Dr. N.G.P.ARTS AND SCIENCE COLLEGE

REGULATIONS 2025-26 for Post Graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc. BIOCHEMISTRY

(For the students admitted during the academic year 2025-26)

Eligibility

The eligibility conditions for admission to M.Sc., in Biochemistry is candidates with B.Sc., in Biochemistry, Biotechnology, Microbiology, Biomedical Science, Biomedical Instrumentation Science, Medical Lab Technology, Bioinformatics, Environmental Sciences, Clinical Lab Technology, Biochemistry (Nanotechnology), Chemistry, Life Sciences, Botany, Zoology, Nutrition and dietetics or an Examinations accepted as equivalent there by Academic Council, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Master of Science Degree in Biochemistry Examination** of this College after a programme of study of two academic years.

Programme Educational Objectives

1. Instill inquisitiveness in students to explore realms of modern biology (Molecular genetics, Marine biochemistry, Pharmaceutical biochemistry, and Immunology, Enzymology and Clinical biochemistry) through interdisciplinary cutting edge research.

2. Empower students to acquire, develop and demonstrate skills in bioinstrumentation, biostatistical and bioinformatic software and tools, and in the fields of Industrial Biochemistry, and Nanotechnology and Cancer biology to meet the relevant demands of traditional and emerging industries.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Postgraduates are cognizant of progressive principles and concepts in diverse branches of modern biology that govern the integrity of dynamic bio-molecular assembly in varied life forms. Alumni are expressive of mastered wisdom to peers and public to expedite basic understanding of issues of social importance through practice and investigation.
PO2	Postgraduates are comprehensive of complex of biological systems, and they have broadened and perfected competency and skills in principal and contingent areas of modern biology. Thereby, alumni as an individual or as a team member can address, investigate, design, develop and demonstrate solutions to important issues facing humanity and preserve natural ecosystems.
PO3	Postgraduates are advantaged to identify and exploit functionally crucial areas in diverse branches of modern biology, and combine it with modern tools to investigate, design, develop, demonstrate and familiarize solutions to both basic and applied research questions in areas of industry, medicine, agriculture, pharmacy, food technology, biotechnology, etc. Alumni are valuable performers as an individual or in a team.
PO4	Postgraduates are competent to enroll in research programs and modeled to receptive of successful career options in diverse branches of modern biology as scholars, managers, counselors, writers, technical experts, field experts, teachers, entrepreneur and a responsible citizen. Alumni have acquired and developed skills to manage projects and finances as individual or as a team member. While discharging duties at varied capacities, postgraduates are inculcated to keep sustainable environment as a goal, and follow ethics of professional stature.
PO5	Postgraduates are infused with metamorphic qualities of education, and inspired to develop scientific temperament and lead a scientific way of life in facing socio-economical challenges that will benefit the society. Alumni are adept at evaluating their learning's to worldwide events. Thereby, they continue their learning lifelong.

TOTAL CREDIT DISTRIBUTION

Course	Credits	Total		Total Credits	Cumulative Total
Core	4	13x 100	1300	52	90
Core	3	1X100	100	03	
Core Practical	3	3 x 100	300	09	
Core Practical	2	3 x 100	300	06	
Project Work	8	1 x 200	200	08	
Discipline Specific Elective (DSE)	3	4 x 100	400	12	
Industrial Training	2	1 x 100	100	2	
			2700	**92**	**92**

CURRICULUM

M.Sc.BIOCHEMISTRY PROGRAMME

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
25BCP1CA	Core-I	Chemistry of Biomolecules	4	-	-	4	48	3	25	75	100	4
25BCP1CB	Core-II	Biochemical techniques and Instrumentation	4	-	-	4	48	3	25	75	100	4
25BCP1CC	Core-III	Enzymes and Enzyme Technology	4	-	-	4	48	3	25	75	100	4
25BCP1CD	Core-IV	Cellular Biochemistry	4	-	-	4	48	3	25	75	100	4
25BCP1CP	Core Practical-I	Enzymes and Cellular Biochemistry	-	-	6	6	72	6	40	60	100	3
25BCP1CQ	Core Practical-II	Biomolecules and Biochemical Techniques	-	-	4	4	48	6	40	60	100	2
25MBP1DA	DSE-I	Microbial Technology	3	1	-	4	48	3	25	75	100	3
25BCP1DA		Cancer Biology, Diagnosis and Therapy										
25BTP1DA		Applied Biotechnology										
Total			**19**	**1**	**10**	**30**	**360**				**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Second Semester												
25BCP2CA	Core-V	Immunology	4	-	-	4	48	3	25	75	100	4
25BCP2CB	Core-VI	Metabolism	4	-	-	4	48	3	25	75	100	4
25BCP2CC	Core-VII	Microbial Biochemistry	4	-	-	4	48	3	25	75	100	4
25BCP2CD	Core-VIII	Genetics and Molecular Biology	4	-	-	4	48	3	25	75	100	4
25BCP2CP	Core Practical-III	Immunology and Molecular Biology	-	-	6	6	72	6	40	60	100	3
25BCP2CQ	Core Practical-IV	Microbial Biochemistry and Metabolism	-	-	4	4	48	6	40	60	100	2
25MBP2DA	DSE-II	Bionanotechnology	3	1	-	4	48	3	25	75	100	3
25BCP2DA		Biochemistry of Toxicology										
25BTP2DA		Forensic Biotechnology										
Total			**19**	**1**	**10**	**30**	**360**				**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Third Semester												
25BCP3CA	Core-IX	Research Methodology and Biostatistics	4	-	-	4	48	3	25	75	100	4
25BCP3CB	Core-X	Plant Biochemistry and Biotechnology	4	-	-	4	48	3	25	75	100	4
25BCP3CC	Core-XI	Genetic Engineering	4	-	-	4	48	3	25	75	100	4
25BCP3CD	Core-XII	Clinical Biochemistry	4	-	-	4	48	3	25	75	100	4
25BCP3CP	Core Practical -V	Clinical Biochemistry	-	-	6	6	72	6	40	60	100	3
25BCP3CQ	Core Practical-VI	Plant Biochemistry and Genetic Engineering	-	-	4	4	48	6	40	60	100	2
25MBP3DA	DSE-III	Medical Laboratory Techniques	3	1	-	4	48	3	25	75	100	3
25BCP3DA		Free Radicals and Antioxidant System										
25BTP3DA		Molecular Therapeutics										
25BCP3CT	IT	Internship	-	-	-	-	-	-	40	60	100	2
Total			**19**	**1**	**10**	**30**	**360**				**800**	**26**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam(h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Fourth Semester												
25BCP4CA	Core-XIII	Bioethics and Biosafety	4	1	-	5	60	3	25	75	100	3
25BCP4CB	Core-XIV	Endocrinology and Developmental Biology	4	1	-	5	60	3	25	75	100	4
25BCP4CV	Core	Project	-	-	16	16	192	6	80	120	200	8
25MBP4DA	DSE-IV	Molecular Diagnostics and Bioinformatics	3	1	-	4	48	3	25	75	100	3
25BCP4DA		Neurobiology										
25BTP4DA		Stem Cell Technology										
Total			**11**	**3**	**16**	**30**	**360**				**500**	**18**
Grand Total											**2700**	**92**

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DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I to IV

Semester I (Elective I) List of Elective Courses

S.No	Course Code	Name of the Course
1.	25MBP1DA	Microbial Technology
2.	25BCP1DA	Cancer Biology, Diagnosis and Therapy
3.	25BTP1DA	Applied Biotechnology

Semester II (Elective II) List of elective Courses

S.No	Course Code	Name of the Course
1.	25MBP2DA	Bionanotechnology
2.	25BCP2DA	Biochemistry of Toxicology
3.	25BTP2DA	Forensic Biotechnology

Semester III (Elective III) List of elective Courses

S.No	Course Code	Name of the Course
1.	25MBP3DA	Medical Laboratory Techniques
2.	25BCP3DA	Free Radicals and Antioxidant System
3.	25BTP3DA	Molecular Therapeutics

Semester IV (Elective IV) List of Elective Courses

S.No.	Course Code	Name of the Course
1.	25MBP4DA	Molecular Diagnostics and Bioinformatics
2.	25BCP4DA	Neurobiology
3.	25BTP4DA	Stem Cell Technology

EXTRACREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S.No.	Semester	Course Code	Course Title
1.	III	25BCPSSA	Bionanotechnology
2.		25BCPSSB	Inheritance, Evolution and Behaviour

Semester – I CORE I: CHEMISTRY OF BIOMOLECULES							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25BCP1CA	CHEMISTRY OF BIOMOLECULES	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The structural organization and functional properties of biomolecules. The basic principles of cancer development and available therapeutic options • The structure and functions of biologically important macromolecules. • The characterization of biological macromolecules.
Prerequisite	Knowledge on Biomolecules

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Assess the importance of carbohydrate containing proteins, homo and heteropolysaccharides.	K4
CO2	Determine the conformational properties of biological proteins.	K5
CO3	Summarize the information about all lipids and their biological significance.	K5
CO4	Explain the different forms of DNA& RNA.	K5
CO5	Illustrate the structure and functions of important heterocyclic compounds.	K3

Mapping with Program Outcomes:					
Cos / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1CA | CHEMISTRY OF BIOMOLECULES

Syllabus

Unit	Content	Hrs	Resources
I	**Polysaccharides** Homo polysaccharides: Structure and biological functions of starch, hemicellulose cellulose, glycogen, chitin, inulin, lignin and peptidoglycans. Hetero polysaccharides: Structure and biological importance of sugar derivatives-glycosaminoglycans, proteoglycans. Glycoprotein – Blood group and bacterial cell wall polysaccharides, O- linked and N- linked oligosaccharides and Lectins. Isolation and Purification of Polysaccharides.	10	Text Book
II	**Proteins** Primary structure- determination of amino acid sequence of proteins. The peptide bond, Peptides of biological importance. Chemical synthesis of peptides- Solid phase peptides synthesis. Denaturation and Renaturation of Proteins. Ramachandran plot. Secondary structure- weak interactions involved, alpha helix, beta sheet and beta turn's. Collagen triple helix. Super secondary structures- helix-loophelix, zinc finger and leucine zipper. Tertiary structure- alpha and beta domains. Quaternary structure- structure of haemoglobin and myoglobin. Protein folding. Outline of various biological functions of proteins.	10	Reference Book
III	**Lipids** Classification, structure, function, physical and chemical properties of lipids. Fatty acids-Saturated, Hydroxy and Unsaturated Fattyacids-Triacylglycerol. Phospholipidsclassification, structure and functions. Ceramides and sphingomyelins. Eicosanoids: Structure and functions of prostaglandins, thromboxanes, leukotrienes. Types and functions of plasma lipoproteins. Amphipathic lipidsmembranes, micelles, emulsions and liposomes. Steroidsstructure and biological role of cholesterol, bile acids, bile salts. Lipid Peroxidation and antioxidants. Growth Factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.	10	Reference Book
IV	**Nucleic Acids** Bases, Nucleosides, Nucleotides, Nucleotides as energy carriers. DNA double helical structure. A, B and Z forms of DNA. Triple and quadruple structures. Physical properties of DNA. Chemicals that react with DNA. Renaturation and denaturation. DNA super coiling and linking number. DNA bending-Protein induced bending. Cruciform DNA, Left-handed DNA. Types of RNA, Secondary and tertiary structure	10	NPTEL

	of RNA.		
V	**Heterocyclic Compounds** Hetero cyclic rings of biologically important compounds. Structure and biological importance of pyridine, pyrole, quinolene, pyrimidine, purine, pteridine, thiazole, imidazole and indole ring containing compounds. Porphyrine – structure and biologically important compounds containing porphyin ring	08	E-Resources and Websites
	Total	**48**	

Text book	1.	David L Nelson and Michael M Cox, 2017, "Lehninger Principles of Biochemistry", 7 th edition. Macmillan Publisher, New York.
	2.	Richard R Sinden, 2012, "DNA Structure and Function", 1st Edition, Academic Press, US.
Reference Books	1.	Jeremy M Berg Lubert Stryer John Tymoczko and Gregory Gatto, 2019, "Biochemistry", 9 th edition, W.H. Freeman and Company, New York..
	2.	Donald Voet, Judith G. Voet, Charlotte W. Pratt,2018, "Voet's Principles of Biochemistry", 5 th edition, John Wiley & Sons, New York
	3.	Theophil Eicher, Siegfried Hauptmann and Andreas Speicher, 2013, "The Chemistry of Heterocycles: Structure, Reactions, Synthesis and Applications", 3 rd Edition, Wiley--VCH Verlag & Co, Weinheim.

Journal and Magazines	Journal of Biomolecules and Biochemistry | Open Access Journals All biomolecules articles | Chemistry World
E-Resources and Website	https://ncert.nic.in/textbook/pdf/lech205.pdf Biomolecule | Definition, Structure, Functions, Examples, & Facts | Britannica https://archive.nptel.ac.in/courses/104/103/104103121/

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

Focus of the Course	Skill Development/ Employability

SEMESTER I
CORE II: BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25BCP1CB	BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • An overview of the scientific basis of instruments. • The advantages and limitations of conventional and modern bio-analytical techniques • The analytical techniques such as Spectroscopy, Centrifugation, Microscopy, Chromatography, Electrophoresis and Radioisotopes.
Prerequisite	Basic knowledge about Biochemical Techniques

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Distinguish the conventional and recent techniques in the field of spectroscopy like ESR, NMR and MS etc.	K5
CO2	Compare and contrast the preparative and analytical ultracentrifugation techniques and the advanced microscopic methods.	K5
CO3	Evaluate the advantages and disadvantages of ancient and recent techniques in chromatography.	K5
CO4	Assess and explain the importance of different types of electrophoresis and blotting techniques.	K4
CO5	Differentiate the different biophysical techniques like X- ray diffraction, ORD, CD etc.	K5

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1CB	BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Spectroscopic techniques Principle, instrumentation and applications of Colorimetry, UV-Visible, FTIR, IR, Fluorescence spectrophotometry, Turbidimetry, Luminometry and Flame emission spectrometry, Electron Spin Resonance, Nuclear Magnetic Resonance, Mass and Raman Spectroscopy.	10	Text Book
II	Centrifugation techniques and Microscopy Tissue homogenization. Disruption of tissues and cells, Centrifuges – Principle, applications, and types. Differential centrifugation, density gradient centrifugation of tissues and cells, Preparative and analytical ultracentrifugation. Basic principles, instrumentation and applications of Microscopes: Light and Compound, Fluorescence, Phase contrast, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM) and Confocal.	10	Reference Book
III	Chromatographic techniques Principle, technique and applications of paper, TLC, HPTLC, column, affinity, ion- exchange, gel filtration, hydrophobic interaction and adsorption chromatography. Principle, components, limitations and applications of GC, GC-MS, HPLC, RP- HPLC, LCMS.	10	NPTEL
IV	Electrophoresis and Blotting techniques Principle, technique and applications of paper, Gels Electrophoresis: Agarose, Native and SDS- PAGE, Isoelectric focusing, 2D PAGE, Denaturing gels, 3D Electrophoresis and applications. Electrophoresis in DNA sequencing, Peptide mapping, N-terminal sequencing of proteins, Next generation sequencing. Principle, technique and applications of western, southern and northern blotting. Chemiluminescence and Phosphorimaging.	10	Reference Book
V	Biophysical and Radio-isotopic methods Principles and applications of X-ray diffraction, ORD and circular dichroism, Types of radiation, half-life and units of radioactivity, Applications of radioisotopes in disease diagnosis	8	E-Resources and Website

	Detection and measurement of radioactivity– Principle, instrumentation and applications of Liquid scintillation counter and Geiger-Muller counter. Autoradiography and its applications.		
	Total	**48**	

Text Book	**1.**	Sawhney and Singh, 2015, "Introductory Practical Biochemistry", 11th edition, Narosa Publishing house, New Delhi.
	2.	Wilson and Walker, 2018, "Principles and Techniques of Biochemistry and Molecular Biology", 8th edition, Cambridge University Press, London.
Reference Books	**1.**	Boyer, R.F, 2012, "Modern Experimental Biochemistry", 3rd edition, Pearson Education Inc, New York.
	2.	Cooper, T.G, 2011, "The Tools of Biochemistry", 1st edition, John Wiley and Sons, New Jersey.
	3.	Pelczar Jr, Chan and Krieg,2012,"Microbiology", 5th Edition, Tata Mc Graw Hill, New York
	4.	Srivastava, S, 2010, "Molecular Techniques in Biochemistry and Biotechnology", 1st edition, New Central Book Publishers, Kolkata.

Journal and Magazines	home - Journal Of Biochemical Technology (jbiochemtech.com) Biochemical Research Methods | Augustus C. Long Health Sciences Library (columbia.edu)
E-Resources and Website	NPTEL :: Biotechnology - Bioanalytical Techniques and Bioinformatics

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability

SEMESTER I
CORE III: ENZYMES AND ENZYME TECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	**25BCP1CC**	**ENZYMES AND ENZYME TECHNOLOGY**	**CORE**	**48**	**-**	**-**	**4**

Preamble	This course has been designed for students to learn and understand • The structure, function and mechanism of enzymes action. • The current and possible future applications of enzyme technologies. • The field of biosensors and enzymes immobilization.
Prerequisite	Basic knowledge about Enzymes

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Examine the structural and functional properties of enzymes, Isolation and purification of enzymes.	K4
CO2	Analyze the enzyme kinetics, types of enzyme inhibition and its kinetics, solve simple problems related to kinetics	K5
CO3	Evaluate the enzyme specificity, mechanism of enzyme action and regulation of enzyme activity	K5
CO4	Value the use of enzymes in industry and the importance of enzymes in clinical diagnostics and therapeutics	K5
CO5	Plan a project on enzyme isolation, purification and application of immobilized enzymes.	K6

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1CC	ENZYMES AND ENZYME TECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Classification, Purification and Active Site** Classification of enzymes, isolation and purification of enzymes, criteria of purity- specific activity, molecular weight determination. Active site: structure, determination of active site amino acids, Investigation of 3D Structure of Active site. Models of enzyme substrate binding: Lock and key model and Induced Fit model. Coenzymes and cofactors in enzyme catalysed reaction. Multi-enzyme complex- Pyruvate dehydrogenase, fatty acid synthase. Measurement of enzyme activity: two-point assay, kinetic assay, using radio-labelled substrates.	10	Text Book
II	**Enzyme Kinetics and Inhibition** Kinetics of single substrate enzyme catalysed reactions: Derivation and Significance of MM Equation, Lineweaver-Burk plot, Eadie- Hofstee plot, Hanes-Woolf plot and Eisenthal and Cornish-Bowden plot. Kinetics of Allosteric enzymes: MWC and KNF models, Hill' equation coefficient. Sequential and non-sequential bisubstrate and multi-substrate reactions. Enzyme inhibition- types and kinetics. Simple problems related to enzyme kinetics.	10	Reference Book
III	**Mechanism of Enzyme Action and Regulation** Enzyme specificity, Significance and Evaluation of activation energy. Mechanism of enzyme action: general acid-base catalysis, covalent catalysis, proximity and orientation effects, Strain and Distortion theory, mechanism of serine proteases - chymotrypsin,–lysozyme, and ribonuclease. Metal activated enzymes and metalloenzymes. Role of metal ions in carbonic anhydrase, superoxide dismutase, carboxy peptidase. Regulation of enzyme activity-covalently modified regulated enzymes, allosteric enzymes, isozymes.	10	Reference Book
IV	**Applications of Enzymes in Industry and Clinical Diagnosis** Enzyme applications in food and allied industries: sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production. Clinical enzymology: Enzymes as thrombolytic agents, anti-	10	NPTEL

	inflammatory agents and digestive aids. Therapeutic use of asparaginase, streptokinase. Enzymes and isoenzymes in diagnosis: LDH, CK and cholinesterase.		
V	**Immobilized Enzymes and Biosensors** Immobilized enzymes: various methods of immobilization, kinetics and applications of immobilized enzyme. Biosensors: Principle, technique and mechanism of Biosensors - Calorimetric biosensors, potentiometric biosensors, Amperometric biosensors, optic biosensors, and immune-sensors. Enzyme engineering: Artificial enzymes. Abzymes and synzymes, Antioxidant enzymes. Strategies and Challenges for the Development of Engineered Enzymes in the Food Industry.	08	**E-Resources and Website**
	Total	**48**	

Text Book	**1.**	*Palmer, T, 2004, "**Understanding enzymes**", 1st edition, East West Press Pvt. Ltd., New Delhi*
Reference Books	**1.**	*Bhatt S.M, 2014, "**Enzymology and Enzyme technology**", 15th edition, S. Chand publishing Ltd, New Delhi..*
	2.	*Palmer, T and Bonner, P L, 2004, "**Enzymes: Biochemistry, Biotechnology, Clinical chemistry**", 1st edition, East West Press Pvt. Ltd., New Delhi..*
	3.	*Price, N C, Stevens, L, 2009, "**Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins**", 3rd edition, Oxford University Press, United Kingdom*
	4.	*Choudhary, N L, Singh, A, 2012, "**Fundamentals of Enzymology**", 1st edition, Oxford Book Company, New Delhi, India..*

Journal and Magazines	https://www.sciencedirect.com/science/article/pii/S2001037014600957 https://internationalbulletins.com/intjour/index.php/ibet/article/view/418 https://www.sciencedirect.com/science/article/abs/pii/S1043452616300377
E-Resources and Website	https://onlinecourses.nptel.ac.in/noc23_bt05/preview[NPTEL] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123961/ https://pubmed.ncbi.nlm.nih.gov/30609693/

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability

Semester – I CORE I: CELLULAR BIOCHEMISTRY							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25BCP1CD	CELLULAR BIOCHEMISTRY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • an overview on cellular organization and function • mechanism of cellular transport, communication, division, and cancer
Prerequisite	Knowledge about Cell organelles and their functions

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Distinguish the composition and orientation of macromolecules constituting bio-membranes and structure and function.	K5
CO2	Distinguish various types of transport system in cells. Compare and contrast different transport process in cells.	K5
CO3	Evaluate pathways of energy generation and utilization, cytoskeleton organization in a cell.	K5
CO4	Assess and explain molecules of cellular integration and pathways of cellular communication.	K4
CO5	Examine cell division events and process of cell death. Understand events leading to cellular transformation.	K5

Mapping with Program Outcomes:					
Cos / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1CD | CELLULAR BIOCHEMISTRY

Syllabus

Unit	Content	Hrs	Resources
I	Membrane Biology Biomembrane structure - fluid mosaic model. Membrane lipids - fluidity, Asymmetry phase transition, Liposomes, Scott Syndrome. Membrane proteins-Types, Orientation, Mobility- Experiments, flippases, proteins or RBC membrane, Bacteriorhodopsin, Porins-aquaporin. RBC ghosts, solubilisation of proteins, lipid anchored proteins. Carbohydrates- cell surface carbohydrates-Lectins..	09	Text Book
II	Membrane Transport Membrane transport - Overview, Passive diffusion, Facilitated diffusion in erythrocytes. Carriers and Ion-Channels. Ion cone, Gradients, Uniporter Catalyzed transport. Active transport systems-Transport process driven by ATP-Ion Pumps: Calcium APTase, Na+K+ATPase, Gastric H+K+ATPase, ATPases that transport peptides and drugs, ABC superfamily- Bacterial PM permeases, Mammalian MDR proteins: Transport process driven by light and ion gradients. Co-transport by Symporters and antiporters. Group translocation, Osmosis and Receptor mediated endocytosis.	10	Text Book
III	Energy metabolism and Cytoskeleton Mitochondria- Reduction potentials, electron transport chain Overview, Complexes, Q-cycle, Cyt-C oxidase complex, Translocation of Protons and the establishment of a proton motive force, Machinery for ATP formation. Chemiosmotic mechanism, APT Synthase Experiments, Inhibitions of Oxidative phosphorylation, Uncouplers. Microtubules - Organization and dynamics, Kinesin and dynein. Microfilaments- Actin- Structures, Assembly, Myosin. Cilia and Flagella- Structure and functions, Intermediary filaments. Striated muscle- structure, excitation-contraction.	09	Text Book
IV	Cellular Integration Extracellular Matrix - Collagen, hyaluronan & proteolycans, laminin, Elastins, fibronectins, Growth factors, Matrix Mettaloproteinases and Integrins. Cell adhesion molecules (CAMs). Cell junctions - Occluding junctions, Anchoring junctions, Communicating junctions. Cell signaling- Signaling molecules and their receptors, functions of cell surface receptors. Pathways of intracellular signal transduction-cAMP pathway, Cyclic GMP, phospholipids and Ca2+, Ras, Raf and Map kinase pathwayl	10	Text Book
V	Protein transport, degradation and cell cycle Post-translational modifications in prokaryotes and eukaryotes, role of signal peptide, role of endoplasmic reticulum and Golgi apparatus. Protein Targeting- signal sequence hypothesis, Targeting of proteins to different compartments Mitochondria, ER, plasma membrane, lysosomes, peroxisomes and chloroplast. translocation, heat shock proteins, molecular chaperons, glycosylation, SNAPs and SNAREs, bacterial signal sequences, mitochondrial, chloroplast and	10	Reference book

	nuclear protein transport, endocytosis-viral entry, ubiquitin tagged protein destruction, Sumoylation. Cell Cycle: Overview and its phases. Regulation of cell cycle and regulatory proteins (Cyclins and CDKCs). Studies of frog oocyte maturation and the discovery of Cyclins. Cell cycle control and check points in yest and mammalian cells.		
	Total	**48**	

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Text book	1.	Harvey Lodish,Arnold Berk, Chris A. Kaiser, Angelika Amon, Hidde Ploegh, 2016, "Molecular Cell Biology", 8th edition, WH Freeman and Company, New York
	2.	Cooper G M, 2018, "The Cell: A Molecular Approach", 8th edition, Sinauer Associates, Inc., USA
Reference Books	1.	Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T.Kilpatrick, 2017"Lewin's GENES XII",12th, Inc; 12th Edition, Jones and Bartlett Publishers, USA.
	2.	Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P, 2015, "Molecular Biology of the cell" 6th edition, Taylor and Francis Company, United Kingdom.
	3.	Kar G, Iwasa J and Marshall M, 2016. "Karp's Cell and Molecular Biology: Concepts and Experiments", 8th edition, John Wiley and Sons, USA.
	4.	James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard, 2017,"Molecular Biology of the Gene", 7th edition, Pearson Education, United Kingtom...

Journal and Magazines	https://bmcmolcellbiol.biomedcentral.com/ https://www.springer.com/gp/journal-impact/life-sciences/cell-biology)
E-Resources and Website	https://onlinecourses.swayam2.ac.in/cec19_bt12 https://www.edx.org/learn/cellular-biology https://nptel.ac.in/courses/102103012

Learning Method	Chalk and Talk/Assignment/Seminar

Focus of the Course	Skill Development/Employability

Semester – I CORE PRACTICAL -I: ENZYMES AND CELLULAR BIOCHEMISTRY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	**25BCP1CP**	**ENZYMES AND CELLULAR BIOCHEMISTRY**	**CORE PRACTICAL**		**-**	**72**	**3**

Preamble	This course has been designed for students to learn and understand • essential laboratory skills in enzyme handling, cellular analysis, cell viability assessment, and protein separation.
Prerequisite	Knowledge on cellular Biochemistry

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Purify and characterize enzymes, analysing kinetic properties and stability.	K5
CO2	Observe and analyze cell structures and processes using microscopy.	K5
CO3	Quantify cell populations and assess viability with various assays.	K5
CO4	Immobilize enzymes and understand metal effects on kinetics.	K5
CO5	Explain protein separation techniques like PAGE for isoenzymes.	K5

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1CP	ENZYMES AND CELLULAR BIOCHEMISTRY

S.No	List of Practicals
1	Partial purification of catalase from natural source
2	Effect of pH, Temperature, Substrate concentration on catalase and determination of Km and Vmax using Lineweaver-Burk graph
3	Assay of enzyme activity and specific activity of catalase
4	Kinetics of activity loss of an enzyme in the presence of trace amounts of metals.
5	Immobilization of enzyme and measurement of its activity
6	Separation of isoenzymes by Native PAGE and SDS PAGE (Demonstration)
7	Preparation of permanent slides and observation of prokaryotic and eukaryotic cells with the help of light microscope
8	Mitosis and cell cycle in Onion root-tip cell
9	Cell counting and viability (Yeast/Bacteria)
10	Determination of osmotic fragility of a cell (Goat RBC) and RBC ghost cell preparation
11	Study of cell viability/ death assay by use of trypan blue or MTT assay
12	Isolation of organelles by subcellular fractionation

Texk Books	1.	Srivastava S, 2010, "Molecular Techniques in Biochemistry and Biotechnology", 1st edition, New Central Book Publishers, New Delhi.
	2.	Keith Wilson, John Walker, 2010. "Principle of Practical Biochemistry", 7th edition, Cambridge University Press, England.

Learning Method	Demonstration/ Hands on Experiments

Focus of the Course	Skill Development/ Employability

Semester – I CORE PRACTICAL II: BIOMOLECULES AND BIOCHEMICAL TECHNIQUES							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25BCP1CQ	BIOMOLECULES AND BIOCHEMICAL TECHNIQUES	CORE		-	48	2

Preamble	This course has been designed for students to learn and understand • about the isolation and estimation of Biomolecules • the identification of samples using chromatography • the techniques for electrophoresis.
Prerequisite	Knowledge on basics of biochemical techniques

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Analysis of sample using colorimeter, UV- Visible	K4
CO2	Demonstrate on separation and purification based on density and size using centrifugation.	K3
CO3	Develop practical knowledge on chromatographic techniques	K3
CO4	Experiment with DNA, RNA using electrophoresis	K3
CO5	Examine the various samples using Flame photometry	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1CQ	BIOMOLECULES AND BIOCHEMICAL TECHNIQUES

S.No	List of Practicals
1	Isolation and estimation of Starch from potato
2	Isolation and estimation of Glycogen from the liver
3	Hemagglutination assay of lectins
4	Isolation and estimation of DNA and RNA from goat liver
5	Isolation and Estimation of Phospholipids
6	Isolation and estimation of Casein from Milk
7	Estimation of sodium by Flame photometry
8	Isolation of lymphocytes from Whole blood using Density Gradient Centrifugation
9	Separation of amino acids/ Sugars by thin layer chromatography
10	Separation of plant pigments by column chromatography
11	Agarose gel electrophoresis of genomic and plasmid DNA
12	Analysis of secondary metabolites using HPLC and HPTLC (Demonstration)

Texk Books	1.	Srivastava S, 2010,"Molecular Techniques in Biochemistry and Biotechnology", 1st edition, New Central Book Publishers, New Delhi.
	2.	Jeyaveera K.N, Tarakaram, 2011,"Biochemical Techniques (A Practical approach)",1st edition, Himalaya Publishing House,India.

Learning Method	Demonstration/ Hands on Experiments

Focus of the Course	Skill Development/ Employability

Semester – I

DSE I: MICROBIAL TECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	25MBP1DA	MICROBIAL TECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The production of Sustainable products using Microorganisms. • The importance of Microorganisms in Pharmaceutical sector. • How to explore the ideas in commercial level
Prerequisite	Knowledge on microbial products and their mass production

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	Inculcate about microbial products and its scale up production through establishing a small scale industry	K2
CO2	Exemplify the ideas about the production and uses of Biofuel and Biofertilizer.	K3
CO3	Demonstrate the commercial production of Biopolymers using Microorganisms.	K4
CO4	Understand the way of cells and enzymes were immobilized for industrial uses.	K3
CO5	Explore the pharmaceutical products and possibilities of converting it to a commercial product.	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2	✓	✓		✓	✓
CO3	✓		✓	✓	✓
CO4	✓		✓		✓
CO5	✓	✓		✓	✓

25MBP1DA: DSE- MICROBIAL TECHNOLOGY
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Single Cell Protein and its Economic Aspects:** Bacterial, Yeast, Fungal and Algal Proteins –Brewer's and Baker's yeast – Food and Fodder yeast – Mushroom (Agaricus, Oyster) and Products from Higher fungi (*Ganoderma lucidum*).	9	Text book Reference Book Journals
II	**Production of Biofuel & Biofertilizer:** Production, Methods and Uses of Bioethanol (*S. cerevisiae*) – Biodiesel (*Chlorella*) – Biohydrogen (*Chlamydomonas*) – Biogas (Methanobacteria). Biofertilizer - N_2 fixing, Phosphate Solubilizing, Phosphate Mobilizing, Plant Growth Promoting Rhizobacteria - Mass production and Applications.	9	Text book Reference Book
III	**Biopolymer production:** Production and Uses of Polyhydroxybutyrate (PHB) – Xanthan – Alginate – Cellulose –Cyanophycin – Levan - Melanin - Welan - Succinoglucan- Curdlan- Chitosan -Polyhydroxyalkanoates - Hyaluronic acid.	9	Text book Reference Book
IV	**Immobilization of Cells & Enzymes:** Cells – Surface attachment of cells – Entrapment - Hydrogel method, Preformed support materials – Containment behind a barrier: Microencapsulation, Immobilization using membranes – Self aggregation of cells –Methods for Enzyme immobilization – Carrier binding method, Intermolecular cross linking – Applications of Immobilized cells and Enzymes.	10	Text book Reference Book
V	**Microbial products with pharmaceutical importance**: Vaccines – Steps of Manufacturing – Growing the microbes and separation – Preparation of Live and killed vaccine – Preparation of Toxoid and uses – BCG Vaccine – Cholera vaccine – Rabies vaccine – Diptheria toxoid. Pharmaceutical industry - certification & accreditation required. Bioentreprenurship opportunities and Funding sources - Government funds, Venture capital, NGOs, Crowd funding and Incubation centers. Antimicrobial compounds from soil microbes -Case study	11	Text book Reference Book Journals
	Total	**48**	

Text Book	1.	Patel A H, 2012, Industrial Microbiology, 2nd Edition, Trinity Press, New Delhi
Reference Books	1.	El-Mansi E M T, Bryce C F A, Dahhou B, Sanchez S, Demain A L and Allman A R, 2012, Fermentation Microbiology and Biotechnology, 3rd Edition, CRC Press, USA
	2.	Bernard R Glick, Jack J Pasternek and Cheryl L Patten, 2010, Molecular Biotechnology -Principles and Applications of Recombianant DNA, 4th Edition, ASM Publishers, USA]
	3.	Nidhi Goel, 2013, Pharmaceutical Microbiology, 1st Edition, Narosa Publishing House, New Delhi.
	4.	Puvanakrishnan R, Sivasubramanian S and Hemalatha T, 2012, Microbial Technology -Concepts and Applications, 1st Edition, MJP Publishers, New Delhi

Journal and Magazines	https://link.springer.com/ https://aem.asm.org/
E-Resource and Websites	https://www.microbialbiotechnology.com/ https://www.asmscience.org/content

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/Employability/Entrepreneurial Development/Innovations/Intellectual Property Rights

Semester – I DSE I: CANCER BIOLOGY, DIAGNOSIS AND THERAPY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	**25BCP1DA**	**CANCER BIOLOGY,DIAGNOSIS AND THERAPY**	**DSE**	**36**	**12**	**-**	**3**

Preamble	This course has been designed for students to learn and understand • Molecular basis of cancer, mutations causing cancer, and repair mechanisms • The basic principles of cancer development and available therapeutic options • The different diagnostic and treatment methods for cancer.
Prerequisite	Basic Knowledge on Cell Biology

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Compare and contrast benign and malignant tumors and the morphological characteristics of cancer cells.	K4
CO2	Justify the molecular basis of cancer. Distinguish interdisciplinary areas in cancer biology.	K5
CO3	Evaluate the molecular mechanism of oncogenesis, tumor biology and the role of cell cycle in cancer	K5
CO4	Validate the role of tumor suppressor genes and apoptosis. Explain about epigenetics.	K5
CO5	Summarize on the choice of diagnosis and therapy available for cancer patients.	K6

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1DA | CANCER BIOLOGY, DIAGNOSIS AND THERAPY

Syllabus

Unit	Content	Hrs	Resources
I	**Introduction** Cancer cell-morphology and growth characteristics. Metastasis and cytoskeleton. Apoptosis. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Differences between benign and malignant tumors.	9	Text Book
II	**Carcinogenesis** Cancer epidemiology and endocrinology. Cancer causing agents- radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Para-neoplastic syndromes. Mutation- definition, significance, rates and frequency. Mutagenic agents. Molecular basis of mutagenesis: induced and spontaneous mutations, crossing over and segregation. Cancer genetics. Chemical carcinogenesis- genetic and epigenetic carcinogens, pro-carcinogens and co- carcinogens, promoters and initiators, testing for carcinogenecity, Ames test. Aberrant metabolism during cancer development.	9	Reference Book
III	**Tumor Markers and Signal Transduction** Oncogenes - RNA and DNA tumor viruses, retroviruses and viral oncogenes and abrupt activation. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- protooncogenesis, oncoproteins, tumor suppressor genes involved in cancer. Radiation- effect of ionizing radiations on DNA, chromosomal aberrations. Cancer Markers: Genetic basis of cancer, use of tumor markers in detection and monitoring of cancer. Signal transduction in cancer: cell-cell interactions, cell adhesion, invasion and metastasis, VEGF signalling and angiogenesis; role of transcription factors. Growth factors- EGF, TNF-α and TGF-β and growth factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.	10	Reference Book
IV	**Cell Cycle, Cell Death and Cancer** Cell Cycle Regulation cancer: control of the cell cycle - cyclins and CDKs, and tumor suppressor genes p53, p21Rb, BRAC1 and BRAC2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing- epigenetic silencing of tumor - suppressor genes.	10	NPTEL
V	**Cancer Diagnosis and Cancer Therapy, Stem Cells and Cancer** Principles and methods of cancer diagnosis - biochemical, genetic, cytotoxic, cell growth and viability tests. Diagnosis of cancer by histopathology, MRI scans, PET scan, cytogenetics test, kariotype, FISH. Strategies of anticancer drug therapy– chemotherapy, gene	10	You Tube Videos

	therapy, immuno therapy, radiotherapy and surgical therapy. Principles of cancer biomarkers and their applications.		
	Total	**48**	

	Note: Case studies related to the above topics to be discussed (Examined Internal only)

Text book	1.	Mc Kinnell R.G et al, 2012, "The Biological Basis of Cancer", Second edition, Cambridge University Press, London.
	2.	Weinberg R.A, 2014, "The Biology of Cancer", Second edition, Garland Science, New York & London.
Reference Books	1	Vincent T. De Vita M. D et al, 2020, "Principles and Practice of Oncology: Primer of Molecular Biology in Cancer", Third edition, Lippincott Williams and Wilkins, Philadelphia.
	2.	Pelengaris S and Khan M, 2010, "The Molecular Biology of Cancer - A bridge from bench to bed side", Second edition, Wiley Black well, London
	3.	Hesketh R, 2013, "Introduction to Cancer Biology", First edition, Cambridge University Press, London.
	4.	Pezzella F et al, 2019, "Oxford textbook of Cancer Biology", First edition, Oxford University Press, London.

Journal and Magazines	https://www.tandfonline.com/toc/kcbt20/current https://journals.lww.com/amjclinicaloncology/pages/default.aspx
E-Resources and Website	https://www.cancer.gov>research>resources; https://nptel.ac.in

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability

Semester - I
DSE I: APPLIED BIOTECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25BTP1DA	APPLIED BIOTECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The applications of biotechnology in plant, animal and Environmental field the basic concept of sequence and series • The applications of biotechnology in health care sector • The products obtained from fermentation and its applications
Prerequisite	Knowledge on Applied Biotechnology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the fundamental applications of Biotechnology	K2
CO2	Know the basics and fundamentals of biotechnology applications in environment	K2
CO3	Discuss about the disease and disease prevention	K3
CO4	Discuss the applications of Enzymes in various fields	K4
CO5	Discuss the production and application of products obtained from fermentation technology	K2

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2	✓		✓	✓	✓
CO3			✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BTP1DA	DSE: APPLIED BIOTECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Agricultural, Plant Biotechnology and Animal Biotechnology:** Applications of transgenic crop technology: Herbicide resistance (Glyphosate Resistance plants), Pest resistance (Bt Cotton) and Virus Resistance. Enhancement of micro-nutrients (Vitamin A). Delayed Fruit Ripening. Molecular pharming in plants. Transgenic animals (Transgenic mice and Transgenic cattle). Production and recovery of products from animal tissue cultures (Blood clotting factors, Growth hormones, insulin)	10	Text Book - 1
II	**Environmental Biotechnology:** Bioremediation- (Bioaugmentation and Biostimulation). Biodegradation of Xenobiotic componds. Bioleaching. Microbially Enhanced Oil Recovery. Biotechnological methods for hazardous waste management. Bioindicators –Biomarkers –Biosensors – Management of effluent toxicity, heavy metal pollution, thermal and radioactive pollution	08	Reference Book - 2
III	**Health Care Biotechnology:** Disease prevention – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines, DNA vaccines, synthetic vaccines. Disease Diagnosis – Probes, monoclonal antibodies and detection of genetic diseases. Disease treatment – interferons, monoclonal antibodies. Gene therapy, enzyme therapy and replacement. Forensic medicine.	10	Reference Book -3
IV	**Enzyme Biotechnology:** Enzymes used for diagnostic purpose- (acid phosphatase, alanine aminotransferase and alkaline phosphatase). Cardiac Biomarkers. Enzymes used for screening liver and kidney diseases. Enzymes used in food industry, leather industry, wool industry, dairy industry and textile industry.	10	Referece Book – 2 and NPTEL
V	**Fermentation Biotechnology:** Production, harvest, recovery and uses – enzymes, antibiotics (Tetracycline), vitamins (B2), aminoacids (glutamic acid), organic solvents (ethanol); organic acids (lactic acid). Single cell protein (algae), beverages (Wine). Formulation of Biofertilizer (Rhizobium), Biopesticides.	10	You Tube Videos and Reference Book - 4
	Total	**48**	

Text Book	1.	Bernard R Glick and Jack J Pasternak, 2010, "Molecular Biotechnology: Principles and Applications of recombinant DNA", 4th Edition, ASM Press
Reference Books	1.	Marwaha S S & Arora K, 2000, "Food processing: Biotechnological application", Asiatech Publishers INC, New Delhi.
	2.	Palmer T, Bonner PLR, 2014, "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 2nd Edition, Woodhead Publishing Limited, Oxford..
	3.	Owen, Jenni Punt and Sharon A Stranford, 2013, "Kuby Immunology",7th Edition, W.H. Freeman and Company, New York.
	4.	Stanbury PF and Whitaker A, 2007, "Fermentation microbiology and Biotechnology", 2nd Edition, Taylor and Francis.

Journal and Magazines	https://www.macrothink.org/journal/index.php/jab, https://link.springer.com/journal/12010
E-Resources and Website	https://www.keaipublishing.com/en/journals/biotechnology-notes/ https://www.drishtiias.com/to-the-points/paper3/biotechnology-and-its-applications https://nptel.ac.in

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Entrepreneurial Development /Employability