

Dr. N.G.P.ARTS AND SCIENCE COLLEGE
REGULATIONS 2024-25 for Post Graduate Programme
(Outcome Based Education model with Choice Based Credit System)

M.Sc. BIOCHEMISTRY
(For the students admitted during the academic year 2024-25)

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



Dr.NGPASC

COIMBATORE | INDIA

M.Sc. Biochemistry (Students admitted during the AY 2024-25)


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												
24BCP1CA	Core-I	Chemistry of Biomolecules	4	-	-	4	48	3	25	75	100	4
24BCP1CB	Core-II	Biochemical techniques and Instrumentation	4	-	-	4	48	3	25	75	100	4
24BCP1CC	Core-III	Enzymes and Enzyme Technology	4	-	-	4	48	3	25	75	100	4
24BCP1CD	Core-IV	Cellular Biochemistry	4	-	-	4	48	3	25	75	100	4
24BCP1CP	Core Practical-I	Enzymes and Cellular Biochemistry	-	-	6	6	72	6	40	60	100	3
24BCP1CQ	Core Practical-II	Biomolecules and Biochemical Techniques	-	-	4	4	48	6	40	60	100	2
24MBP1DA	DSE-I	Microbial Technology	3	1	-	4	48	3	25	75	100	3
24BCP1DA		Cancer Biology, Diagnosis and Therapy										
24BTP1DA		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												
24BCP2CA	Core-V	Immunology	4	-	-	4	48	3	25	75	100	4
24BCP2CB	Core-VI	Metabolism	4	-	-	4	48	3	25	75	100	4
24BCP2CC	Core-VII	Microbial Biochemistry	4	-	-	4	48	3	25	75	100	4
24BCP2CD	Core-VIII	Genetics and Molecular Biology	4	-	-	4	48	3	25	75	100	4
24BCP2CP	Core Practical-III	Immunology and Molecular Biology	-	-	6	6	72	6	40	60	100	3
24BCP2CQ	Core Practical-IV	Microbial Biochemistry and Metabolism	-	-	4	4	48	6	40	60	100	2
24MBP2DA	DSE-II	Bionanotechnology	3	1	-	4	48	3	25	75	100	3
24BCP2DA		Biochemistry of Toxicology										
24BTP2DA		Forensic Biotechnology										
Total			19	1	10	30	360				700	24

Harini
BoS Chairman/HoD
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 Coimbatore – 641 048

 Dr.N.G.P. Arts and Science College		
APPROVED		
BoS- 18 th 07.11.24	AC- 18 th 26.11.24	GB -



Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ES E	Total	
Third Semester												
24BCP3CA	Core-IX	Research Methodology and Biostatistics	4	-	-	4	48	3	25	75	100	4
24BCP3CB	Core-X	Plant Biochemistry and Biotechnology	4	-	-	4	48	3	25	75	100	4
24BCP3CC	Core-XI	Genetic Engineering	4	-	-	4	48	3	25	75	100	4
24BCP3CD	Core-XII	Clinical Biochemistry	4	-	-	4	48	3	25	75	100	4
24BCP3CP	Core Practical-V	Clinical Biochemistry	-	-	6	6	72	6	40	60	100	3
24BCP3CQ	Core Practical-VI	Plant Biochemistry and Genetic Engineering	-	-	4	4	48	6	40	60	100	2
24MBP3DA	DSE-III	Medical Laboratory Techniques	3	1	-	4	48	3	25	75	100	3
24BCP3DA		Free Radicals and Antioxidant System										
24BTP3DA		Molecular Therapeutics										
24BCP3CT	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													
24BCP4CA	Core-XIII	Bioethics and Biosafety	4	1	-	5	60	3	25	75	100	3	
24BCP4CB	Core-XIV	Endocrinology and Developmental Biology	4	1	-	5	60	3	25	75	100	4	
24BCP4CV	Core	Project	-	-	16	16	192	6	80	120	200	8	
24MBP4DA	DSE-IV	Molecular Diagnostics and Bioinformatics	3	1	-	4	48	3	25	75	100	3	
24BCP4DA		Neurobiology											
24BTP4DA		Stem Cell Technology											
Total			11	3	16	30	360				500	18	
Grand Total											2700	92	



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.	24MBP1DA	Microbial Technology
2.	24BCP1DA	Cancer Biology, Diagnosis and Therapy
3.	24BTP1DA	Applied Biotechnology

Semester II (Elective II) List of elective Courses

S.No	Course Code	Name of the Course
1.	24MBP2DA	Bionanotechnology
2.	24BCP2DA	Biochemistry of Toxicology
3.	24BTP2DA	Forensic Biotechnology

Semester III (Elective III) List of elective Courses

S.No	Course Code	Name of the Course
1.	24MBP3DA	Medical Laboratory Techniques
2.	24BCP3DA	Free Radicals and Antioxidant System
3.	24BTP3DA	Molecular Therapeutics

Semester IV (Elective IV) List of Elective Courses

S.No.	Course Code	Name of the Course
1.	24MBP4DA	Molecular Diagnostics and Bioinformatics
2.	24BCP4DA	Neurobiology
3.	24BTP4DA	Stem Cell Technology

EXTRACREDIT COURSES

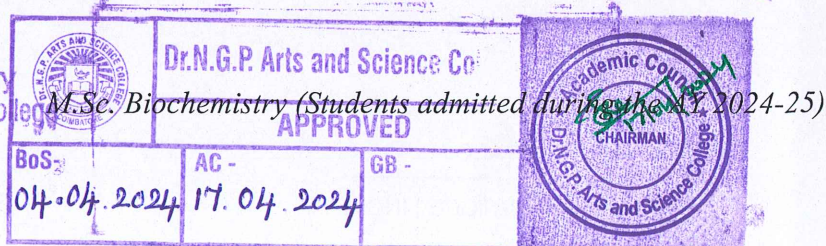
The following are the courses offered under self study to earn extra credits:

S.No.	Semester	Course Code	Course Title
1.	III	24BCPSSA	Bionanotechnology
2.		24BCPSSB	Inheritance, Evolution and Behaviour



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SEMESTER I
CORE : CHEMISTRY OF BIOMOLECULES

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BCP1CA	CHEMISTRY OF BIOMOLECULES	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand <ul style="list-style-type: none">• 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	Basic knowledge about cell biology	
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	Describe the structure and functions of important heterocyclic compounds.	K6

Mapping with Program Outcomes:

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



Syllabus

Unit	Content	Hours	E-Contents / 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-loop-helix, 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. Fattyacids-Saturated, Hydroxy and Unsaturated Fattyacids-Triacylglycerol. Phospholipids-classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids: Structure and functions of prostaglandins, thromboxanes, leukotrienes. Types and functions of plasma lipoproteins. Amphipathic lipids-membranes, micelles, emulsions and liposomes. Steroids-structure and biological role of cholesterol, bile acids, bile salts. Lipid Peroxidation and antioxidants.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 of RNA.	10	NPTEL
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.	08	E-Resources and Website



	Porphyrine – structure and biologically important compounds containing porphyrin ring.		
	Total	48	

Text Book	1.	David L Nelson and Michael M Cox, 2017, “Lehninger Principles of Biochemistry”, 7 th edition. Macmillan Publisher, New York.
Reference Books	1.	Richard R Sinden, 2012, “DNA Structure and Function”, 1 st Edition, Academic Press, US.
	2.	Jeremy M Berg Lubert Stryer John Tymoczko and Gregory Gatto, 2019, “Biochemistry”, 9 th edition, W.H. Freeman and Company, New York.
	3.	Donald Voet, Judith G. Voet , Charlotte W. Pratt, 2018, "Voet's Principles of Biochemistry", 5 th edition, John Wiley & Sons, New York
	4.	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	https://www.pulsus.com/journal-biomolecules-biochemistry.html https://www.researchgate.net/topic/Biomolecules/publications https://www.chemistryworld.com/biomolecules/2509.tag
E-Resources and Website	https://ncert.nic.in/textbook/pdf/lech205.pdf https://www.britannica.com/science/biomolecule https://archive.nptel.ac.in/courses/104/103/104103121/

Learning Methods	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/Employability



SEMESTER I
CORE: BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BCP1CB	BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION	CORE	48	-	-	4

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> • 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	✓	✓	✓	✓	✓



24BCP1CB - BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	<p>Spectroscopic techniques</p> <p>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.</p>	10	Text Book
II	<p>Centrifugation techniques and Microscopy</p> <p>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.</p> <p>Basic principles, instrumentation and applications of Microscopes: Light and Compound, Fluorescence, Phase contrast, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM) and Confocal.</p>	10	Reference Book
III	<p>Chromatographic techniques</p> <p>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.</p>	10	NPTEL
IV	<p>Electrophoresis and Blotting techniques</p> <p>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.</p> <p>Principle, technique and applications of western, southern and northern blotting. Chemiluminescence and Phosphorimaging.</p>	10	Reference Book
V	<p>Biophysical and Radio-isotopic methods</p> <p>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</p> <p>Detection and measurement of radioactivity– Principle, instrumentation and applications of Liquid scintillation</p>	8	E-Resources and Website



	counter and Geiger-Muller counter. Autoradiography and its applications.		
	Total	48	

Text Book	1.	Sawhney and Singh, 2015, "Introductory Practical Biochemistry", 11 th edition, Narosa Publishing house, New Delhi.
	2.	Wilson and Walker, 2018, "Principles and Techniques of Biochemistry and Molecular Biology", 8 th edition, Cambridge University Press, London.
Reference Books	1.	Boyer, R.F, 2012, "Modern Experimental Biochemistry", 3 rd edition, Pearson Education Inc, New York.
	2.	Cooper, T.G, 2011, "The Tools of Biochemistry", 1 st edition, John Wiley and Sons, New Jersey.
	3.	Pelczar Jr, Chan and Krieg, 2012, "Microbiology", 5 th Edition, Tata Mc Graw Hill, New York
	4.	Srivastava, S, 2010, "Molecular Techniques in Biochemistry and Biotechnology", 1 st 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
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Focus of the Course	Skill Development/Employability
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SEMESTER I]
CORE: ENZYMES AND ENZYME TECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BCP1CC	ENZYMES AND ENZYME TECHNOLOGY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand <ul style="list-style-type: none">• 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	✓	✓	✓	✓	✓



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-inflammatory agents and digestive aids. Therapeutic use of asparaginase, streptokinase. Enzymes and isoenzymes in diagnosis: LDH, CK and cholinesterase.	10	NPTEL



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", 1 st edition, East West Press Pvt. Ltd., New Delhi
Reference Books	1.	Bhatt S.M, 2014, "Enzymology and Enzyme technology", 15 th edition, S. Chand publishing Ltd, New Delhi..
	2.	Palmer, T and Bonner, P L, 2004, "Enzymes: Biochemistry, Biotechnology, Clinical chemistry", 1 st 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", 3 rd edition, Oxford University Press, United Kingdom
	4.	Choudhary, N L, Singh, A, 2012, "Fundamentals of Enzymology", 1 st 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 : CELLULAR BIOCHEMISTRY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BCP1CD	CELLULAR BIOCHEMISTRY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand <ul style="list-style-type: none">• 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	✓	✓	✓	✓	✓



24BCP1CD - CELLULAR BIOCHEMISTRY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	<p>Membrane Biology</p> <p>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.</p>	09	Text Book
II	<p>Membrane Transport</p> <p>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.</p>	10	Reference Book
III	<p>Energy metabolism and Cytoskeleton</p> <p>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.</p>	09	Text Book
IV	<p>Cellular Integration</p> <p>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 pathway.</p>	10	Reference book



V	<p>Protein transport, degradation and cell cycle</p> <p>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 nuclear protein transport, endocytosis-viral entry, ubiquitin tagged protein destruction, Sumoylation.</p> <p>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 yeast and mammalian cells.</p>	10	Reference book
	Total	48	

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.
Reference Books	1.	Cooper G M, 2018, "The Cell: A Molecular Approach", 8th edition, Sinauer Associates, Inc., 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 Kingdom..

Journal and Magazines	https://bmcmolcellbiol.biomedcentral.com/impact/life-sciences/cell-biology	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

Learning Method	Chalk and Talk/Assignment/Seminar
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Focus of the Course	Skill Development/Employability
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24BCP1CP	CORE PRACTICAL I: ENZYMES AND CELLULAR BIOCHEMISTRY	SEMESTER I
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Total Credits: 3

Total Instructions Hours: 72 h

S.No

List of Experiments

- 1 Partial purification of catalase from natural source
- 2 Effect of pH, Temperature, Substrate concentration on catalase and determination of K_m and V_{max} 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

References

- 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



24BCP1CQ	CORE PRACTICAL II : BIOMOLECULES AND BIOCHEMICAL TECHNIQUES	SEMESTER I
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Total Credits: 2
Total Instructions Hours: 48 h

S.No	List of Experiments
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)

References

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.



Semester – I

DSE: MICROBIAL TECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MBP1DA	MICROBIAL TECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand <ul style="list-style-type: none">• 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	✓	✓		✓	✓

24MBP1DA - 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 (<i>Agaricus</i> , <i>Oyster</i>) and Products from Higher fungi (<i>Ganoderma lucidum</i>).	9	Text book Reference Book Journals
II	Production of Biofuel & Biofertilizer: Production, Methods and Uses of Bioethanol (<i>S. cerevisiae</i>) – Biodiesel (<i>Chlorella</i>) – Biohydrogen (<i>Chlamydomonas</i>) – 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 – Diphtheria toxoid. Pharmaceutical industry - certification & accreditation required. Bioentrepreneurship 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, 2 nd 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, 3 rd Edition, CRC Press, USA
	2.	Bernard R Glick, Jack J Pasternek and Cheryl L Patten, 2010, Molecular Biotechnology -Principles and Applications of Recombinant DNA, 4 th Edition, ASM Publishers, USA
	3.	Nidhi Goel, 2013, Pharmaceutical Microbiology, 1 st Edition, Narosa Publishing House, New Delhi.
	4.	Puvanakrishnan R, Sivasubramanian S and Hemalatha T, 2012, Microbial Technology -Concepts and Applications, 1 st 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
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Focus of the Course	Skill Development/Employability/Entrepreneurial Development/Innovations/Intellectual Property Rights
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SEMESTER I
DSE I: CANCER BIOLOGY, DIAGNOSIS AND THERAPY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BCP1DA	CANCER BIOLOGY,DIAGNOSIS AND THERAPY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand <ul style="list-style-type: none"> • 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 about 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	✓	✓	✓	✓	✓



24BCP1DA - CANCER BIOLOGY, DIAGNOSIS AND THERAPY

Syllabus

Unit	Content	Hours	E-Contents / 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.	09	Text Book
II	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 carcinogenicity, Ames test. Aberrant metabolism during cancer development.	09	Reference Book
III	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 signaling 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 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	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 therapy, immuno therapy, radiotherapy and surgical therapy. Principles of cancer biomarkers and their	10	You Tube Videos



	applications.		
	Total	48	

Text Book	1.	Mc Kinnell R.G et al, 2012, "The Biological Basis of Cancer", Second edition, Cambridge University Press, London.
Reference Books	1.	Weinberg R.A, 2014, "The Biology of Cancer", Second edition, Garland Science, New York & London.
	2.	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.
	3.	Pelengaris S and Khan M, 2010, "The Molecular Biology of Cancer - A bridge from bench to bed side", Second edition, Wiley Black well, London
	4.	Hesketh R, 2013, "Introduction to Cancer Biology", First edition, Cambridge University Press, London.
	5.	Pezzella F et al, 2019, "Oxford textbook of Cancer Biology", First edition, Oxford University Press, London

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

Learning Methods	Chalk and Talk/Assignment/Seminar
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Focus of the Course	Skill Development/Employability
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Semester - I
DSE I: APPLIED BIOTECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24BTP1DA	APPLIED BIOTECHNOLOGY	DSE	36	12	-	3

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> • 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
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Prerequisite	Knowledge on Applied Biotechnology
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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	✓	✓	✓	✓	✓

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 compounds. 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	Reference 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	



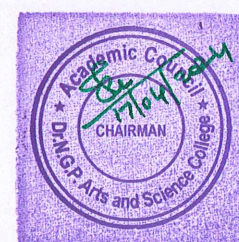
Text Book	1.	Bernard R Glick and Jack J Pasternak, 2010, "Molecular Biotechnology: Principles and Applications of recombinant DNA", 4 th Edition, ASM Press
Reference Books	1.	Marwaha S S & Arora K, 2000, "Food processing: Biotechnological application", Asiatech Publishers INC, New Delhi.
	2.	Palmer T,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

COIMBATORE | INDIA

M.Sc. Biochemistry (Students admitted during the AY 2024-25)

SEMESTER II
CORE: IMMUNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24BCP2CA	IMMUNOLOGY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand: <ul style="list-style-type: none">the immune system and its componentsthe defense mechanisms against infection, and Immune-related diseasesbasic immunological principles involved in research, clinical/applied science	
Prerequisite	Basic knowledge about Immunology	
Course Outcomes (COs)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Distinguish primary & secondary responses, humoral & cell mediated immunity, innate & adaptive immunity	K4
CO2	Explain the concepts of antigen, antibody & antigen-antibody interaction	K4
CO3	Analyze complement activation, identify cytokines, infer immune responses to infections & AIDS	K4
CO4	Evaluate the basis of allergic responses, transplantation and tumor immunology	K5
CO5	Justify the practical application of vaccines & immunological techniques	K5

Mapping with Program Outcomes:

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



Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Cells of Immune System and Immune Responses Cells of Immune System: Hematopoiesis, hematopoietic growth factors, Regulation of hematopoiesis, clinical uses of stem cells. Lymphoid cells and myeloid cells, CD antigens and membrane molecules of immune cells. Development, maturation, activation and differentiation of T-cells and B-cells, adhesion molecules. Immune Responses: Humoral and cell-mediated immune responses, primary and secondary immune responses, Clonal selection theory.	10	Text Book, Reference book and NPTEL, You Tube Videos
II	Antigens, Immunoglobulins and Antigen Recognition Antigens: B-cell epitopes, T-cell epitopes, antigenicity and immunogenicity, factors influencing immunogenicity, Haptens, adjuvants; Immunoglobulins: Structure and functions, Isotype, allotypes, Idiotypes; Classes, Immunoglobulins super family. Organization and expression of immunoglobulin genes, generation of antibody diversity. Class switching. T-cell receptor and its diversity. Antigen Recognition: MHC-Genetic organization and inheritance, Antigen processing and presentation (Cytosolic and Endocytic pathway).	10	Text Book, Reference Book and You Tube Videos
III	Complement, Cytokines, Cytotoxicity, Immune Responses to Infections and AIDS Complement system: components of complement activation and its biological consequences – classical, alternative and lectin pathways. Cytokines: IL, IFN, TNF, CSF- role in immune regulation, Cytokine receptors, Cytokine antagonists. Cell mediated immunity: CTL mediated cytotoxicity, NK cell mediated toxicity. Primary and secondary immunodeficiency diseases. AIDS: Structure of HIV, destruction of T cells, CD4+/CD8+ ratio, immunity to HIV virus, AIDS vaccine.	9	Text book, Reference book and E-Resources
IV	Hypersensitivity, Autoimmunity, Animal Models, Transplantation and Cancer immunology Hypersensitivity reactions: Type I, II, III & IV. Autoimmunity - organ specific (Hashimoto's thyroiditis) and systemic (Rheumatoid arthritis, Systemic lupus erythematosus) diseases. Experimental Animal Models: inbred strains, SCID mice, nude, knockout mice. Transplantation immunology: Immunologic basics of Graft rejection, MHC antigens in transplantation and HLA tissue typing, Immunosuppressive	9	Text book, Reference book NPTEL, and E-Resources

	therapy. Cancer immunology: Immune response to tumors, Immunological surveillance of cancer, Cancer immunotherapy.		
V	<p>Vaccines and Immunotechniques</p> <p>Vaccines: Active and passive immunization, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, multivalent subunits vaccines, COVID 19 vaccine. Immunotechniques: Hybridoma technology - Introduction, Antibody engineering (production of monoclonal antibodies). Agglutination, precipitation, immune-diffusion, immuno-electrophoresis, ELISA, RIA, western blot, Avidin – biotin mediated immunoassay. Immunohistochemistry – immunofluorescence, immunoferritin technique. Fluorescent immunoassay, fluorescence activated cell sorting (FACS). Cytokines assay: ELISPOT. Lymphocytes transformation test (LTT); Lymphoblastoid cell lines. Chemiluminescence.</p>	10	Text book, Reference book, Journals, E-Resources and You Tube Videos
	Total	48	

Text Book	1.	<i>Kindt, T., Goldsby, R.A and Osborne, B.A. 2018, "Kuby Immunology", 8th Ed, Prentice Hall, New Delhi.</i>
	2.	<i>Kenneth M. Murphy, Paul Travers, Mark Walport., 2011, "Janeway's Immunobiology", 8th edition, Garland Science, New York.</i>
Reference Books	1.	<i>Delves, Martin, Burton, Roitt. 2001, "Roitt's Essential Immunology", 11th Edition, Blackwell Publishers, Oxford</i>
	2.	<i>Abbas, A.K., Lichtman, A.H., and Pillai S. 2015, "Cellular and Molecular Immunology", 8th Edition, Elsevier Saunders. (eBook at: http://library.anu.edu.au/record=b3609426)</i>
	3.	<i>Parham P. 2014, "The Immune System", 4th Edition, Garland Science, New York.</i>
	4.	<i>Fathimunisa Begum, 2014, "The Elements of Immunology", 1st Edition, PHI Learning Private Limited, New Delhi.</i>

Journal and Magazines	https://academic.oup.com/ooim/pages/why-publish https://bmccimmunol.biomedcentral.com/articles https://onlinelibrary.wiley.com/journal/1607?msocid=0a9007f47c6567280cef13567dc866c7 https://academic.oup.com/discovimmunology
E-Resources and Website	https://archive.nptel.ac.in/courses/102/105/102105083/ [NPTEL] https://archive.nptel.ac.in/courses/102/103/102103038/ [NPTEL] https://onlinecourses.nptel.ac.in/noc23_hs05/preview [Swayam]

	https://www.coursera.org/learn/immunologyfundamentalsimmunitybcells? msockid=0a9007f47c6567280cef13567dc866c7 https://www.classcentral.com/subject/immunology?free=true
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Learning Methods	Chalk and Talk/ Video tutorials/ PPT/ GD/ Assignment/ Seminar
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Focus of the Course	Skill Development/ Employability
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SEMESTER - II CORE : METABOLISM							
Semester	Corse Code	Course Name	Category	L	T	P	Credits
II	24BCP2CB	METABOLISM	CORE	48	-	-	4

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> • energy generation and utilization in a biological system • catabolic and anabolic pathways of biologically vital macromolecules • the regulation of metabolic pathways
Prerequisite	Knowledge on enzymology

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the bioenergetics principles, Electron transfer and oxidative phosphorylation.	K2
CO2	Illustrate the carbohydrate metabolism. Distinguish the regulation and analysis of metabolic pathways.	K3
CO3	Demonstrate the lipid metabolism and its regulation	K3
CO4	Analyze amino acids metabolic pathways and predict the metabolic interaction among the major organ.	K4
CO5	Evaluate the Porphyrin metabolism, Nucleic acid metabolism and its regulation.	K5

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



24BCP2CB	METABOLISM
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Syllabus

Unit	Content	Hrs	Resources
I	Bioenergetics, ETC and Oxidative Phosphorylation Enthalpy, Entropy, Spontaneous and non-spontaneous thermodynamic reaction, equilibrium constant and concept of free energy, Free energy change in a reaction, Importance of coupled process in living things, Phosphoryl group transfers and ATP, Biological Oxidation -Reduction reactions. Electron Transfer reaction in Mitochondria: Components of ETC and its organization, Sequence of Electron Transport. Oxidative Phosphorylation: ATP synthase- Structure and Mechanism of action, Inhibitors of ETC, Uncouplers, P/O ratio, Mitochondrial Transport systems - Glycerophosphate shuttle system, Malate-aspartate shuttle system.	10	Text Book Reference Books E-Resources
II	Pathway regulation, analysis and Carbohydrate Metabolism Pathway Regulation: Regulation of Intermediary metabolism, Role of regulatory enzymes, Energy charge. Strategies for pathway analysis: Single step and Multistep pathway analysis. Glycolysis and gluconeogenesis: Pathway, Key enzymes and Co-ordinate regulation. Pyruvate dehydrogenase complex and the regulation of this enzyme through reversible covalent modification. The citric acid cycle and regulation. The pentose phosphate pathway, Glucuronic acid pathway. Metabolism of glycogen and regulation. Metabolism of galactose and fructose. The glyoxylate cycle, Cori cycle, Anaplerotic reactions, Futile cycles and their applications.	10	Text Book Reference Books E-Resources
III	Lipid Metabolism Lipid metabolism: Lipogenesis-Biosynthesis of long chain fatty acid, Fatty acid synthase complex, Control of acetyl CoA carboxylase, Role of hormones, Effect of diet on fatty acid biosynthesis. Biosynthesis of triacylglycerol and phospholipids. Biosynthesis and degradation of cholesterol and its regulation. β Oxidation of fatty acids, Regulation of fatty acid metabolism. Ketogenesis and Ketolysis. Composition and synthesis of lipoproteins and their transport in the body. Biosynthesis of Prostaglandins, Thromboxanes and Leukotrienes.	10	Text Book Reference Books E-Resources
IV	Metabolism of Amino acids and Integrated Metabolism Amino acids metabolism: An overview on Gamma-glutamyl cycle. An overview Methionine as methyl donor (SAM pathway). An overview & regulation of urea cycle. Biosynthesis of Alphaketoglutarate family, Pyruvate family. 3-Phosphoglycerate family, Aspartate family and Aromatic amino acid family. Allosteric regulation of glutamine synthase. Integration of metabolism: Three forms of energy	9	Text Book Reference Books E-Resources



	storage, Metabolism in a multicellular organism, Metabolic interaction among major organ systems-Brain, Muscle, Heart, Adipose tissue and Liver.		
V	Porphyrin and Nucleic acids metabolism Porphyrin metabolism: Biosynthesis and degradation of heme, chlorophyll and cytochrome and their regulation. Nucleic acid metabolism: Pathways of purines and pyrimidines biosynthesis (both de novo and salvage pathways) and degradation. Regulation of purine biosynthesis: PRPP aminotransferases. Regulation of pyrimidine biosynthesis: Aspartate carbamoyltransferase.	9	Text Book Reference Books E-Resources
	Total	48	

Text book	1.	Nelson D L and Cox M M, 2017, "Lehninger's Principles of Biochemistry", 7th Edition, Macmillan Learning, New Delhi.
	2.	Garrett R H and Grisham, 2017, "Biochemistry", 6th Edition, Brooks/Cole Cengage Learning, Boston
Reference Books	1.	Rodwell V W, Bender, D A, Botham, KM, Kennelly P and Weil P A, 2018, "Harper's Illustrated Biochemistry" 31st Edition, The McGraw-Hill Inc, New York.
	2.	Veer Bala Rastogi and Aneja K R , 2016, "Zubay's Principle of Biochemistry", 5th Edition, Medtec Publishers, New Delhi
	3.	Berg J M, Tymoczko, J L , Gatto Jr, G J and Stryer, L, 2019, "Biochemistry", 9th Edition, W H Freeman and Company, New York
	4.	Voet D and Voet J G, 2011, " Biochemistry" 4th Edition, John Wiley and Sons, New York.

Journal and Magazines	metabolism clinical and experimental - https://www.metabolismjournal.com/ Journal of Metabolic Health https://journalofmetabolichealth.org/index.php/jmh
E-Resources and Website	NPTEL Overview And Integration Of Cellular Metabolism, IIT haragpur https://nptel.ac.in/courses/104105139/ NPTEL :: Chemistry and Biochemistry - BioChemistry https://archive.nptel.ac.in/courses/104/105/102105034/ Medical Biochemistry: Metabolism of Fats and Lipids Udemy https://www.udemy.com/course/medical-biochemistry-metabolism-of-fats-and-lipids/?couponCode=IND21PM

Learning Method	Chalk and Talk/PPT/ Video tutorials/Assignment/Seminar/GD/Case Study
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Focus of the Course	Skill Development/ Employability
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SEMESTER II
CORE: MICROBIAL BIOCHEMISTRY

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24BCP2CC	MICROBIAL BIOCHEMISTRY	CORE	48	-	-	4

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> • The major metabolic and energy exchange pathways in microbial cell homeostasis • The applications of biotechnology in diverse areas of agriculture, medicine and environmental biology • The production of antibiotics, amino acids, vitamins and single cell protein from microbial source
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Prerequisite	Basic knowledge about the production of microbial products
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Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Evaluate the importance of microbial nutrition, bacterial growth and its growth kinetics	K5
CO2	Summarize the central metabolic pathways existing in microbes	K2
CO3	Compare different types of fermentation technology	K3
CO4	Value the application of microbes in agriculture, mining, and energy production and food industry	K5
CO5	Elaborate the production of antibiotics, amino acids and single cell protein from microbial source	K5

Mapping with Program Outcomes:

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



Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Microbial Nutrition, Medium, Growth and Measurement Microbial Nutrition: nutritional requirements and uptake of nutrients by microbial cells; Transport of sugars into bacterial cell– the bacterial phosphotransferase system. Transport of non-PTS sugars. Membrane bound transport systems- E.coli lactose permease, Beta-methyl galactoside system. Nutritional groups of microorganisms (autotrophs, heterotrophs and mixotrophs). Growth media: synthetic, complex, selective, enrichment and differential media. Microbial Growth- different phases of growth in batch cultures, synchronous, continuous and biphasic growth. Factors influencing microbial growth. Methods for measuring microbial growth. Bacterial Cell cycle.	9	Text Book, Reference book, NPTEL and E-Resources
II	Microbial Energy and Synthesis Biology Energy yielding metabolism: carbohydrates– EMP, HMP, TCA– importance in bacteria. Phosphoketolase pathway, ED pathway, characteristics of electron transport in bacteria. Bacterial Chemotaxis and quorum sensing. Biosynthesis of cell wall– peptidoglycan, teichoic acid, lipids; biosynthesis of straight and branched chain fatty acids, unsaturated fatty acids and cyclopropane fatty acids. Synthesis of triacylglycerols, phospholipids, glycolipids and polyisoprenoids. Amino acid synthesis in microbes. Metabolism of purines and pyrimidines.	10	Text Book, Reference book, NPTEL and E-Resources
III	Fermentation Technology Fermentation technology: Principles of fermentation, surface, submerged and solid-state fermentations. Batch, fed batch, semi-continuous and continuous culture techniques. Strain improvement for better yield, Downstream processing. Design and construction of Bioreactors Monitoring and control of bioreactor: Online and off line control, Controlling systems: Temperature, flow rate, pressure, pH, DO, gas analysis. Types of fermentors: Waldhof, tower, cylindro-conical, air-lift, deep-Jet, cyclone column, packed tower and rotating disc fermenter. Types of reactions in fermentations.	9	Text Book, Reference book, NPTEL and E-Resources
IV	Environmental and Agricultural Technology Genetically modified organisms. Production of biogas from agricultural wastes. Production of bio-insecticides from bacteria and fungi. Bio fertilizers - bacteria and blue-green	10	Text Book, Reference book,

	algae. Use of microbes in mineral beneficiation and oil recovery. Environmental Microbiology: Microbiology of food-food spoilage, controlling food spoilage, types of food borne diseases, microbiology of fermented food, Applied environmental microbiology- water purification and sanitary analysis. Waste water treatment. Bio-degradation, bioremediation and bio- augmentation.		NPTEL and E-Resources
V	Industrial and Pharmaceutical Biotechnology Production of antibiotics: source, production, recovery and uses of penicillin, tetracycline, streptomycin, amoxicillin. Production of bacterial and fungal polysaccharides; Commercial production of xanthan gum. Single cell protein production and application. Microbial production of Primary metabolites: organic acids (Acetic acid, lactic acid, and citric acid), Organic solvents (acetone, butanol, ethanol, glycerol). Alcoholic beverages (Beer, Wine and Brandy Amino acids (glutamic acid, lysine, threonine, phenylalanine) and Vitamins (B12, B2, and vitamin-C). Enzymes amylase, proteases, streptokinase.	10	Text Book, Reference book, NPTEL and E-Resources
	Total	48	

Text Book	1.	Joanne. M. Willey, Linda M. Sherwood, Christopher. J. Wollverton, 2011, "Prescott's Microbiology", 8th Edition, Mc Graw Hill International, New York.
Reference Books	1.	El-Mansi, E.M.T. Bryce C.F.A. Daou, B, Sanchez.S, Demain .A.L., 2014, "Fermentation Microbiology & Biotechnology", (3rd Edition, Taylor & Francis Group, UK
	2.	Lanshing M, Prescott, John. P. Harley, Donald A Klein, 2009, "Microbiology", 4th Edition, Mc Graw Hill International Edition, New York.
	3.	Srivastava M L, (2008). "Fermentation Technology", 1st Edition, Narosa Publishing House, New Delhi.
	4.	Patel A H, 2016,"Industrial Microbiology", 2nd Edition, Trinity Press, New Delhi.

Journal and Magazines	https://link.springer.com/journal/10438 https://microbiologysociety.org/journals-publication/microbiology-today.html https://appliedmicrobiology.org/publishing-resources/microbiologist-magazine.html
E-Resources and Website	https://archive.nptel.ac.in/courses/102/103/102103015/ https://www.coursera.org/lecture/industrial-bioprocess-development/types-of-bioreactors-Iu3qa Industrial Biotechnology - Course Microbial Physiology and metabolism - Course

Learning Methods	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/Employability



Semester – II CORE: GENETICS AND MOLECULAR BIOLOGY							
Semester	Corse Code	Course Name	Category	L	T	P	Credits
II	24BCP2CD	GENETICS AND MOLECULAR BIOLOGY	CORE	48	-	-	4

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> • The core principles of genetics and molecular biology • How genetic information flows from DNA to RNA to protein and its regulation mechanisms • Demonstrate knowledge of the molecular machinery of living cells.
Prerequisite	Knowledge on cell Biology

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Illustrate basic principles of Mendelian & Non-Mendelian inheritance and core genetic concepts.	K3
CO2	Summarize the mechanisms of DNA replication and recombination.	K2
CO3	Explain the mechanisms of Transcription and Translation	K2
CO4	Analyse the processes of gene regulation and predict how a gene will be expressed under specific circumstances	K4
CO5	Compare and contrast various molecular events of DNA damage & repair.	K4

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

24BCP2CD	GENETICS AND MOLECULAR BIOLOGY
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Syllabus

Unit	Content	Hrs	Resources
I	Genetics Mendelian Principles: Segregation, Independent Assortment, Dominance relations, Multiple alleles, Incomplete dominance, Over dominance. Gene interaction, Epistasis, lethal genes, Sex determination and sex linkage, linkage, crossing over and chromosome mapping. Chromosomal theory of inheritance, Chromosomal aberrations and evolutions, Extrachromosomal Inheritance, maternal effects. Introduction to Population genetics, gene frequency, factors affecting gene frequency, Hardy-Weinberg Law. Genetic drift, Pedigree analysis and genetic counselling, Eugenics. Fine structure of Gene, cistron, recon, Structures of Eukaryotic and Prokaryotic genes. Experimental evidence for DNA as the genetic material.	10	Text Book E-resources
II	Replication and Recombination Replication in prokaryotes: Replication in circular chromosomes- Cairns model, rolling circle model. Eukaryotic replication, replication fidelity. Replication in RNA virus (retroviruses). Inhibitors of replication. DNA recombination: Homologous recombination: Holliday Model and Rec BCD pathway. Site-specific recombination: Lambda phage integration, and excision rearrangement. Transposition: Prokaryotic transposition, conservative and replicative transposition. Eukaryotic transposable elements: Retro-Transposons, DNA -Transposons	10	Text Book Reference books E resources
III	Transcription and Translation Transcription: coding strand, template strand, sense strand and antisense strand, promotor, DNA dependent RNA polymerase, role of Pribnow box, template binding, prokaryotic transcription, Rho-dependent and independent transcription, posttranscriptional processing in prokaryotes, alternative splicing, RNA editing. Nuclear export of mRNA- mRNA stability. Inhibitors of transcription Eukaryotic transcription, post-transcriptional modifications of eukaryotic RNAs, RNA splicing, introns and splicing reactions, exons and enhancers Genetic code: deciphering of the genetic code, Salient features, prokaryotic and eukaryotic protein biosynthesis: initiation, elongation, translocation and termination, polysomes, Regulation of translation, Inhibitors of translation, Post translational modification of proteins	10	E- Resources Reference books
IV	Gene Regulation Regulation of gene expression in prokaryotes: operon model- lac, trp, araBAD operons, Riboswitches, Heat shock response in <i>E.coli</i> , Flagellar variation in salmonella; Lux Operon and quorum sensing, Two component systems in nutrient sensing. Regulation of gene expression in eukaryotes: Britten-Davidson model, transcriptional regulation. C-value paradox, repetitive DNA. Genes controlling yeast mating types, Xenopus 5S rRNA in oocytes, Silk fibroin gene, Drosophila sex determination, Chicken globin genes and Environmental gene regulation	10	E Resources



V	DNA Damage and Repair Mutagenesis: Spontaneous and Induced mutations – Physical and Chemical mutagenesis, Molecular mechanisms of mutagenesis – Transition, Transversion, Frame Shift, missense and nonsense mutations. Detection of mutations: CLB Method and attached X method. DNA repair – Direct reversal repair, double strand break repair in mammals, Excision repair - base and nucleotide excision repair, mismatch repair, recombination repair, SOS response and mutagenic repair	8	Reference books Text Book
Total		48	

Text book	1.	Ajoy Paul, 2011, "Text book of Genetics", 1st Edition, Books and Allied (P) Ltd, Kolkatta.
	2.	Jeyanthi GP, 2009, "Molecular Biology", 1st Edition, MJP Publisher, Chennai
Reference Books	1.	Robert F. Weaver, 2011, "Molecular biology", 5th Edition, McGraw Hill Education, London.
	2.	Karp G, Iwasa J and Marshall W, 2015, "Karp's Cell and Molecular Biology: Concepts and Experiments", 8th Edition, John Wiley and Sons, New Jersey
	3.	Klug WS, Cummings MR, Spencer CA, Palladino MA and Killian D, 2018, "Concepts of Genetics", 12th Edition, Pearson Education, London.
	4.	Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh, H, Amon A and Martin KC, 2016, "Molecular Cell Biology", 8th Edition, W.H. Freeman, New York.

Journal and Magazines	https://link.springer.com/journal/12041 https://www.sciencedirect.com/journal/journal-of-molecular-biology)
E-Resources and Website	https://onlinecourses.swayam2.ac.in/cec21_bt05 https://onlinecourses.nptel.ac.in/noc24_bt07

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/
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Focus of the Course	Skill Development/ Employability
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SEMESTER – II							
CORE PRACTICAL: IMMUNOLOGY AND MOLECULAR BIOLOGY							
Semester	Corse Code	Course Name	Category	L	T	P	Credits
II	24BCP2CP	IMMUNOLOGY AND MOLECULAR BIOLOGY	CORE PRACTICAL		-	72	3

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> the knowledge of isolation and purification techniques of antibodies and nucleic acids. comprehend and apply the immunological techniques for diagnosis of infectious diseases, immune disorders and research. the comprehensive knowledge of molecular biology techniques like gel electrophoresis.
Prerequisite	Knowledge on Immunology and Molecular Biology

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Justify the results of agglutination and immunodiffusion reactions	K5
CO2	Apply ELISA and identify the concentration of antigens.	K3
CO3	Interpret the laboratory tests in the diagnosis of infectious diseases.	K5
CO4	Experiment with nucleic acids extraction procedures and quantify the nucleic acid using spectrometer	K3
CO5	Set up and interpret agarose gel electrophoresis protocols	K5

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

24BCP2CP	IMMUNOLOGY AND MOLECULAR BIOLOGY
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Syllabus

S.No

Contents

- 1 Isolation of Immunoglobulin Y (IgY) from chicken eggs
- 2 Partial purification of antibodies - Ammonium sulphate precipitation and dialysis
- 3 Isolation of lymphocytes from blood
- 4 Precipitation reaction - Single and Double Immunodiffusion
- 5 Immuno-electrophoresis
- 6 Latex Agglutination test
- 7 Enzyme linked immunosorbent assay (ELISA)
- 8 Blood smear preparation and identification of leucocytes by staining
- 9 Isolation of chromosomal DNA from blood, quantification of DNA and separation of DNA on agarose gel electrophoresis
- 10 Isolation of plasmid DNA from bacterial culture and separation on agarose gel electrophoresis
- 11 Isolation of total RNA from yeast/bacteria, quantification and separation on agarose gel electrophoresis
- 12 Transformation of *E. coli* cells with plasmid DNA and blue or white colony test for lac⁺/lac⁻
- 13 Effect of UV dose on survival rate of bacteria
- 14 Determination of DNA damage by comet assay (Demonstration)
- 15 Karyotyping (Demonstration)

Manuals	1.	Frank C. Hay and Olwyn, M.R. Westwood, 2002, "Practical Immunology", 4th Edition, Blackwell Science, United States.
	2.	Gakhar SK, 2013, "Molecular Biology- A laboratory manual", 1st Edition, I.K International, New Delhi

Learning Method	Demonstration/ Hands on Experiments/ Group Trials
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Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development
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SEMESTER – II							
CORE PRACTICAL: MICROBIAL BIOCHEMISTRY AND METABOLISM							
Semester	Corse Code	Course Name	Category	L	T	P	Credits
II	24BCP2CQ	MICROBIAL BIOCHEMISTRY AND METABOLISM	CORE PRACTICAL		-	48	2

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> the basic protocols in bioprocess and Microbial technology concepts in separation and quantification of various cellular metabolites and biomolecules
Prerequisite	Knowledge on Microbial Biochemistry and Metabolic pathways

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Recognize the fundamentals of inoculum preparation and fermentation media.	K2
CO2	Perform the basic protocols in industrial production of pigments, Wine, Acetic acid, Amylase and antibiotics	K4
CO3	Design a protocol to screen and isolate industrially important microorganisms	K5
CO4	Perform isolation of cellular metabolites and biomolecules from biological samples.	K4
CO5	Assess the levels of various cellular metabolites and biomolecules in biological samples	K4

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

24BCP2CQ	CORE PRACTICAL: MICROBIAL BIOCHEMISTRY AND METABOLISM
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Syllabus**S.No****Contents**

- 1 Determination of microbial growth-turbidity method
- 2 Production of extracellular metabolites from actinomycetes- Melanin.
- 3 Screening of Antibiotic producing microorganisms (crowded plate technique)
- 4 Production and assay of amylase activity by shake flask method by batch fermentation
- 5 Production and estimation of red wine from grapes.
- 6 Production and estimation of acetic acid by *Aspergillus niger*
- 7 Estimation of Glucose by DNS Method.
- 8 Estimation of pyruvate by DPNH (2, 4-dinitrophenylhydrazine) method.
- 9 Estimation of Methionine.
- 10 Estimation of Protein by Bradford's method
- 11 Estimation of MDA as an index of Lipid Peroxidation.
- 12 Estimation of Lipoproteins.
- 13 Estimation of Iron by Wong's Method.

Manuals	1.	Kulandaivel and Janarthanan 2012, " Practical Manual on Fermentation Technology ", First Edition, I.K International Publishing House Ltd, New Delhi.
	2.	Sadasivam S and Manickam A, 2018," Biochemical Methods ", Third Edition, New Age International Pvt Ltd Publishers, Chennai

Learning Method	Demonstration/ Hands on Experiments/ Group Trials
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Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations
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Semester – II DSE: BIONANOTECHNOLOGY							
Semester	Corse Code	Course Name	Category	L	T	P	Credits
II	24MBP2DA	BIONANOTECHNOLOGY	DSE	36	12	-	3

Preamble	<p>This course has been designed for students to learn and understand</p> <ul style="list-style-type: none"> the role of microbes and other eukaryotes in the synthesis of nanoparticles advanced methods of characterization of nano particles educate the potential applications of nano particles/ materials in a variety of areas.
Prerequisite	Knowledge on Biological science

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explore the basics of Nanosciences and its applications	K3
CO2	Synthesize nanoparticles at the laboratory scale.	K4
CO3	Analyze the nanoparticles by spectral and electron microscopic techniques	K4
CO4	Apply bionanomaterials in drug development and delivery.	K4
CO5	Criticize the merits and demerits of nanomaterial applications.	K4

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



24MBP2DA	BIONANOTECHNOLOGY
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Syllabus

Unit	Content	Hrs	Resources
I	Introduction to bionanotechnology History - concept and future prospects - application in Life Sciences. Terminologies - nanotechnology, bionanotechnology, nanobiomaterials, biocompatibility, nanomedicine, nano tube, nanowires, quantum Dots, nanocomposite, nanoparticles, nanosensors, Nanofiber, Dendrimeter. Emergence of Bionanotechnology.	10	Text Book 1 Reference book 1
II	Synthesis of nanoparticles Synthesis - Top-down approach & bottom-up approach - Types of nanoparticles production - principle and mechanism of synthesis - physical - Sonicator, Ball mill, ablation, evaporation-condensation; chemical - reducing method - chemical reduction, irradiation, electrochemical, photoreduction; biological - microbes, plants. Green synthesis	10	Text Book 2 Reference book 1
III	Characterization of Nanoparticles Physical and chemical properties of nanoparticles. Characterization- UV-Vis spectroscopy, particle size analyzer, Electron Microscopy - HRTEM, SEM, AFM, EDS, XRD. Other tools and techniques required for bionanotechnology: X- Ray crystallography, FTIR, NMR.	10	Text Book 1 Reference book 3
IV	Applications of bionanotechnology Targeted drug delivery, biosensors and biomarkers, food and agriculture, DNA nanotech, nanoviricides, tissue engineering, gene delivery. Antibacterial activities of nanoparticles. Toxicology in nanoparticles - Dosimetry. Molecular nanotechnology - nanomachines - collagen.	9	Text Book 2 Reference book 2
V	Merits and demerits of nanoparticles Health and safety implications from nanoparticles: Health issues - Environmental issues - Need for regulation - Societal implications - Possible military applications Potential benefits and risks for developing countries - Intellectual property issues. Bioinformatic tools in nanotechnology: molecular modeling, docking, computer assisted molecular design. Case study- Merits and demerits of any two nanoparticles in health and environment safety	9	Text Book 2 Reference book 4
Total		48	

Text books	1.	Parthasarathy BK. 2007, Introduction to Nanotechnology, Isha Publication.
	2.	Elisabeth Papazoglou and Aravind Parthasarathy. 2007, Bionanotechnology, Morgan and Claypool Publishers, New Delhi.
Reference Books	1.	Bernd Rehm, 2006, Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press.
	2.	David E Reisner and Joseph D Bronzino, 2008, Bionanotechnology: Global Prospects. CRC Press, New Delhi.
	3.	Ehud Gazit, 2006, Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press.
	4.	Kamali Kannangara, 2005, Nanotechnology: Basic science and Emerging technologies- Mick Wilson, Overseas Press.

Journal and Magazines	https://jnanobiotechnology.biomedcentral.com https://nano-magazine.com
E-Resources and Website	https://archive.nptel.ac.in/courses/118/107/118107015 https://www.coursera.org/learn/nanotechnology

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study
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Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations
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SEMESTER II
DSE: BIOCHEMISTRY OF TOXICOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24BCP2DA	BIOCHEMISTRY OF TOXICOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand The biochemical basis of toxicology The effects and metabolism of toxins General toxicology, methods of toxicity testing, toxins from microbes, carcinogenic & teratogenic toxins, pesticide, metal and chemical toxicology	
Prerequisite	Basic knowledge about Toxicity	
Course Outcomes (COs)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the importance of toxicology	K2
CO2	Distinguish and evaluate the biochemical effects of toxic agents on cellular macromolecules and tissues	K4
CO3	Compare the different genetic methods used for testing toxicity	K4
CO4	Analyze the effects and metabolism of various microbial toxins, teratogens and carcinogens	K4
CO5	Assess the mode of action of toxic pesticides, heavy metals, chemicals and air pollutants	K5

Mapping with Program Outcomes:

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



Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Introduction to Toxicology Definition and scope of toxicology, Classification of toxic agents. Dose-response relationship: Synergism and Antagonism, Determination of ED50 and LD50. Acute and chronic exposures, Factors influencing toxicity - Abiotic and Biotic factors, Chemical interactions - Bioaccumulation and Bio-magnification	9	Text Book, Reference book and E-Resources
II	Biochemical basis of Toxicology Toxicokinetics-ADME (Absorption, Distribution, Metabolism and Excretion) and Toxicodynamics. Mechanisms of Toxicity, Interaction of toxicant with target molecules - Disturbance of excitable membrane function. Altered calcium homeostasis. Blood brain barrier penetration. Organ Toxicology, Genetic and reproductive toxicology, Toxicogenomics.	9	Text Book and Reference Book
III	Principles and procedures of testing for acute toxic effects Toxicity testing - In-vitro test systems - Bacterial mutation tests: Fluctuation tests, Ames test, Eukaryotic mutation test: Micronucleus Test, Comet Assay, Chromosomal Aberration Test. In-vivo mammalian mutation tests - Host mediated assay and Dominant lethal test. Use of drosophila in toxicity testing. Toxicity testing in animals. Toxicological evaluation of Recombinant DNA-derived proteins.	10	Text book, Reference book, E-Resources and YouTube Videos
IV	Effects and Metabolism of toxins Fungal toxins, Mycotoxins - Aflatoxins, Bacterial toxins - Exotoxins and Endotoxins, Viral toxins, Algal toxins, Teratogens, Carcinogens, Mutagens, Snake venom toxin, Spider, Scorpion and Jellyfish toxins, Antivenom. Xenobiotic metabolism: Phase I- III reactions, Cytochrome-P450. Free radical theory of oxygen toxicity.	10	Text book, NPTEL, and E-resources
V	Pesticide toxicology, Metal toxicology, Chemical toxicology, Air and water pollutants Mechanism and site of action of Chlorinated organics (DDT, BHC), organophosphates and carbamates. Fungicides, Herbicides. Environmental consequences of pesticide toxicity. Biopesticides, Mode of action of toxic heavy metals - arsenic, mercury, cadmium and lead. Biochemical effects of ozone, peroxyacetyl nitrate (PAN), carbon monoxide, nitrogen oxides, sulphur dioxide and cyanide. Drug induced	10	Text book, NPTEL and Reference book

	toxicity-example- Paracetamol. Common air pollutants, water pollutants and their sources, air pollution due to methyl-isocyanate (MIC) and asbestos. Toxicology of food additives, Case studies.		
	Total	48	

Text Book	1.	<i>Klaassen Curtis, D., 2019, "Casarett and Doull's Toxicology - The basic Science of Poisons", 9th edition, McGraw Hill Education, London.</i>
	2.	<i>Cockerham, L.G. and Shane, B.S., 2019, "Basic Environmental Toxicology", 1st edition, CRC Press, New York</i>
Reference Books	1.	<i>Robert, S.M. and James, R.C., 2015, "Principles of Toxicology: Environmental and Industrial Applications", 3rd Edition, John Wiley and Sons, New York.</i>
	2.	<i>De, A.K., 2017, "Environmental Chemistry", 8th Edition, Newage International Publishers, New Delhi..</i>
	3.	<i>Gupta, P.K., 2016, "Fundamentals of Toxicology - Essential concepts and Applications", 1st edition, Academic Press, Cambridge, USA.</i>
	4.	<i>Gupta, R., 2019, "Biomarkers in Toxicology", 2nd Edition, Academic Press, Cambridge, USA.</i>

Journal and Magazines	https://www.sciencedirect.com/science/article/abs/pii/S014181302100354 https://www.europeanreview.org/wp/wp-content/uploads/1633-1653.pdf https://pmc.ncbi.nlm.nih.gov/articles/PMC10247286/ https://www.tandfonline.com/doi/full/10.1080/17435390.2020.1815886
E-Resources and Website	https://onlinecourses.swayam2.ac.in/ini24_bt04/ [NPTEL] https://byjus.com/biology/difference-between-biomagnification-and-bioaccumulation/

Learning Methods	Chalk and Talk/ Video tutorials/PPT/ GD/ Assignment/ Seminar
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Focus of the Course	Skill Development/Employability/Entrepreneurial development/Innovations
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Semester – II DSE: FORENSIC BIOTECHNOLOGY							
Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24BTP2DA	FORENSIC BIOTECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand <ul style="list-style-type: none">• Basics and fundamentals of the sample collection and examination in forensic aspects• Different types of DNA profiling and DNA databases used in Forensic analysis• Applications of Forensic Biotechnology in various fields	
Prerequisite	Knowledge on techniques and applications of forensic Biotechnology	
Course Outcomes (COs)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Infer the sample collection for forensic examinations	K3
CO2	Know the methods to characterize the different samples on forensic prospective	K3
CO3	Interpret and examine forensic evidence by DNA profiling methods	K3
CO4	Analyze and interpret the forensic DNA Statistics and Database	K4
CO5	Conclude the significance and applications of Forensic Biotechnology	K5

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



Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Forensic science - History, scope, branches and functions. Forensic science in international perspectives- INTERPOL and FBI. Duties of forensic scientists. Forensic laboratories in India and worldwide. Collection and Preservation of biological samples-Blood, Semen, Saliva, Vomit, Hair, Fibers, Urine and Fecal matter from crime scene.	08	https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000699/ M011531/ET/1516257285FSC_P12_M5_e-text.pdf
II	Importance of Hair, Sperm and Blood in forensic characterization. Hair- morphology, tests for their identification. Blood- composition and properties, presumptive and confirmatory tests. Sperm- composition, morphology of spermatozoa, presumptive and confirmatory tests (including Azoospermic semen stains), seminal fluid isozymes typing.	10	1516257136FSC_P12_M2_e-text.pdf
III	Structure of DNA, DNA extraction-organic and inorganic extraction. Variations in DNA related to forensic Biotechnology, DNA profiling-history and applications. Methods used in DNA profiling- Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction (PCR), RAPD, Short Tandem Repeat (STR) Analysis, Single Nucleotide Polymorphism (SNP) Analysis, Mitochondrial DNA (mtDNA) Profiling, Y-Chromosome STR (Y-STR) Analysis and Variable Number Tandem Repeats (VNTR) Analysis.	10	https://www.frontiersin.org/journals/ecology-and-evolution/articles/10.3389/fevo.2021.646130/full
IV	DNA Statistics- allele frequency, Random Match Probability (RMP), Paternity/Maternity index, Sibling index. Impact of Human genome project on Forensic Biotechnology. DNA forensic databases; Ethical, legal, and social issues associated with DNA data banking, potential benefits of DNA data banking, quality control, certification and accreditation.	10	https://wbja.nic.in/wbja_adm/files/dna%20profilin g%20%20cfl.pdf
V	Forensic Biotechnology Applications –Criminal investigations, Disputed paternity cases, Child swapping, Disaster Victim Identification (DVI), Civil immigration, Veterinary, Wildlife,	10	https://www.walshmedicalmedia.com/open-access/application-of-dna-fingerprinting-in-an-

Environment, Public Health and Epidemiology, Agriculture and Food safety. New and Future technologies for Forensic Biotechnology.		alleged-case-of-paternity-2161-1009-1000165.pdf
Total	48	

Text Book	1.	Richard Saferstein E, 2020, "Forensic Science Handbook", 2 nd Edition, Prentice Hall, New Delhi.
Reference Books	1.	William Tilstone J, Kathleen Savage A and Leigh Clark A, 2006, "Forensic Science: An Encyclopedia of History, Methods and Techniques", 1 st Edition, ABC – CLINO Inc, California.
	2.	Allan Jamieson and Scott Bader, 2016, "A Guide to Forensic DNA Profiling", 10 th Edition, John Wiley & Sons, UK.
	3.	John Butler M, 2005, "Forensic DNA Typing - Biology, Technology, and Genetics of STR Markers", 2 nd Edition, Academic Press, United States.
	4.	John Butler M, 2009, "Fundamentals of Forensic DNA Typing", 1 st Edition, Academic Press, United States.

Journal and Magazines	Singh, Harendra Nath. (2021). Collection, Preservation and Transportation of Biological Evidence Forensic DNA Analysis. 9. 1123-1130.
E-Resources and Website	https://pmc.ncbi.nlm.nih.gov/articles/PMC3168143/ https://www.sciepublish.com/article/pii/279 https://blog.bccresearch.com/technology-trends-shaping-the-future-of-forensics-industry

Learning Methods	Learning Management System, PPT, Flipped Classroom
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Focus of the Course	Skill Development/Employability/Entrepreneurial Development
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