonal antibodies in therapy;	08

	• vaccines and their applications in animal infections; • gene therapy for animal diseases.			
VII	**Hybridomas and cell transformation** • The basis of hybridoma technology, Storage of hybridoma cells • Monoclonal antibodies and their commercial production • Commercial production of monoclonal antibodies and their use for mankind.			08
VIII	**Application of Animal Cell Culture Technology** • Transgenic cells and animals & their application; • Organ culture, Histotypic& organotypic culture, rearinganimal models and advantages • Potential of transgenic animals to improve human welfare in Agriculture, medicine and industry, • ethical and value issues in animal biotechnology			08
Mode of examination	Theory			
Weightage Distribution	CA	MTE	ETE	
	30%	20%	50%	
Text book/s*	Developmental Biology. 6th Edition. Gilbert SF Comparative Reproductive Biology. Ed: Schatten H, Constantinescu GM. Blaackwell Publishing. 2007			
Other References	Comparative Reproductive Biology. Ed: Schatten H, Constantinescu GM. Blaackwell Publishing. 2007			

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	Year-3rd	Semester:5th
Subject: Biotechnology		
Course Code: BSB206	Course title: Enzyme Technology	

Course Outcomes

After studying this course, students will be able to

- Get an overview on enzymes, their nomenclature and factors affecting enzyme activity
- Understand the factors affecting rate of biochemical reactions, lock and key as well as induced fit hypothesis
- Learn kinetics of enzyme catalysis as well as inhibition reactions
- Paraphrase the isolation, purification and immobilization of enzymes
- Implement use of enzymes in leather, dairy, pharmaceutical, food processing and various other industries for human welfare

Credit:04	Core: compulsory
Max. Marks: 25+75	Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**Enzymes as Catalysts: Overview** • Proteins as catalysts (Historical background); Enzyme characteristics and properties • Enzyme nomenclature & classification; EC number of enzymes • Factors affecting Enzyme Activity; Co-enzyme; Co-factors	**7**
II	**Factors affecting the rate of chemical reactions** • Collision theory, activation energy and transition state theory • Catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site) • Fischer's lock and key hypothesis, Koshland's induced fit hypothesis	**7**
III	**Enzyme Kinetics** • Kinetics of single substrate reactions, enzyme inhibition Irreversible and reversible inhibition, • Competitive non-competitive and un-competitive inhibition	**6**
IV	**Isolation and purification of enzymes**; • Localization of proteins in various organelles, enzyme • Immobilization: Adsorption, Matrix entrapment, Encapsulation Cross linking, covalent binding and their examples • Advantages and disadvantages of different immobilization techniques	8
V	**Industrial and Clinical Applications of Enzymes:** • Account Applications in Comprehensive beverage industry • Applications in leather industry, Applications in food processing industry • Applications in dairy industry, • Applications in pharmaceutical industry	08
VI	**Structure and function of coenzyme** • Structure and function of coenzyme - reactions involving TPP, pyrodoxal phosphate, • Nicotinamide, flavin nucleotide, coenzyme A and biotin	08

	• Industrial utilization of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.			
VII	**Enzyme as biocatalysts** • Associated techniques for enzyme applications; Co-immobilization of biocatalysts and cofactor cycling. • Enzyme stabilization & protein engineering; Catalytic antibodies; Enzymatic catalysis in bioseparations; • Biocatalytic applications in organic synthesis-hydrolytic reactions, oxidation reduction reactions, formation of C-C bond, addition & elimination reactions, glycosyl transfer reactions, isomerization, halogenation / dehalogenation reactions.			08
VIII	**Large scale production and purification of enzyme**; • Cofactors and their role in enzyme activity • Enzyme engineering: In vitro approaches to improve functional efficiency • Recombinant enzymes and their uses			08
Mode of examination	Theory			
Weightage Distribution	CA	MTE	ETE	
	30%	20%	50%	
Text book/s*	Palmer T., Bonner P. L., Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, Woodhead Publishing (2007)			
Other References	Lubert Stryer: Biochemistry, WH Freeman, USA (2002)			

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit 6									
A						X			X
B						X			X
C						X			X
Unit 7									
A							X		X
B							X		X
C							X		X
Unit 8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**2**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**2**	**2**	**3**	**2**

Program/Class:	**Year-3rd**	**Semester: 6th**
Subject: Biotechnology		
Course Code: BSB310	**Course title: Industrial Biotechnology**	

Course Outcomes

After successfully completion of this course students will be able to:

- Learn the basics of industrial biotechnology and unit operations used in biotech industries.
- Apply microbes for the production of industrially important enzymes.
- Learn the basics of sustainable processing for biobased products to further understand their impact on global sustainability.
- Gain knowledge about basics of biosensors and commercial biosensors.
- Develop new approaches to pollution prevention, resource conservation, and cost reduction during bioprocessing.
- Comprehend the basic concept of industrial biotechnology and the requirements for its application.

Credit:04	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	**Topics**	**Total No. of Lectures (60)**
I	**Introduction to Industrial Biotechnology** • Units and dimensions • Unit operations involved in Industrial Biotechnology • Products and market economics relating to industrial biotechnology	**7**
II	**Production of commercially important enzymes** • Cellulases, Amylase, Lipase, Proteases, Lysozyme Lysozyme • Enzymes for the food, pharmaceutical and detergent Industries • Biotechnological advances in enzyme production	8
III	**Biotransformation** • Transformation – steroids, alkaloids, and polysaccharides • Recent advances in biotransformation (Indigo, Xanthan, Malanins) • Natural bio-preservatives (nisin)	8
IV	**Biosensors** • Types of Biosensors • Biomedical Sensors • Commercial examples of Biosensors	6
V	**Industrial Bio-waste management** • Types of industrial waste • Techniques of waste treatment • Value addition to industrial waste	8
VI	**Technological processes for industrial manufacture** • Selected foods of commercial importance from plants and animal sources. • Process involved in preparation of Yoghurt, acidophilus milk, Koumis, kefir, cheese, bread, alcoholic beverage, vinegar and	8

	oriental fermented food. • Food packaging, Equipment involved in the commercially important food processing methods.	
VII	**Production of industrially important enzymes**: • Solid state fermentation, submerged fermentation, • Extraction, Purification and characterization of industrial • enzymes, industrial process using enzymes for production of drugs and fine chemicals, Enzyme based biosenso	08
VIII	**Introduction and production of secondary metabolites with some case study.** • Production of bioplastics (PHB, PHA), • bioinsecticides, bioherbicides, biopolymers, • Biofertilizers and biological weapons with reference to anthrax,	08
Mode of examination	Theory	

Weightage Distribution	CA	MTE	ETE	
	30%	20%	50%	

1. Michael L. Shuler and Fikret Kargi (2009, Second edition) Bioprocess Engineering-Basic concepts. Pearson Prentice Hall
2. Pauline M. Doran (2010) Bioprocess Engg. Principles. Elsevier, California.
3. B. D. Singh (2009, Revised edition) Biotechnology- Expanding Horizons. Kalyani publishers, Ludhiana-141008

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	**Year-3rd**	**Semester: 6th**
Subject: Biotechnology		
Course Code: BSB310	**Course: Enzymology Lab**	

Course Outcomes

After successfully completion of this course students will be able to:

- To understand the mode of action of salivary amylase
- Preparation of standard curve for calculation of enzyme activity.
- Assaying the activity of industrially important amylase enzyme using 3,5-Dinitrosalicylic acid method.
- To determine the pH optima of amylase enzyme
- To determine the temperature optima of amylase enzyme

Credit:02	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**Salivary amylase** Mode of action of α-amylase on starch	**12**
II	**Calculation of Enzyme Activity** Preparation of standard curve	12
III	**Assaying the activity of industrially important Amylase** 3'5'- Dinitrosalicylic acid method	**12**
IV	**pH optima** To determine the pH optima of amylase enzyme	**12**
V	**Temperature optima** To determine the temperature optima of amylase enzyme	12

Suggested Readings

Fundamentals of Enzymology: Nicholas Price & Lewis Stevens
Enzymes : Biochemistry, Biotechnology and Clinical Chemistry- Trevor Palmer
Biochemistry text books by Stryer, Voet and Lehninger (Relevant Chapters)

CO-PO mapping

Outcome no.→	1	2	3	4	5	6	7	8	9
Syllabus topic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	**Year-3rd**	**Semester: 6th**
Subject: Biotechnology		
Course Code: BSP305	**Course: Industrial Biotechnology Lab**	

Course Outcomes

After successfully completion of this course students will be able to:

- Practical knowledge of fermenter other instruments and their components
- Isolation and screening of microorganisms
- Practical knowledge of solid-state fermentation.
- Able to produce different biomolecules
- Cradle to grave knowledge of microbial process engineering.

Credit:02	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**Bioreactor and other instruments** • Demonstration of working principles of various components of a batch bioreactor • Demonstration of working principles of biosafety cabinet; and autoclave; centrifuge	**12**
II	Demonstration of working principles of centrifuge and incubator. • **Isolation and screening of microorganism** • Isolation and screening of microorganism producing enzyme (proteases) • Isolation and screening of microorganism producing acid (citric acid)	**12**
III	**Practical related to microbial fermentation** • Fermentative production of Amylase • Fermentative production of Beer	**12**
IV	**Practical related to Enzyme assay** Estimation of Protease activity.	**12**
V	**Practical related to solid state fermentation** Citric acid production be solid state fermentation	**12**

Suggested Readings

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
3. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods And Applications, VCH Pub. 1989.

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	Year-3rd	Semester: 6th
Subject: Biotechnology		
Course Code: BSB310	**Course title: Plant Biotechnology**	

Course Outcomes

The student will be able to understand following purposes

- the concept of totipotency
- concept of culture media for plants and its formulations.
- The student will learn about the culturing methods in Plant tissue culture.
- The student will be able to explain the process of zygotic and somatic embryogenesis.
- The student will be able to demonstrate the process of micropropagation and its utility.
- The student will learn about production and optimization of secondary metabolites by using different cultural techniques.
- The students will learn about the basic concepts of plant tissue culture and its application for human, social and environmental welfare.

Credit:04	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**Introduction of plant Biotechnology** • History of plant tissue culture • Concept of totipotency • Media composition & Growth Hormones	7
II	**Culture Initiation** • Explant; Callus Initiation • maintenance of callus, Subculture • Cytodifferentiation- advantage and disadvantage	8
III	**Somatic Embryogenesis** • Somatic and zygotic embryo • Process of embryogenesis; isolation of protoplast & its Fusion • Somatic and zygotic embryo	8
IV	**Micropropagation** • Micropropagation technique • Purpose of micropropagation • Factors responsible for micropropagation	6
V	**Production of Secondary Metabolism** • Concept of Primary & Secondary metabolites • Production and optimization of secondary metabolites, Elicitor • Hairy root culture: Advantage , Disadvantage	8
VI	**Organoganesis;** • Somatic embryogenesis; transfer and establishment of whole plants in soil (hardening) • Rapid clonal propagation and production of virus -free plant • In vitro pollination; embryo culture and embryo rescue . Protoplast fusion, selection of hybrid cells; symmetric and asymmetric hybrids, cybrids	8

VII	**Nuclear cytology of cultured plant cells and somaclonal variations** • Production of haploid plants and their utilization • Cryopreservation and slow growth for germplasm conservation. • Production of Biochemicals from cells and tissue cultures	08
VIII	**Gene transfer in nuclear genome and chloroplasts**; • Agrobacterium-mediated gene transfer, direct gene transfer, antibiotic marker-free transgenics • Transgenic plants: insect resistance, virus resistance, abiotic stress tolerance, longer shelf life. • Strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden rice).	08
Mode of examination	Theory	

Weightage Distribution	CA	MTE	ETE	
	30%	20%	50%	

Text book/s*	Bhojwani S.S., Dantu P.K., "Plant Tissue Culture: An Introductory Text", Springer, 2013. Stewart C.N., "Plant Biotechnology and Genetics: Techniques and Applications", Wiley-Interscience'2008. Oksman-Caldentey K-M., "Plant Biotechnology and Transgenic Plants; CRC Press, 2002.	
Other References	Oksman-Caldentey K-M., "Plant Biotechnology and Transgenic Plants; CRC Press, 2002.	

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	Year-3rd	Semester: 7th
Subject: Biotechnology		
Course Code: BSB310	Course title: Bioprocess Technology	

Course outcomes

After studying this course, students will be able to

- Understands basics of fermentation
- Describe the mode of operation of the bioreactors
- Understands Control in Fermentorand transport phenomena
- Summarize the Downstream Processing
- Determine the quality of the fermentation Product

Credit:04	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topic	Total No. of Lectures(60)
I	**Basics of fermentation** • Basic principle in bioprocess technology.Upstream: Media formulation, Inoculum development and aseptic transfers. • History of fermentation, submerged and solid state fermentation, Nutrient requirements for microbial growth, Growth kinetics of microbes. • Sterilization of media and equipments for fermentation	08
II	**Different mode of bioreactor operation** • Batch, Continuous and Fed batch mode of operation. • Operational design of Bioreactor- vessel, agitator, sparger, baffles, types of Bioreactors- STR,CSTR • Airlift fermenter, Fluidized bed reactor, Packed bed reactor, Immobilized cells and enzymes bioreactor	08
III	**Control in Fermentor and transport phenomena** • Measurement, monitoring and control of physical, chemical and biological parameters in a bioreactor. • Transport phenomena in bioreactor, Aeration and agitation in bioreactors. • pH and temperature control in bioreactor.	08
IV	**Downstream Processing** • Solids (Insolubles) Removal: Filtration;Centrifugation; Coagulation and flocculation; • Foam fractionation; Whole-broth treatment; Primary Product Isolation: Cell disruption • Liquid extraction; Dissociation extraction; Ion-exchange adsorption; precipitation;	08
V	**Quality assurance (QA) of fermentation product** • Detection and Quantification of the product by physicochemical, biological and enzymatic methods,	08

	• Sterility testing, c. Pyrogen testing – Endotoxin detection, • Ames test and modified Ames test, e. Toxicity testing, f. Shelf life determination	
VI	**Industrial production of chemicals** • Ethanol, Acids (citric, acetic and gluconic), solvents (glycerol, acetone and butanol), • Antibiotics (penicillin, streptomycin and tetracycline),	07
VII	**Semisynthetic antibiotics Production** • Amino acids (lysine and glutamic acid), Single cell protein	06
VIII	**Factors affecting production in industry** • Aeration and agitation: Requirement of oxygen in industrial processes. • Concept of volumetric oxygen transfer coefficient and its determination (kLa). Factors affecting (kLa	07
Mode of examination	Theory	
Weightage Distribution	**C**A: 30%	MTE: 20% / ETE: 50%
Text book/s*	1. Principles of fermentation technology, Stanbury P.F. et al, Butterworth-Heinemann Ltd, 2. Oxford Industrial Microbiology by Casida	
Other References	1. Industrial Microbiology by Cruger 2. Food Microbiology by Frazier	

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

B301: Animal Biotechnology

L T P: 4-0-0 **Credit: 4**

Program/Class:	**Year-3rd**	**Semester: 7th**
Subject: Biotechnology		
Course Code: BSB310	**Course title: Animal Biotechnology**	

Course outcomes

After studying this course, students will be able to

- Understand the methods of obtaining cells from the tissue for cell culture.
- Classify the different types of media used in animal cell culture based on cell types and the cell line types.
- Know about the animal cell cloning and the methods of transfecting cells in the culture.
- Explain the stem cell technology and its applications.
- Understand the basics of tissue and organ culture as well as the applications of transgenic animal in different sectors.
- To get a complete knowledge about various techniques and methodology used in animal biotechnology.

Credit:04	**Core: compulsory**
Max. Marks: 25+75	**Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topic	**Total No. of Lectures(60)**
I	**Introduction to Animal Cell Culture** • Structure and organization of animal cell; sources of cell • Techniques of obtaining cells by disaggregation of tissues, Enzymatic disaggregation • EDTA treatment; Types of cell culture, Equipments required for animal cell culture	07
II	**Development of Cell Lines** • Medium preparations and its various types Natural, artificial serum protein free media • Advantages and disadvantages of sub culturing techniques, viable cell counts with haemocytometer, development of cell lines, • Types of cell lines, their characteristics, suspension culture advantages & culture. Disadvantages, totipotency in animal cell	07
III	**Animal Cell Cloning** • Cloning, types of cell cloning methods of cloning • Transfection; methods, retro-virus mediated gene transfer • Embryonic stem cell-mediated gene transfer, artificial twining, risk of cloning cloned animals.	06
IV	**Stem Cell Culture and Technology** • Stem cell technology; haematopoiesis, methods to study repopulation assay, • In vitro cloning assay, long term culture • Embryonic stem cell culture, Application of stem cell culture.	08

V	**Application of Animal Cell Culture Technology** • Transgenic cells and animals & their application; • organ culture, Histotypic & organotypic culture, rearing animal models and advantages • Potential of transgenic animals to improve human welfare in Agriculture, medicine and industry, ethical and value issues in animal biotechnology	08
VI	**Animal transgenesis:** • Mechanism of transferring genes into specific animal tissues and cell lines. • Production of transgenic animals (cattle, mice, sheep, goat, pig and fish) and chimeras. • Artificial insemination and embryo transfer.	08
VII	**Application of transgenic animals:** • Production of useful proteins and other products in transgenic animals • Production of regulatory proteins, blood products, vaccines. • Hhormones and other therapeutic proteins).	08
VIII	**Gene Manipulation** • Strategy of gene delivery, in vitro translation, expression in mammalian cells. Chromosome engineering, • Targeted gene replacement, gene editing, gene regulation and silencing	08

	Mode of Examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	

Suggested Readings

1. Freshney I.R., “Culture of Animal Cells: A Manual of Basic Technique”, Wiley, 2005.
2. Jenkins N., “Animal Cell Biotechnology: Methods and Protocols”, Humana Press, 2006.
3. Shenoy M., “Animal Biotechnology”, Laxmi Pub, 2007.

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

School: SBSR		**Batch: 2018-21**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 06**	
1	Course Code	**BSP305**	
2	Course Title	**Plant Biotechnology Laboratory**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	To learn methods of cell isolation from tissues and differentiate between animal and plant cell culture techniques.	
6	Course Outcomes	CO1: Identify standard operating procedures for laboratory equipments. CO2: Estimate free drug and drug-conjugates by spectrophotometry. CO3: Isolate and separate DNA (by electrophoresis) from animals pre-treated with drugs. CO4: Prepare drug-conjugates and purify by column chromatography. CO5: Separate total proteins by PAGE and visualize protein bands by Coomassie blue staining method. CO6: Design and conduct an experiment. CO7: Analyze experimental results and communicate data through writing.	
7	Course Description	To Plan and carry out the experiment and to learn methods of cell isolation from tissues and determine enzyme activity and inhibition of different proteins. Design and conduct the experiment.	
8	Outline syllabus		Total hours 60
	Unit 1	Basics about Plant Cell Culture	12
	Unit 2	To Prepare the material required for various cell culture practices in sterile conditions To Prepare serum from the given blood sample	12
	Unit 3	Purify DNA and separate DNA by agarose gel electrophoresis. To prepare desired medium for the plant culture	12
	Unit 4	Conduct an experiment to detect glucose from given sample.	12
	Unit 5	To prepare permanent slide using the given section like stem, root and leaf To grow organic Lemon/rose artificially	12

Suggested Readings

1. Freshney R.I., "Culture of Animal Cells: A Manual of Basic Technique", Wiley-Liss, 2005.
2. Boyer R.F., "Biochemistry Laboratory: Modern Theory and Techniques", Prentice Hall, 2011.

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

School: SBSR			
Program:			
Branch:			
1	Course Code		
2	Course Title	**Animal Biotechnology Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	**Compulsory**	
5	Course Objective	To learn methods of cell isolation from tissues and determine enzyme activity and inhibition of different proteins.	
6	Course Outcomes	CO1: Perform detection of protein from the given samples. CO2:Carry out an experiment for the detection of starch. CO3:Distinguish glucose from the given sample with the help of designed experiment. CO4:Design and conduct the experiment. CO5:Protein separation by chromatographic techniques. CO6:Plan and carry out the experiment. CO7:Carry out an experiment for the visualization of DNA on agarose gel. CO8:Design and conduct the experiment. CO9:Plan and carry out an experiment for the separation and quantification of fat from milk	
7	Course Description	To Plan and carry out the experiment and to learn methods of cell isolation from tissues and determine enzyme activity and inhibition of different proteins. Design and conduct the experiment.	
8	Outline syllabus		CO Mapping
	Unit 1	Isolation of Macrophages from allergy induced mice	**12**
	Unit 2	Effect of different allergens on total lymphocyte count	**12**
	Unit 3	Isolation of genomic DNA from Blood samples	**12**
	Unit 4	Purification and quantification of isolated DNA samples	**12**
	Unit 5	RAPD analysis of genomic DNA isolated from different blood samples	**12**

Suggested Readings

1. Practical manual of Biotechnology by Ritu Mahajan,Jitendar Sharma, RK Mahajan, Vayu Education of India
2. Practical Microbiology by DK Maheshwari, S Chand Publications.

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**

Program/Class:	Year-3rd	Semester: 7th
Subject: Biotechnology		
Course Code: BSB 306	Course title: Genomics	

Course Outcomes

The student will be able to understand following purposes

- Comprehend the basic concept of Genome and its importance.
- Choose the right of sequencing method.
- Differentiate between different sequencing methods and the degree of enhancement in techniques with application of bioinformatics.
- Relate the differences between different Genome structure.
- Apply the techniques of locating unidentified genes in a sequence and their organization.
- Discuss different application of Genomics in different field of study
- Be familiar with the different techniques used in genome analysis.

Credit:04	Core: compulsory
Max. Marks: 25+75	Passing Marks: as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topics	Total No. of Lectures (60)
I	**DNA Sequencing** • Introduction to concept of Genome; DNA and RNA as genome • Information flow in Biology; DNA Sequencing technologies, Maxam-Gilbert • Sanger method of Sequencing, manual and automated	08
II	**Whole Genome Sequencing** • Concept and application of Whole genome sequencing, Shot Gun Sequencing methods • Clone contig Sequencing methods; Pyrosequencing • Genome sequence data and genome databases; Application of Bioinformatics in genomics	08
III	**Genome Anatomy** • Difference between gene and genome; Prokaryotic and eukaryotic genome structure, • Intergenic spaces, gene families, monopartite genome, multipartite genome, split genes, overlapping genes; • C value Paradox, viral genome, Yeast and Drosophila genome structure	08
IV	**Functional genomics** • Gene prediction methods, function prediction, Annotation, Functional, genomics, its tools and methodologies, • organellar genomes, endosymbiosis • Comparative genomics its tools and methodologies, phylogeny	08
V	**Application of Genomics** • Application of comparative genomics, Pharmaco-genomics • Application of genomics in crop improvement • Application of genomics in industry; personalized medicine	08

VI	**Transformation and tumorigenesis** • Cell transformation and tumourigenesis: Cell cycle check point and cancer • Oncogenes, Tumour suppressor genes, • DNA repair genes and genetic instability,				07
VII	**Epigentics modification** • Epigenetic modifications, telomerase activity, • centrosome malfunction, Genetic heterogeneity and • clonal evolution and gene manipulation				07
VIII	**Familial cancer** • Retinoblastoma, Wilms' tumour, Li-Fraumeni syndrome, • colorectal, cancer, breast cancer Genetic predisposition to sporadic cancer				06
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	1. Brown TA. Genomes 3. 3rd edition. Oxford: Wiley-Lis; (2002) 2. Pevsner J., "Bioinformatics and Functional Genomics", John Wiley and Sons, 2008.			
	Other References	1. Lewin B., Jocelyn E.K., Elliot S., "Lewin Genes XI", Jones and Bartlette; (2014) 2. Bioinformatics: Tools and Applications, David Edwards, Jason Stajich, David Hansen, Springer Science & Business Media, (2009)			

CO-PO mapping

Outcomeno.→	1	2	3	4	5	6	7	8	9
Syllabustopic↓									
Unit1									
A	X								X
B	X								X
C	X								X
Unit2									
A		X							X
B		X							X
C		X							X
Unit3									
A			X						X
B			X						X
C			X						X
Unit4									
A				X					X
B				X					X
C				X					X
Unit5									
A					X				X
B					X				X
C					X				X
Unit6									
A						X			X
B						X			X
C						X			X
Unit7									
A							X		X
B							X		X
C							X		X
Unit8									
A								X	X
B								X	X
C								X	X

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO2	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO4	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO6	**3**	**2**	**3**	**1**	**1**	**3**	**2**
CO7	**3**	**2**	**3**	**1**	**2**	**3**	**2**
CO8	**3**	**2**	**3**	**1**	**2**	**3**	**2**