



Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

M. Sc.
Biochemistry
(CBCS)
effective from
Session: 2025-26

Date: _____
Volume No.: _____



Annexure-1

M.Sc. Biochemistry

Program Objectives

The aim of this program is to provide a broad overview of biochemistry, and thus produce graduates with sufficient knowledge and expertise to apply them in basic biosciences research and teaching.

The program has following specific objectives:

1. To provide an intensive and in-depth knowledge to the students in diverse areas of basic and applied biochemistry
2. To impart knowledge and skills necessary to synthesize commercially and therapeutically significant products.
3. To provide bioinformatics skills for biological sequence data mining
4. To train the students to take up wide variety of roles like researchers, scientists, and academicians
5. To provide the students hands on training for the technical review and literature search for designing research problems

Programme Outcome (PO)

PO1: Technical Knowledge: Substantial multidisciplinary knowledge about basic sciences related to specialization for solving various complex scientific problems.

PO2: Development of critical analytical approach in identifying, understanding various problem in the present world, that can be solved with the help of basic scientific knowledge and its applications.

PO3: Ability to contribute towards innovative thinking, scientific approach, and trouble-shooting skills for various problems by utilizing scientific knowledge in accordance with health- environment safety, cultural and social aspects.

PO4: Can independently carry out a complete scientific work process, including the theoretical background, hypotheses generation, collecting and analyzing data as along with the interpretation of results and their presentation

PO5: Critically evaluate appropriate tools and techniques as well as high competency and multidisciplinary experience for obtaining accurate results within limited resources

PO6: Understands the role of biochemistry in society, health related issues, environmental concerns and cultural problems through scientific interventions.

PO7: Assessment of impact specifically on environment and society due to proposed innovation-based solutions and for obtaining sustainable development.

PO8: Should be familiar with the research & professional ethics as well as responsibility taking capability for standard practices.

PO9: has the ability to successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines.

PO10: Empower learner's multiple competencies and adding quality dimension to learner's knowledge for proper documentation, effective report writing and presentations.

PO11: Inculcate managerial skills specifically finance management, team building capacity, individual approach along with existing scientific multidisciplinary knowledge for handling projects and better-quality outcomes

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Mahayogi Gorakhnath University Gorakhpur

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PO12: Aware of recent scientific updates and advanced technologies for quality work and to fulfil the need of the hour throughout life.

Program Specific Outcome (PSO)

The aim of this program is to prepare students to take up a career in biochemistry industry or research. The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of biochemistry.

PSO1: Fundamental multidisciplinary knowledge will enable students to design, conduct experiment, analyze and interpret data for investigating problems in biochemistry and allied fields.

PSO2: Capability to understand the potentials, and impact of biochemical innovations on environment and their implementation for finding sustainable solution to issues pertaining to environment, health sector, society etc.

PSO3: This course will develop effective communication, managerial and other skills in students to carry out advanced projects and collaborations even across the disciplines.

PSO4: Help to evolve with recent innovations and scientific updates in the technological era in accordance with best scientific temperament, professional and research ethics throughout life.

Post Graduate Diploma in Biochemistry

Program Objectives

The aim of this program is to provide a overview of biochemistry, and thus produce Post Graduate Diploma with sufficient knowledge and expertise to apply them in basic biosciences.

The program has following specific objectives:

1. To provide an intensive and in-depth knowledge to the students in diverse areas of basic and applied biochemistry
2. To impart knowledge and skills necessary to synthesize commercially and therapeutically significant products.

Programme Outcome (PO)

PO1: Technical Knowledge: Substantial multidisciplinary knowledge about mathematics, basic sciences, related to specialization for solving various complex scientific problems.

PO2: Development of critical analytical approach in identifying, understanding various problem in the present world, that can be solved with the help of basic scientific knowledge and its applications.

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PO3: Critically evaluate appropriate tools and techniques as well as high competency and multidisciplinary experience for obtaining accurate results within limited resources

PO4: Understands the role of biochemistry in society, health related issues, environmental concerns and cultural problems through scientific interventions.

Program Specific Outcome (PSO)

The aim of this program is to prepare students to take up a career in biochemistry industry or research. The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of biochemistry.

PSO1: Fundamental multidisciplinary knowledge will enable students to design, conduct experiment, analyze and interpret data for investigating problems in biochemistry and allied fields.

PSO2: Capability to understand the potentials, and impact of biochemical innovations on environment and their implementation for finding sustainable solution to issues pertaining to environment, health sector, society etc.



Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
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M. Sc. Biochemistry
Study Evaluation Scheme (Choice Based Credit System)
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1-Year PG

Curricular Components	PG Programme (one year) for 4-yr UG (Hons. /Hons. With Research) given by CCFPP-2024 of UGC			
	Coursework (C)	Research thesis/project/Patent (R)	UGC Total Credits	MGUG Total Credits
Coursework + Research	20	20	40	20 (C)+ 20 (R) = 40
Coursework	40	-	40	40 (C)
Research	-	40	40	40 (R)

Note: A 1-year PG in Biochemistry is for students who have completed a 4-year Bachelor's programme with Honors or Honors with Research in Biochemistry/Biotechnology/Life Science/ Botany/Zoology/Environmental Science.

2- Year PG

Curricular Components		Two-Year PG Programme			
		Coursework (C)	Research thesis/project/Patent (R)	UGC Total Credits	MGUG Total Credits
PG Diploma		40	-	40	44 (C) = 44
1 st Year (1 st and 2 nd Semester)		42		42	44 (C) = 44
Students who exit at the end of 1st year shall be awarded a Post Graduate Diploma in Biochemistry					
2 nd Year (3 rd and 4 th Semester)	Coursework + Research	20	20	40	20 (C) + 20 (R)= 40
	Coursework	40	-	40	40 (C) = 40
	Research	-	40	40	40 (R) = 40

Note: A 2-year PG in Biochemistry is for students who have completed a 3-year bachelor's Programme in Biochemistry/Biotechnology/Life Science/ Botany/Zoology/Environmental Science.



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M. Sc. Biochemistry
Study Evaluation Scheme (Choice Based Credit System)
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I Year: I Semester																																																																																									
S N o	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty																																																																														
						CIE	ESE																																																																																		
Theory																																																																																									
1	MSB101	General Biochemistry	4	0	0	30	70	100	4	Core	Own faculty																																																																														
2	MSB102	Cell biology and Genetics	4	0	0	30	70	100	4	Core	Own faculty																																																																														
3	MSB103	Analytical techniques in Biochemistry	4	0	0	30	70	100	4	Core	Own faculty																																																																														
4	MSB104	Molecular Biology	4	0	0	30	70	100	4	Minor /Elective	Own/other faculty																																																																														
5	MSB121SE	Biostatistics	3	0	0	30	70	100	3	Minor /SEC	Other faculty																																																																														
Practical																																																																																									
6	MSB151	General Biochemistry and Analytical Techniques Lab	0	0	2	30	70	100	1	Core	Own faculty																																																																														
7	MSB152	Cell and Molecular Biology Lab	0	0	2	30	70	100	1	Core	Own faculty																																																																														
8	MSB153	Biostatistics Lab	0	0	2	30	70	100	1	Core	Other faculty																																																																														
Total			19	0	6	240	560	800	22																																																																																
<table><tr><td colspan="2"></td><td colspan="2">GE</td><td colspan="2">Generic Elective</td><td colspan="4" rowspan="5"></td></tr><tr><td colspan="2">L</td><td colspan="2">Lecture</td><td colspan="2">AECC</td><td colspan="2">Ability Enhancement Compulsory Course</td></tr><tr><td colspan="2">T</td><td colspan="2">Tutorial</td><td colspan="2">SEC</td><td colspan="2">Skill Enhancement Courses</td></tr><tr><td colspan="2">P</td><td colspan="2">Practical</td><td colspan="2">DSE</td><td colspan="2">Discipline Specific Elective</td></tr><tr><td colspan="2">CIE</td><td colspan="2">Continuous Internal Evaluation</td><td colspan="4">MOOCs/SWAYAM/NPTEL Courses</td></tr><tr><td colspan="2"></td><td colspan="2"></td><td colspan="2">MSB103 Analytical techniques</td><td colspan="2">https://onlinecourses.swayam2.ac.in/ugc19_bt16/preview</td><td colspan="4"></td></tr><tr><td colspan="2"></td><td colspan="2"></td><td colspan="2">MSB101 Biochemistry</td><td colspan="2">https://onlinecourses.swayam2.ac.in/cec20_bt12/preview</td><td colspan="4"></td></tr><tr><td colspan="2">ESE</td><td colspan="2">End Semester Examination</td><td colspan="8">Note: 1. The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024. 2. In the first semester, every student will be assigned a faculty supervisor who will prepare the student for mini- and major projects.</td></tr></table>														GE		Generic Elective						L		Lecture		AECC		Ability Enhancement Compulsory Course		T		Tutorial		SEC		Skill Enhancement Courses		P		Practical		DSE		Discipline Specific Elective		CIE		Continuous Internal Evaluation		MOOCs/SWAYAM/NPTEL Courses								MSB103 Analytical techniques		https://onlinecourses.swayam2.ac.in/ugc19_bt16/preview										MSB101 Biochemistry		https://onlinecourses.swayam2.ac.in/cec20_bt12/preview						ESE		End Semester Examination		Note: 1. The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024. 2. In the first semester, every student will be assigned a faculty supervisor who will prepare the student for mini- and major projects.							
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I Year: II Semester											
S N o	Course Code	Course	L	T	P	Evaluation Scheme		Tot al	Credit s	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSB201	Bioenergetics and Metabolism	4	0	0	30	70	100	4	Core	Own faculty
2	MSB202	Enzymology and Enzyme Technology	4	0	0	30	70	100	4	Core	Own faculty
3	MSB203	Human Physiology	4	0	0	30	70	100	4	Core	Own faculty
4	MSB204	Clinical Biochemistry	4	0	0	30	70	100	4	Core	Own faculty
5	-----	Discipline Specific Elective-1 (DSE-1)	3	0	0	30	70	100	3	DSE-1	Own faculty
Practical											
6	MSB251	Enzymology and Enzyme Technology lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSB252	Bioenergetics and Metabolism Lab	0	0	2	30	70	100	1	Core	Own faculty
8	MSB253	Clinical Biochemistry & Physiology Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			19	0	6	240	560	800	22		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AEC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

*There will be no credit and no grading for it.

Discipline Specific Elective-1 (DSE-1)	
Code	Subject Name
MSB2101	Drug design and Molecular modelling
MSB2102	Applied Biochemistry
MSB2103	Food analysis and Assurance
MOOCs/SVAYAM/NPTEL Courses	
MSB2103 Food Analysis and Assurance	https://onlinecourses.swayam2.ac.in/cec20_ag06/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024.

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PG Diploma in Biochemistry



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II Year: III Semester																																																	
S. No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty																																						
						CIE	ESE																																										
Theory																																																	
1	MSB301	Plant Biochemistry	4	0	0	30	70	100	4	Core	Own faculty																																						
2	MSB302	Microbiology	3	0	0	30	70	100	3	Core	Own faculty																																						
3	MSB303	Immunology	4	0	0	30	70	100	4	GE-2	Own faculty																																						
4	MSB321SE	Genomics, Proteomics and Bioinformatics	3	0	0	30	70	100	3	SEC	Own faculty																																						
5	-----	DSE-2	3	0	0	30	70	100	3	DSE-2	Own faculty																																						
Practical																																																	
6	MSB351	Microbiology and Immunology lab	0	0	2	30	70	100	1	Core	Own faculty																																						
7	MSB352	Bioinformatics lab	0	0	2	30	70	100	1	Core	Own faculty																																						
8	MSB352ST	Summer Training / Internship	0	0	2	30	70	100	1	Core	Own faculty																																						
Total			17	0	6	240	560	800	20																																								
OR																																																	
MSB3101PJ		Dissertation			40	30	70	100	20																																								
<table><tr><td></td><td></td></tr><tr><td>L</td><td>Lecture</td></tr><tr><td>T</td><td>Tutorial</td></tr><tr><td>P</td><td>Practical</td></tr><tr><td>CIE</td><td>Continuous Internal Evaluation</td></tr><tr><td>ESE</td><td>End Semester Examination</td></tr></table><table><tr><td>GE</td><td>Generic Elective</td></tr><tr><td>AECC</td><td>Ability Enhancement Compulsory Course</td></tr><tr><td>SEC</td><td>Skill Enhancement Courses</td></tr><tr><td>DSE</td><td>Discipline Specific Elective</td></tr></table><table><tr><th colspan="2">Discipline Specific Elective-2 (DSE-2)</th></tr><tr><th>Code</th><th>Subject Name</th></tr><tr><td>MSB3101</td><td>IPR, Bioethics and Biosafety</td></tr><tr><td>MSB3102</td><td>Environmental Toxicology</td></tr><tr><td>MSB3103</td><td>Pharmacovigilance</td></tr><tr><td>MSB3104</td><td>Nanobiochemistry</td></tr><tr><td></td><td></td></tr><tr><td></td><td>MOOCs/SVAYAM/NPTEL Courses</td></tr><tr><td>MSB302 Immunology</td><td>https://onlinecourses.swayam2.ac.in/cec20_bt05/preview</td></tr></table>														L	Lecture	T	Tutorial	P	Practical	CIE	Continuous Internal Evaluation	ESE	End Semester Examination	GE	Generic Elective	AECC	Ability Enhancement Compulsory Course	SEC	Skill Enhancement Courses	DSE	Discipline Specific Elective	Discipline Specific Elective-2 (DSE-2)		Code	Subject Name	MSB3101	IPR, Bioethics and Biosafety	MSB3102	Environmental Toxicology	MSB3103	Pharmacovigilance	MSB3104	Nanobiochemistry				MOOCs/SVAYAM/NPTEL Courses	MSB302 Immunology	https://onlinecourses.swayam2.ac.in/cec20_bt05/preview
L	Lecture																																																
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MSB3101	IPR, Bioethics and Biosafety																																																
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II Year: IV Semester

S. No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSB401	Research Methodology	4	0	0	30	70	100	4	Core	Own faculty
2	MSB402	Industrial Biochemistry	4	0	0	30	70	100	4	Core	Own faculty
3	MSB403	Molecular Diagnostics	3	0	0	30	70	100	3	GE-2	Own faculty
4	MSB421 SE	Genetic Engineering	4	0	0	30	70	100	4	SEC	Other faculty
5	-----	DSE -3	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSB451	Industrial Biochemistry Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSB452	Molecular Diagnostic and Genetic Engineering Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			18	0	4	210	490	700	20		

OR

8	MSB410 1PJ	Dissertation			40	30	70		20		
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L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AEC C	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-3 (DSE-3)	
Code	Subject Name
MSB4101	Pharmacogenomics
MSB4102	Cancer Biology
MOOCs/SWAYAM/NPTEL Courses	
MSB401 Research Methodology	https://onlinecourses.swayam2.ac.in/cec24_ge02/preview
MSB403 Molecular Diagnostics	https://onlinecourses.nptel.ac.in/noc24_ge36/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024.

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Letter Grades and Grade Points

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Computation of SGPA and CGPA

The following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by student, i.e.

$$\text{SGPA (Si)} = \sum (C_i \times G_i) / \sum C_i$$

Where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th course.

Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	(Credit x Grade)
1	Course 1	3	A	8	$3 \times 8 = 24$
1	Course 1	4	B +	7	$4 \times 7 = 28$
1	Course 1	3	B	6	$3 \times 6 = 18$
1	Course 1	3	O	10	$3 \times 10 = 30$
1	Course 1	3	C	5	$3 \times 5 = 15$
1	Course 1	4	B	6	$4 \times 6 = 24$
		20			139
SGPA					$139/20=6.95$



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ii. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\text{CGPA} = \sum(C_i \times S_i) / \sum C_i$$

where S_i is the SGPA of the i th semester and C_i is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit 20	Credit 20	Credit 20	Credit 20
SGPA 6.9	SGPA 7.8	5.6	6.0
CGPA= $(20 \times 6.9 + 20 \times 7.8 + 20 \times 5.6 + 20 \times 6.0)/80 = 6.6$			

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts



I Year: I Semester (Theory)

General Biochemistry

Code: MSB101

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To study various biomolecules of a cell and their structural characterization.
2. To study various function and interrelationship of biomolecules
3. To elucidate the molecular basis of diseases to enable the development of novel therapies and treatments
4. To study the biochemical basis of inherited disorders and their associated sequelae.

Unit-1 Properties of water and Buffers

Physical properties and structure of water, ionization of water; Structure of the Atom, Mass number. Acids, Bases and Buffers, buffer action, Henderson–Hasselbalch equation, biological relevance of pH and pKa, determination of pKa of weak acid, and buffer capacity, preparation of buffers. Solutions: Units for expressing strength of solutions: Normality, molarity, molality, mole, ppm, ppb. Calculations with examples

Unit-2 Amino acids and Proteins

Amino acids and proteins: Classification, structure and physicochemical properties, Isoelectric point, Zwitter ion; Peptide bonds, peptides of biological importance, therapeutic peptides and biologics, peptides synthesis; Proteins-classification, structure of proteins-primary, secondary (helices, beta sheets, loops, turns) tertiary and quaternary; Myoglobin, hemoglobin; Ramachandran plot, protein-denaturation, protein sequencing, Protein structure and sequence databases.

Unit-3 Carbohydrates

Carbohydrates-classification and structure; structure and functions of mono and Oligosaccharides; Polysaccharides-homo and hetero polysaccharides; starch, glycogen, and cellulose; carbohydrate conjugates; amino sugars, glycoproteins, proteoglycans. Glycomics; Carbohydrate Arrays for Basic Science and as Diagnostic Tools

Unit-4 Lipids

Lipids- classification, structure and properties of fatty acids, phospholipids, sphingolipids, fats, oils and waxes; structure and function of Eicosanoids, Structure and properties of sterols, and steroids. Biogenesis and functions of lipid bodies in animals, plants and microorganisms; Vitamins-chemistry and functions of fat- and water-soluble vitamins

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Unit-5 Nucleic Acids

Nucleic Acids-Nucleosides, Nucleotides, Chemical synthesis of nucleotides, Structure of DNA and RNA; Different types of DNA and RNA; Different types of small RNAs; Physicochemical properties of nucleic acids; Denaturation and renaturation of nucleic acids. Nucleotide sequencing; nucleotide databases and nucleotide sequence databases. Nucleosides, Nucleotides and Nucleic Acids as Therapeutics; CRISPR-Cas9, CRISPR-based diagnostics.

Suggested Readings

1. Voet, D. and Voet, J.G. Biochemistry Latest Edition, Wiley Publishers, USA. ISBN: 9781118918401
2. Stryer, L., Berg, J.M. and Tymoczko, J.L. Biochemistry 5th Revised Edition, Macmillan Publishers (W.H. Freeman), USA, 2002. ISBN: 9780716746843
3. Nelson, D.L. and Cox, M.M. Lehninger Principles of Biochemistry 8th Edition, W.H. Freeman, New York, 2021. ISBN: 9781319381493
4. Vasudevan, D.M. and Sreekumari, S. Textbook of Biochemistry for Medical Students 9th Edition, Jaypee Brothers Medical Publishers, India, 2023. ISBN: 9789354657953
5. Satyanarayana, U. and Chakrapani, U. Biochemistry 5th Edition, Elsevier / Books and Allied Pvt. Ltd., India, 2017. ISBN: 9788131248850

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Explain various biomolecules of a cell and their structural characterization
2. Understand the function and interrelationship of biomolecules
3. Integrate the various aspects of metabolism, and their regulatory pathways.



Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

I Year: I Semester (Theory)
Cell Biology and Genetics
Code: MSB102

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To study and understand structural organization of prokaryotes and eukaryotes.
2. To study the structure and function of intracellular organelles and cell cycle and regulation
3. To understand basic concepts of genome organization and molecular basis of inheritance
4. To have the knowledge in genome mapping and population genetics

Unit-1 Membrane structure and function

Structure of Prokaryotic and Eukaryotic cells; Membrane structure and function-structure of model membrane, lipid bilayer, membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes

Unit-2 Structural organization and function of intracellular organelles:

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Cell junctions, Cell adhesion; Basics of cell signaling- transmembrane, cytosolic and nuclear receptors, integrin and tyrosine kinase signaling, GPCRs role of secondary messengers.

Unit-3 Cell cycle and its regulation (Cyclins and CDKs) cell division:

Cell cycle and its regulation (Cyclins and CDKs) cell division: mitosis, meiosis and cytokinesis, check points-role of Rb and p53, apoptosis, necrosis, ageing; cell differentiation: Introduction to stem cells, Cell death, Apoptosis and; Cancer cells, virus-induced cancer, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth.

Unit-4 Introduction of Genetics

Genome organization, Structure of chromosome; Introduction to genetics, historical development of genetics, Mendelian genetics; Concept of gene: Allele, multiple alleles, pseudo allele and complementation tests. Linkage and crossing over, recombination of genes in a chromosome, epistasis, pleiotropy.

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X-linked inheritance. Polygenic inheritance, Y-chromosome inheritance. Pedigree analysis; Mutations; Types, causes and detection, mutant types; Molecular basis of mutations, **Mutation rate.**

Unit-5 Genome Mapping and Population Genetics:

Gene mapping and human genome project: Physical mapping; linkage and association
Population genetics and evolution: Phenotype; Genotype; Gene frequency; Hardy Weinberg law; Factors distinguishing; Hardy Weinberg equilibrium; Mutation selection; Migration; Gene flow; Genetic drift

References / Test Book:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. Molecular Biology of the Cell 5th Edition, Garland Science, New York, 2008. ISBN:9780815341055
2. Lodish, H. et al. Molecular Cell Biology 4th Edition, W.H. Freeman & Company, 2000. ISBN: 9780716737063
3. Smith, C. and Wood, E. Cell Biology 2nd Edition, Chapman & Hall, London, 1996. ISBN: 9780412586203
4. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. Lewin's Genes XI Jones & Bartlett Learning, Burlington, MA, 2014. ISBN: 9781449659851
5. Thompson, M.W. and Thompson, R.E. Genetics in Medicine 6th Edition, Saunders (Elsevier), 2004. ISBN: 9780721602653
6. Hartl, D.L. and Jones, E.W. Genetics: Analysis of Genes and Genomes 6th Edition, Jones & Bartlett Publishers, 2000. ISBN: 9780763715569
7. Strachan, T. and Read, A.P. Human Molecular Genetics 3rd Edition, Garland Science, 2004. ISBN: 9780815341826

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Explain structural characterization and function of prokaryotic and eukaryotic cells
2. Understand the genome mapping and population genetics
3. Integrate the various aspects of cell cycle and regulation.

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I Year: I Semester (Theory)

Analytical Techniques in Biochemistry

Code: MSB103

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. The course introduces students to the different types of analytical techniques.
2. To teach basic principle of microscopy and chromatography and their applications.
3. To teach basic principle of cell fractionations, estimation of molecular mass of protein, separations of proteins by different techniques.
4. To comprehend the properties of water, acids, bases, buffers, and solutions.

Unit-1 Microscopy

Microscopy: Resolving powers of different microscopes; Light Microscopy: Basic principles, components and applications of Bright field, phase contrast, fluorescence microscopy, Electron microscopy- Principle, preparation of specimens; TEM, SEM and their applications; Confocal microscopy, Microtomy, specific staining of cells and cell organelles, Flowcytometry

Unit-2 Chromatography and Electrophoretic techniques

TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity; Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis

Unit-3 Centrifugation

Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuges -Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods

Unit-4 Spectroscopy Techniques

Electromagnetic radiations, Beer-Lamberts law principles and applications of colorimetry, spectrophotometry. Concept and biological application of UV, Visible, and Raman spectroscopy; fluorimetry, flame photometry; Fluorescence; MS, NMR, PMR, ESR and Plasma Emission spectroscopy. X-ray Diffraction.

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Unit-5 Optical Techniques Principle, Instrument design, methods and application of Fluorescence; Polarising, Flowcytometry and Cytophotometry; Circular dichroism (CD), optical rotatory dispersion (ORD), Relation between CD and ORD, application of ORD in conformation and interactions of biomolecules

Suggested Readings

1. Freifelder, D. Physical Biochemistry: Applications to Biochemistry and Molecular Biology 2nd Edition, W.H. Freeman & Company, San Francisco, 1982. ISBN: 9780716714446
2. Wilson, K. and Walker, J. Principles and Techniques of Practical Biochemistry 5th Edition, Cambridge University Press, 2000. ISBN: 9780521799659
3. Holme, D. and Peck, H. Analytical Biochemistry 3rd Edition, Longman, 1998. ISBN: 9780582294387
4. Scopes, R.K. Protein Purification: Principles and Practice 3rd Edition, Springer-Verlag, 1994. ISBN: 9780387940728
5. Academic Press (Editors: Sidney P. Colowick and Nathan O. Kaplan) Selected Readings from Methods in Enzymology, Academic Press. ISSN (series): 0076-6879

Course Learning Outcomes (CLOs): On completion of this course, the students will have the knowledge about:

1. Understanding physical properties of water, buffers and solutions
2. Remembering and understanding the basics of microscopies and their application. Chromatography techniques and their use in separation of different compounds.
3. Remembering and understanding the mechanisms of centrifugation and electrophoresis of proteins/ nucleic acids.



I Year: II Semester (Theory)

Molecular Biology

Code: MSB104

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To offer detailed knowledge about the DNA replication, repair and recombination mechanism
2. To study and understand about gene expression and translation
3. To have knowledge in post translation modifications and mutations

Unit 1. Structure of DNA and RNA

DNA: Chemistry of DNA, DNA structure, Different conformations of DNA (B, A and Z), Denaturation DNA topology: Supercoiling, Biology of Supercoiled DNA, DNA topoisomerases and their mechanism of action. RNA: RNA double helices, RNA triple helices, Watson-Crick and Hoogsteen base pairing, mini double helices formed by ApU and GpU, turns and bands in UpAH; DNA- protein interactions: General features, Sequence specific DNA binding protein motifs, ss DNA binding proteins

Unit 2. DNA Dynamics: Replication, Recombination, and Repair

Models of DNA replication (Semi-conservative, semi-discontinuous, bidirectional replication, rolling circle, mitochondrial D loop), Enzymes involved in replication, Mechanisms and control. Recombination: Homologous recombination, transposition and site specific recombination. Repair: Proofreading and MMR, post-replication repair and SOS, photo-reactivation repair, excision and DSB repair.

Unit 3. RNA Synthesis

Prokaryotic transcription-subunits of RNA polymerase, E. coli promoters, sigma factor and promoter recognition, alternative sigma factors, initiation, elongation, Rho-dependent and independent termination of transcription. Eukaryotic transcription- Initiation, promoter elements, RNA polymerases, transcription factors, regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers. Post Transcriptional Modifications: RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA. RNA splicing: Nuclear splicing, tRNA splicing, alternate splicing.

Unit 4. Protein Synthesis and Gene Regulation

Protein Synthesis: Discovery of the genetic code; Universal genetic code, Degeneracy of codons, Termination codons, Wobble hypothesis; ribosomes, tRNA, amino acyl tRNA

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synthetase – classification, proofreading activity of amino acyl tRNA synthetase; Detailed mechanism of Prokaryotic and Eukaryotic translation – initiation, elongation and termination; mRNA surveillance. Regulation of gene expression – Lac operon, Trp operon, Ara operon, RNA interference, mechanism and applications; microRNA – its role in translational regulation and cancer; Manipulating cellular mRNA translation - Crispr-Cas technology.

Unit 5. Post translational modifications, Protein localization and Application of Molecular biology

Post Translational processing – Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation. Protein Localization – Co- and post-translational protein translocation; chaperones and protein folding, signal sequences, translocons, leader sequences. Application-Antisense and Ribozyme Technology, Southern and fluorescence in situ hybridization for genome analysis, Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis.

Suggested Readings:

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., and Losick, R. Molecular Biology of the Gene 7th Edition, Pearson Education, 2013. ISBN: 9780321762434
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P. Molecular Biology of the Cell 5th Edition, Garland Science, New York, 2008. ISBN: 9780815341055
3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., and Scott, M.P. Molecular Cell Biology 8th Edition, W.H. Freeman & Company, 2016. ISBN: 9781464183393
4. Krebs, J.E., Kilpatrick, S.T., and Goldstein, E.S. Lewin's Genes XI Jones & Bartlett Learning, Burlington, MA, 2014. ISBN: 9781449659851
5. P.S. Verma and V.K. Agarwal Cell Biology, Genetics, Molecular Biology, Evolution and Ecology S. Chand Publishing, Latest Edition. ISBN: 9789352837326
6. Veer Bala Rastogi Molecular Biology 4th Edition, MedTech Science Press, 2015. ISBN: 9789384007567
7. Goswami, T.K. Molecular Biology and Genetic Engineering Narosa Publishing House, 1st Edition, 2005. ISBN: 9788173196025

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Learn the processes of DNA replication, repair and recombination mechanism.
2. Comprehend the mechanisms of transcription, RNA processing and post transcriptional Modifications
3. Acquire mechanistic knowledge about translational process in prokaryotes and eukaryotes



I Year: I Semester (Theory)

Biostatistics

Code: MSB121SE

L	T	P	C
3	0	0	3

Course Objectives:

1. To teach the basic of statistics and their applications in biology.
2. Understanding of data and its analysis with the help of computers and interpretation of data analysis.
3. Understanding the basics of computers and computational data analysis which in-turn can be used for interpretation of data analysis.
4. To make awareness about different type of software packages and their use.

Unit 1: Introduction to Biostatistics & Data Handling

- Definition, scope, and significance of biostatistics
- Data and its measurement scales
- Data collection and classification
- Tabulation and frequency distribution
- Diagrammatical and graphical representation of data- Line, Bar, Pie Chart, Histogram, Frequency Polygon, Ogive

Unit 2: Measures of Central Tendency and Dispersion

- Concepts of statistical measures
- Measures of Central tendency: Mean, Median, Mode
- Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation

Unit 3: Measures of Relationship

- Correlation: Types and interpretation
- Karl Pearson's Coefficient of Correlation
- Spearman's Rank Correlation
- Simple Linear Regression Analysis

Unit 4: Sampling Techniques and Probability Distributions

- Definition of population & sample,
- Sampling criteria, and sample size determination
- sampling & type of sampling technique
- Probability Distributions: Binomial, Poisson, Normal
- Normal Probability Curve, Skewness, Kurtosis

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Unit 5: Hypothesis Testing & Statistical Software

- Basics concept of hypothesis
- Type of hypothesis, critical region, errors (Type I and II), significance level, p-value
- **Parametric test & non-Parametric test-**
 - Chi-Square Test (χ^2)
 - Student's t-tests (independent, paired)
 - F-test, Z-test, ANOVA
 - Mann-Whitney U test
- Introduction to SPSS and its applications in biostatistics

Suggested Readings

1. Rastogi, Veer Bala. *Biostatistics* 3rd Edition, MedTech Science Press, 2022. ISBN: 9789393553694
2. Rao, N.S.N. and Murthy, N.S. *Applied Statistics in Health Sciences* 2nd Edition, Jaypee Brothers Medical Publishers (P) Ltd., 2010. ISBN: 9788184488546
3. Gupta, S.C. and Kapoor, V.K. *Fundamentals of Mathematical Statistics* 11th Edition, S. Chand & Sons, 2002. ISBN: 9788121908688
4. Sinha, P.K. and Sinha, Priti. *Computer Fundamentals: Concepts, Systems and Applications* 8th Edition, BPB Publications, 2003. ISBN: 9788176567525
5. Jain, Satish. *IT Tools and Business Systems* Revised 2010 Edition, BPB Publications, 2010. ISBN: 9788183330495
6. Sagman, S. *Microsoft Office 2000 for Windows* 2nd Indian Print, Pearson Education, 2001. ISBN: 9788131705094
7. Kothari, C.R. *Research Methodology: Methods and Techniques* 2nd Revised Edition, New Age International Publishers, 2004. ISBN: 9788122415222

Course Learning Outcomes (CLOs): On completion of this course, the students will be:

1. Understanding and remembering the knowledge of biostatistics and their use in biological experiments.
2. Remembering and understanding the sampling, collection of data, and test hypothesis during statistical analysis. Measures different tendency and deviations.
3. Remembering and understanding the fundamentals of computers and its parts and handling of different operating systems.
4. Remembering and understanding the use of different software packages in handling of computers.

Date: _____
Volume No.: _____



I Year: I Semester (Practical)

Biochemistry and Analytical Techniques Lab

Code: MSB151

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. To make use of conventional techniques/ instruments to perform biochemical analysis relevant to clinical screening and diagnosis biochemistry.
2. To analyze and interpret investigative data.
3. To understand the theory and principles of chromatography, electrophoresis, and spectrophotometry

Experiments

1. Qualitative analysis of Carbohydrates.
2. Qualitative analysis of Amino acids and Proteins
3. Qualitative analysis of Lipids.
4. Qualitative analysis of Nucleic acids.
5. Estimation of given protein by Biuret test
6. Separation of amino acids by chromatographic techniques
 - a. Circular paper chromatography.
 - b. Ascending paper chromatography.
7. Separation and identification of sugars by Thin Layer Chromatography (TLC)
8. Polyacrylamide gel electrophoresis of proteins.
 - a. Native: Acidic and Basic
 - b. SDS: Reducing and non-reducing.

Suggested Readings

1. Plummer, D.T. *An Introduction to Practical Biochemistry* 3rd Edition, McGraw Hill Education (India), 2017. ISBN: 9789352605954
2. Sawhney, S.K. and Randhir Singh *Introductory Practical Biochemistry* Revised Edition, Narosa Publishing House, 2005. ISBN: 9788173190795
3. Jayaraman, J. *Laboratory Manual in Biochemistry* 2nd Edition, New Age International Publishers, 2011. ISBN: 9788122418308

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4. Wilson, K. and Walker, J. *Principles and Techniques of Biochemistry and Molecular Biology* 8th Edition, Cambridge University Press, 2018. ISBN: 9781107162273
5. Upadhyay, A., Upadhyay, K. and Nath, N. *Principles and Techniques of Biophysics and Molecular Biology* Revised Edition, Himalaya Publishing House, 2019. ISBN: 9789352621282
6. Holme, D.J. and Peck, H. *Analytical Biochemistry* 3rd Edition, Pearson Education, 2002. ISBN: 9780582294387

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Make use of conventional techniques/ instruments to perform biochemical analysis relevant to clinical screening and diagnosis biochemistry.
2. Understand the theory and principles of chromatography, electrophoresis, and spectrophotometry
3. Analyze and interpret investigative data.

Date: _____
Volume No.: _____



I Year: I Semester (Practical)
Cell and Molecular Biology Lab
Code: MSB152

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. To understand and observation of cells and cell types.
2. To perform the isolation and observation of the cell organelles
3. To observe and understand cell cycles in cells

Experiments

1. Study and maintenance of Microscopes
2. Measuring the length and breadth of the cell by using micrometer
3. Measurement of Onion epidermal cell
4. Mitosis and the Cell Cycle in Onion Root-Tip Cells
5. Cell Counting and viability
6. Identification of the blood cell types in human blood
7. Plasmid DNA isolation and DNA quantitation: Plasmid mini-preps
8. Agarose gel electrophoresis
9. Restriction Enzyme digestion of DNA
10. Purification of DNA from an agarose gel
11. Isolation and determination of DNA from bacteria, plant and animal cells.
12. DNA estimation by Diphenylamine method.
13. Determination of DNA and purity by UV absorption method.

Suggested Readings

1. Celis, Julio E. Cell Biology: A Laboratory Handbook Academic Press, 1997. ISBN: 9780121647308
2. Chaitanya, K.V. Cell and Molecular Biology: A Lab Manual I.K. International Publishing House Pvt. Ltd., 2013. ISBN: 9789382332432
3. Bonifacino, J.S., Dasso, M., Harford, J.B., Lippincott-Schwartz, J., and Yamada, K.M. (Eds.) Current Protocols in Cell Biology March 2019 Edition, Wiley. ISSN: 1934-2616 (Online Series)
4. Powar, C.B. Cell Biology Himalaya Publishing House, Latest Edition. ISBN: 9789352621567

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Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Understand and observe the cells and cell types.
2. Perform the isolation and observation of the cell organelles
3. Observe and understand cell cycles in cells



I Year: I Semester (Practical)

Biostatistics Lab

Code: MSB153

L	T	P	C
0	0	2	1

Course objective:

1. To teach the basic of statistics and data representation, data entry and data analysis in biology.
2. Understanding the basics of different statistical methods such as mean, median, mode, variations, etc.
3. To demonstrate the making computer file in MS office and MS-DOS operating systems.
4. To teach the working of office packages.

Experiments

1. Statistical Data Representation and Tabulation
2. Statistical Data entry in computer application software
3. Statistical Data Analysis.
4. Statistical Major Methods: Mean, Median, Mode, Standard Deviation, Correlation and Regression.
5. Computing the Sampling.
6. Graphical representation of data by Histogram, Frequency polygons, frequency curves and
7. Calculation of measures of location & Calculation of measures of dispersion.
8. Calculation of moments, measures of skewness and measures of Kurtosis.
9. Fitting of curves by method of least squares.
10. Determination of regression lines and calculation of correlation coefficient – grouped and ungrouped data.
11. Calculation of correlation ratios and rank correlation coefficients.
12. Calculation of measures of association in contingency tables.
13. Parametric test & non-Parametric test.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Understand the Representation and Tabulation.
2. Perform the data by Histogram, Frequency polygons, frequency curves
3. Observe and understand the method of various biostatistical software.

Date: _____
Volume No.: _____



M. Sc. Biochemistry
Study Evaluation Scheme (Choice Based Credit System)
Effective from the session 2025-26

I Year: II Semester

S. No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSB201	Bioenergetics and Metabolism	4	0	0	30	70	100	4	Core	Own faculty
2	MSB202	Enzyme and Enzyme technology	4	0	0	30	70	100	4	Core	Own faculty
3	MSB203	Human Physiology	4	0	0	30	70	100	4	Core	Own faculty
4	MSB204	Clinical Biochemistr	4	0	0	30	70	100	4	core	Own faculty
5	-----	Discipline Specific Elective-1 (DSE-1)	3	0	0	30	70	100	3	DSE-1	Own faculty
Practical											
6	MSB251	Enzymology and Enzyme Technology lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSB252	Bioenergetics and Metabolism Lab	0	0	2	30	70	100	1	Core	Own faculty
8	MSB253	Clinical Biochemistry & Physiology Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			19	0	6	240	560	800	22		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AEC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

*There will be no credit and no grading for it.

Discipline Specific Elective-1 (DSE-1)	
Code	Subject Name
MSB2101	Drug design and Molecular modelling
MSB2102	Applied Biochemistry
MSB2103	Food analysis and Assurance
MOOCs/SWAYAM/NPTEL Courses	
MSB2103 Food Analysis and Assurance	https://onlinecourses.swayam2.ac.in/cec20_ag06/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024.

P.G. Diploma in Biochemistry

P.G. Diploma in Biochemistry

Date: _____
 Volume No.: _____



I Year: II Semester (Theory)

Bioenergetics and metabolism

Code: MSB201

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To understand the metabolism of biomolecules and their regulation in living cells
2. To have knowledge in basic concepts of bioenergetics
3. To study respiration mechanism and electron transport

Unit-1 Bioenergetics

Bioenergetics: Concept of free energy, standard free energy, determination of ΔG for a reaction; Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions; Biological oxidation-reduction reactions; Redox potentials; Relation between standard reduction potentials & free energy change; High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates alongwith reasons for high ΔG

Unit-2 Metabolism of carbohydrates

Metabolism of Carbohydrates: Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond; Pentose phosphate pathway and its regulation; Gluconeogenesis, glycogenesis and Glycogenolysis; Glyoxylate and Gamma amino butyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway; Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle

Unit-3 Metabolism of lipids and nucleotides

Metabolism of Lipids: Introduction, hydrolysis of tri-acylglycerols, α -, β - oxidation of fatty acids; Fatty acid biosynthesis; Lipid biosynthesis; Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle; Nucleotides metabolism: Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway; Biosynthesis of Vitamins – Ascorbic acid, thiamine, pantothenic acid and Folic acid.

Unit-4 Amino acid metabolism

Amino acid metabolism - Transamination, decarboxylation, Oxidative and non-oxidative deamination of amino acids; metabolism of methionine, histidine, phenylalanine, tyrosine,

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Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

tryptophan, lysine, valine, leucine, isoleucine and polyamines; Urea cycle and its regulation. Overview of biosynthetic pathways of amino acids and their regulation; Assimilation of ammonia, biosynthesis of essential and non-essential amino acids, regulation of glutamine synthetase and aspartate family of amino acids.

Unit-5 Respiration and Electron transport

TCA cycle: Central role of TCA cycle in energy generation and biosynthesis of energy rich bond; Integration/regulation of carbohydrate, lipid and protein metabolism Electron Transport Chain in Mitochondria and chloroplast: Organization and role in electron capture Oxidative Phosphorylation: Electron transfer reactions in mitochondria; F1F0 ATPase - Structure and mechanism of action; Chemiosmotic theory; Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores; Regulation of oxidative phosphorylation.

Suggested readings:

1. Nelson, D.L. and Cox, M.M. *Lehninger: Principles of Biochemistry* 4th Edition, W.H. Freeman & Company / Macmillan / Worth Publishers, 2005. ISBN: 9780716743392
2. Voet, D. and Voet, J.G. *Fundamentals of Biochemistry* 3rd Edition, John Wiley & Sons, New York, 2004. ISBN: 9780471214959
3. Garrett, R.H. and Grisham, C.M. *Biochemistry* 2nd Edition, Saunders College Publishing, New York, 1999. ISBN: 9780030223184
4. Berg, J.M., Tymoczko, J.L., and Stryer, L. *Biochemistry* 6th Edition, W.H. Freeman & Company, New York, 2007. ISBN: 9780716787242
5. Murray, R.K., Granner, D.K., Mayes, P.A., and Rodwell, V.W. *Harper's Illustrated Biochemistry* 26th Edition, McGraw-Hill / Prentice Hall International, 2003. ISBN: 9780838536841
6. Mathews, C.K., van Holde, K.E., and Ahern, K.G. *Biochemistry* 3rd Edition, Addison Wesley Publishing Company, 2000. ISBN: 9780805346140
7. Rawn, J.D. *Biochemistry* Panima Publishing Corporation, New Delhi, 2004. ISBN: 9788171790294

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand the pathways associated with the degradation and biosynthesis of biomolecules
2. Analyze the mechanistic basis for the action of selected enzymes, the thermodynamic basis for the folding and assembly of proteins and other macromolecules
3. Learn the fundamentals of respiration and electron transport.

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Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

II Year: II Semester (Theory)

Enzymology and Enzyme Technology

Code: MSB202

L	T	P	C
4	0	0	4

Course objective:

1. The objective is to offer detailed knowledge about enzymes, which catalyses the entire biochemical reactions in life processes.
2. To understand the basic principles of enzymes kinetics.
3. To know the mechanisms of enzymes inhibitions and regulations
4. To teach the industrial applications of enzymes.

Unit 1: Enzymology:

Introduction, general characteristics of enzymes, activation energy, coupled reactions, active site and its importance, thermodynamics and equilibrium; enzyme activity; specific activity and units; ribozymes; abzymes; classification and nomenclature of enzymes. Enzyme assays: types, continuous and discontinuous assays; optimization of enzyme assays. factors influencing catalytic efficiency and the mechanisms employed. Mechanism of catalysis of various key enzymes at the molecular level.

Unit 2: Enzyme kinetics:

significance; rapid equilibrium and steady state approach, Henry Michaelis-Menten's and Haldane equations, significance of K_m , catalytic efficiency and turnover number; kinetic perfection. Order of kinetics. Methods of plotting, enzyme kinetics data: Lineweaver-Burk, Hanes-Woolf, Woolf-Augustinsson-Hofstee, Eadie-Scatchard; direct linear plot; Advantages and disadvantages; Integrated form of the Henry-Michaelis-Menten equation; Effect of pH and temperature. transient kinetics, flow techniques (continuous, stopped, quenched), temp-jump relaxation experiments.

Unit 3: Enzyme Inhibition:

Models and types of inhibition; Kinetics and diagnostic plots. Reversible inhibition – competitive, non-competitive, uncompetitive, mixed inhibition; irreversible inhibition; determination of K_i values. Multisubstrate enzymes; Multisite and Allosteric enzymes; Models and examples.

Unit 4: Regulation and control of enzyme activity:

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Isozymes, zymogens, reversible covalent modification, irreversible covalent modification, Half-site reactivity; Bifunctional enzymes.

Unit 5: Applied Enzymology:

Application of enzymes in industry, diagnostics and medicine, agriculture, research; Immobilized enzymes. Synthetic or artificial enzymes and enzyme engineering.

References/ Text Books:

1. I.H. Segel. 2010. Biochemical Calculations (2nd Ed), John Wiley and Sons, California, USA. ISBN: 978-0-471-77421-1.
2. P. F. Cook, W.W. Cleland. 2007. Enzyme Kinetics and Mechanism, Garland Science Publishing, London, England and New York, USA. ISBN: 978-0815341406.
3. T. Palmer, P. Bonner. 2007. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2nd Ed.), Woodhead Publishing House, Chichester, England. ISBN: 978-0- 857099921.
4. R. Burgess, M. P. Deutcher. 2009. Guide to Protein Purification, Academic Press, San Diego, USA. ISBN: 978-0-12-374978-9.
5. D. Purich. 2010. Enzyme Kinetics: Catalysis and Control (1st Ed.), Academic Press, San Diego, USA. ISBN: 978-0-123809247.
6. N.C. Price, L. Stevens. 2000. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins, Oxford University Press, USA. ISBN: 978-0-198-502296.

Course Learning Outcomes (CLOs):

On completion of this course, the students will be able to:

1. Understand the basics about enzymes, their nomenclature and classification and reactions.
2. Understanding the mechanisms of the enzyme kinetics.
3. Comprehend the basics of mechanism of action of enzymes and their regulation.
4. Explain various applications of enzymes in different fields.



I Year: II Semester (Theory)

Human Physiology

Code: MSB203

L	T	P	C
4	0	0	4

Course Objectives

1. To provide students with a comprehensive understanding of the structure and integrated function of human organ systems.
2. To explore the biochemical and molecular mechanisms that regulate physiological processes such as circulation, respiration, digestion, excretion, and neuro-muscular coordination.
3. To develop the ability to correlate physiological principles with clinical conditions and diseases affecting human health.
4. To enable students to critically interpret physiological data and apply theoretical knowledge to experimental and real-life biomedical contexts.

Unit-1 Blood– Composition, functions of blood and plasma, Blood corpuscles, formed elements, blood volume, blood volume regulation haemopoiesis, haemostasis, blood groups, haemoglobin, immunity, Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia.

Unit-2 Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. **Respiratory system** - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit-3 Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. **Sense organs** -Vision, hearing and tactile response; **Thermoregulation** - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization; **Stress and adaptation**

Unit-4 Digestive system - Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins, and nucleic acids. **Endocrinology and reproduction** - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

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Unit-5 Excretory system - kidney and structure of the nephron. Comparative physiology of excretion, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Suggested Reading

1. Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology 15th Edition, Elsevier, 2021. ISBN: 9780323673127
2. Ganong, W.F. Review of Medical Physiology 26th Edition, McGraw-Hill Education, 2019. ISBN: 9781260122404
3. Sherwood, L. Human Physiology: From Cells to Systems 9th Edition, Cengage Learning, 2015. ISBN: 9781305643406
4. Silverthorn, D.U. Human Physiology: An Integrated Approach 8th Edition, Pearson Education, 2018. ISBN: 9781292260433
5. Chatterjee, C.C. Human Physiology (Vol. I & II) 13th Edition, CBS Publishers & Distributors, 2016. ISBN: 9788123926109 (Vol I), 9788123926116 (Vol II)
6. Sembulingam, K. and Sembulingam, P. Essentials of Medical Physiology 8th Edition, Jaypee Brothers Medical Publishers, 2023. ISBN: 9789356963564
7. Jain, A.K. Textbook of Physiology (Vol. I & II) 5th Edition, Avichal Publishing Company, 2019. ISBN: 9788177393062 (Vol I), 9788177393079 (Vol II)
8. Suja, S. Human Physiology 2nd Edition, Scitech Publications (India), 2018. ISBN: 9788183717034

Course Learning Outcomes

1. Students will be able to explain the physiological roles of major organ systems and their contribution to maintaining homeostasis.
2. Students will demonstrate an understanding of cellular and molecular mechanisms underlying processes like nerve conduction, muscle contraction, and hormone signaling.
3. Students will be capable of analyzing physiological alterations in disease states such as anemia, renal failure, and hormonal imbalances.
4. Students will acquire the skills to interpret experimental data, perform physiological measurements, and relate them to theoretical knowledge.



I Year: II Semester (Theory)

Clinical Biochemistry

Code: MSB204

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To discuss the fundamental of quality control and biochemistry of body fluids.
2. To explain the clinical significance of the laboratory tests.
3. To study the biochemistry of different diseases.
4. To determine various substances including substrates, enzymes, hormones, etc. and their use in diagnosis and monitoring of disease are applied
5. To evaluate the biochemical abnormalities which commonly occur in the clinical samples with physiology.

Unit-1 Quality Control and Body Fluid Analysis

Quality Control Parameters: Quality control, accuracy, precision, specificity, sensitivity and **Reference values**, limitation of errors allowable in the laboratory; **Body Fluids:** Chemistry, composition & functions of lymph, CSF, and synovial fluid; **Urine Analysis and Phlebotomy:** Urine formation, excretion and urine analysis; collection of bloods, anti-coagulants, preservatives of blood.

Unit-2 Carbohydrate Metabolism Disorders and Diabetes

Hypoglycemia and Hyperglycemia. Diabetes Mellitus- Type I & II, glucose tolerance test (GTT), HbA1c, diabetic ketoacidosis, diabetic retinopathy, diabetic nephropathy, Glaucoma, diabetic coma, gestational diabetes, juvenile diabetes. Inborn errors of carbohydrate metabolism. Glycosuria, fructosuria, pentosuria, galactosemia, Glucose-6-phosphate dehydrogenase (G6PD) deficiency and glycogen storage diseases. Hyperglucagonemia, Lactose intolerance. Advanced glycation end products.

Unit 3: Lipid and Amino Acid Metabolism Disorders

Lipid profile., fatty liver, atherosclerosis, arteriosclerosis, lipid storage diseases, hypolipoproteinemia and hyperlipoproteinemia, Niemann-Pick disease, Gaucher's disease, Tay-Sach's disease, LCAT deficiency, Fabry's disease, Jaundice, hepatitis, cholestasis, cirrhosis, and gallstones. Cystinuria, Phenylketonuria, Maple syrup disease, Alkaptonuria, Albinism and Hartnup disease, Lesch-Nyhan syndrome, Hyperuricemia, Gout, Hypouricemia- Xanthinuria and lithiasis, Orotic aciduria, renal calculi, uremia

Unit-4 Electrolyte Balance & Clinical Biomarkers

Date: _____
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Electrolyte & Acid-Base Homeostasis: Electrolytes, reabsorption of electrolytes, acid-base balance, regulation of electrolyte content of body fluids and maintenance of pH

Fluid and Sodium Regulation: Regulation of sodium and water balance, renin-angiotensin system,

Electrolyte Biomarkers: Clinical investigation of sodium, potassium, chloride; **Molecular**

Biomarkers: Clinical tissue analysis, biopsy, liquid biopsy, circulating enzymes, hormones, RNA and DNA as molecular diagnosis of different diseases.

Unit-5 Diagnostic Enzymology and Systemic Disorders

Diagnostic enzymes: ALT, AST, ALP, CK, LDH, amylase, lipase, cholinesterase; Organ function tests: liver, kidney, pancreas, heart; Hemoglobin types, heme metabolism, thalassemia, sickle cell anemia; Clotting mechanisms, bleeding disorders (hemophilia, DIC); Malnutrition, energy balance, and BMR; Osteoporosis and bone metabolism; Overview of diagnostic strategies: enzymatic assays, point-of-care testing, integrated diagnosis

Suggested Readings:

1. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W., and Weil, P.A. Harper's Illustrated Biochemistry 30th Edition, McGraw-Hill Education, 2015. ISBN: 9781259252865
2. Crook, Martin A. Clinical Biochemistry and Metabolic Medicine 8th Edition, CRC Press (Taylor & Francis Group), 2012. ISBN: 9781444138276
3. Vasudevan, D.M., Sreekumari, S., and Vaidyanathan, K. Textbook of Biochemistry for Medical Students 7th Edition, Jaypee Brothers Medical Publishers, 2010. ISBN: 9789350254842
4. Bishop, M.L., Fody, E.P., and Schoeff, L.E. Clinical Chemistry: Techniques, Principles, Correlations 6th Edition, Lippincott Williams & Wilkins, 2012. ISBN: 9781451118698
5. Vasudevan, D.M. and Sreekumari, S. Practical Textbook of Biochemistry for Medical Students 2nd Edition, Jaypee Brothers Medical Publishers, 2005. ISBN: 9788180614048
6. Manna, Amal Kumar Textbook of Medical Biochemistry 2nd Edition, Academic Publishers, Kolkata, 2012. ISBN: 9788189781703

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Discuss the fundamental of quality control and biochemistry of body fluids.
2. Explain the clinical significance of the laboratory tests.
3. Describe the biochemistry of different diseases.
4. Determine various substances including substrates, enzymes, hormones, etc and their use in diagnosis and monitoring of disease are applied

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I Year: II Semester (Theory)
Discipline Specific Elective-1 (DSE-1)
Drug Designing and Molecular Modelling
Code: MMB2101

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To learn lead discoveries and analog based drug design
2. To describe physicochemical properties and the techniques involved in QSAR
3. To explain various structure-based drug design methods (Molecular docking, Denovo drug design) and techniques in Virtual Screening
4. To learn the concept of pharmacophore and modelling techniques.

Unit-1 Introduction to Drug Discovery/Development

Drug Discovery, Drug Development, Source of Drugs, Structural effects on drug action, Drugs Derived from Natural Products, Existing Drugs as a Source for New Drug Discovery, Screening for New Drug Leads, Modern “Rational Approach” to Drug Design.

Unit-2 Lead discovery and Analog Based Drug Design

Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation. Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

Unit-3 Quantitative Structure Activity Relationship (QSAR)

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

Unit-4 Molecular Modelling and Virtual Screening Techniques

Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening, De novo drug design, Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening.



Unit-5 Bioinformatics and Molecular Modelling

Introduction to Bioinformatics, chemoinformatic, pharmacophore, ADME databases, chemical, biochemical and pharmaceutical databases. Introduction to molecular mechanics and quantum mechanics., Energy Minimization methods and Conformational Analysis, Global Conformational Minima Determination.

Suggested readings:

1. Kerns, E.H.; Di, L. Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization, Academic Press, Oxford, 2008
2. BMC – Burger's Medicinal Chemistry and Drug Discovery, 6th Edition, Vol. 1. Principles and Practice, edited by M. E. Wolff, John Wiley & Sons: New York, 2003.
3. PMC – Principles of Medicinal Chemistry, 7th Edition, edited by T.L. Lemke, D. A. Williams, V. F. Roche, and S.W. Zito, Williams and Wilkins: Philadelphia, 2013.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain the various stages of drug discovery.
2. Learn lead discoveries and analog based drug design
3. Describe physicochemical properties and the techniques involved in QSAR
4. Explain various structure-based drug design methods (Molecular docking, Denovo drug design) and techniques in Virtual Screening
5. Describe the concept of pharmacophore and modelling techniques.



I Year: II Semester (Theory)
Discipline Specific Elective-1 (DSE-1)
Applied Biochemistry
Code: MSB2102

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To understand principle and types of bioreactors.
2. To learn about medicinal chemistry.
3. To explain principle and methods of marine bio technology.
- 4.

Unit-1 Bioreactors

Bioreactors: General principles, Systems applied for Bioconversion, Kinetics of Immobilized system; Bioconversion of water – Insoluble precursors, synthetic precursors; Bioreactors systems design and operation; Bioreactors types – Stirred Tank, Airlift, Rotary drum bioreactors

Unit-2 Medicinal Biochemistry

Plants affecting Human health – A General account of injurious plants, Remedial plants and Psychoactive plants; Production of Pharmaceutical compounds – Antitumor compounds, Alkaloids, Steroids and saponins; Production of Food Additives: Colors – Anthocyanins, Betalains, Crocin & Crocetin, and other Capsaicinoids

Unit-3 Marine Bio Technology

Marine Biotechnology: Principles, Techniques, Methodology and Application of Aquaculture for Crustacean production. Medical Application of Marine resources – Anticancer and Antiviral compounds, antimicrobial agents, Marine Toxins. Marine natural product – production of Agar and Carrageenan Sea weeds and their application

Unit: 4 Vaccines

Vaccines: Principles of vaccination, Design of vaccines. Conventional vaccines – Whole organism, live and attenuated, purified macromolecules. New generation vaccines- Recombinant antigen vaccines, recombinant vector antigens, DNA vaccines, synthetic vaccines, edible vaccines. Vaccine delivery systems – Liposomes, micelles, ISCOMS. Strategies for developing vaccines for malaria, HIV and Salmonellosis. Gene therapy –Types and use of rDNA constructs for gene therapy. Microarrays and biochips. Principle and applications of Metabolic engineering.



Unit-5 Nanotechnology

Nano biotechnology- Principle and applications of Nanotechnology. Techniques of Nano material characterization: Preparation and characterization of nanoparticles: nanoparticulate carrier system, Electron microscopy Atomic force microscopy. Nanostructures and Nanosystems. Applications in drug designing, drug delivery & protein engineering.

Suggested reading:

1. Ramawat, K.G. and Merillon, J.M. *Biotechnology: Secondary Metabolites* 1st Edition, Science Publishers, 1999. ISBN: 9781578080539
2. Lewis, W.H. and Elvin-Lewis, M.P.F. *Medical Botany: Plants Affecting Human Health* 2nd Edition, Wiley, 2003. ISBN: 9780471628824
3. Parthasarathy, V.A., Bose, T.K. and Das, P. *Biotechnology of Horticultural Crops* Naya Prokash, Kolkata, 2001. ISBN: 9788185421856
4. Khan, A.K. and Khanum, A. *Role of Biotechnology in Medicinal and Aromatic Plants* Vol. 1, Ukaaz Publications, Hyderabad, 2007. ISBN: 9788186860258

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain the fundamental principles and operational strategies of bioprocess systems, including bioreactors and bioconversion techniques.
2. Analyze the role of bioactive plant compounds and evaluate their applications in pharmaceuticals and food industries.
3. Demonstrate knowledge of marine biotechnology techniques and assess the biomedical and industrial significance of marine-derived resources.
4. Compare conventional and advanced vaccine technologies and explain modern approaches such as gene therapy, microarrays, and biochips.
5. Apply nanotechnology principles to biological systems with emphasis on nanoparticle synthesis, characterization, and their biomedical applications.



I Year: II Semester (Theory)

Discipline Specific Elective-1 (DSE-1)

Food Analysis and Assurance

Code: MSB2103

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To explain the food regulations and standards.
2. To study the various biochemical analysis tests for proteins, fats and oils
3. To determine diverse quality assurance methods for food products.
4. To have the knowledge about the production of food additives

Unit-1 Introduction

Introduction, Food Regulations and Standards - Sampling methods - Sample preparation for analysis; Statistical evaluation of analytical data - Official Methods of Food Analysis. Moisture in foods - determination by different methods - ash content of foods, wet, dry ashing, microwave ashing methods; Significance of Sulphated Ash, water soluble ash and acid insoluble ash in foods; titratable Acidity in foods, determination of dietary fiber and crude fiber.

Unit-2 Food analysis and food additives

Refractive indices of oils and fats, total soluble solids in fruit juice and honey, specific rotation of sugars, estimation of simple sugars and disaccharides by polarimeter; Immunoassay techniques and its applications in foods. Production of Food Additives: Colours – Anthocyanines, Betalaines, Crocin & Crocetin and other capsaicinoids, flavours – Vanilla, Garlic and onion, sweeteners – Steviosides and Thaumatin

Unit-3 Proteins analysis

Importance of protein analysis, Methods of analysis (Principle, procedure, application) Kjeldahl Method, Biuret method, Lowry method, Bi-cinchoninic Acid method, Ultraviolet (UV) 280nm Absorption, Dye binding method, Bradford method, Ninhydrin method & Turbidimetric method

Unit-4 Analysis of Vitamins and minerals

Importance of vitamin analysis: Extraction methods, Bio assay method for vitamin D Physico-chemical Methods: Vitamin A (Carr – Price method Thiamine by thiochrome method, Riboflavin – fluorometric method, Niacin-colorimetric method, Vitamin D – HPLC method, Analysis of minerals: Microwave digestion. Analysis of the following minerals (Principle and

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procedure), Calcium – EDTA titration. Phosphorus – colorimetric method. Copper, Iron and zinc by ICP. Vitamins, thiamin and riboflavin, Niacin by colorimetric method. Analysis of ash

Unit-5 Food quality assurance

Methods for quality assessment (Sensory, Physical, Chemical & Microbiological) of food materials: fruits, vegetables, cereals, milk & dairy products, meat, poultry, egg and processed food products. Quality Control (QC) System: Importance & functions; Quality Assurance (QA) System: Definition & Importance. Comparison of QC & QA Systems.

Suggested Readings:

1. Gould, Wilbur A. *Food Quality Assurance* 1st Edition, AVI Publishing Company, Westport, Connecticut, USA, 1977. ISBN: 9780870552656
2. Gould, Wilbur A. and Gould, Ronald W. *Total Quality Assurance for the Food Industries* 3rd Edition, CTI Publications Inc., Maryland, USA, 2001. ISBN: 9780930027973
3. Gruenwedel, D.W. and Whitaker, J.R. (Eds.) *Food Analysis: Principles and Techniques* Volumes 1–8, Marcel Dekker Inc., New York, 1984. Note: Multivolume set; ISBN varies by volume. Example (Vol. 1): ISBN: 9780824761509
4. Pomeranz, Y. and MeLoan, C.E. *Food Analysis: Theory and Practice* 3rd Edition, CBS Publishers and Distributors, New Delhi, 1996. ISBN: 9788123909324
5. Herschdoerfer, S.M. (Ed.) *Quality Control in the Food Industry* Vols. 1–4, Academic Press, London, 1968–1987. ISBN (Vol. 1): 9780123428011

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain about the food regulations and standards.
2. Determine the various biochemical analysis tests for proteins, fats and oils
3. Explain diverse quality assurance methods for food products.
4. Discuss about the production of food additives

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II Year: II Semester (Practical)
Enzymology and Enzyme technology Lab
Code: MSB251

L	T	P	C
0	0	2	1

Course Objectives

1. To develop fundamental and practical understanding of enzyme activity, specificity, and kinetics through hands-on laboratory experiments.
2. To train students in enzyme assay techniques, including the determination of specific activity, optimum conditions (pH, temperature), and kinetic parameters (K_m and V_{max}).
3. To provide exposure to enzyme inhibition mechanisms, and enable students to distinguish between competitive and non-competitive inhibition experimentally.
4. To introduce enzyme purification and characterization techniques, such as ammonium sulfate precipitation, dialysis, and electrophoresis for isoenzyme analysis.
5. To familiarize students with applications of enzyme technology, including enzyme immobilization, industrial enzyme production, and enzyme-based biosensors.

Experiments

1. Estimation of Enzyme Activity and Specific Activity (e.g., Amylase or Urease)
2. Effect of pH on Enzyme Activity
3. Effect of Temperature on Enzyme Activity
4. Effect of Substrate Concentration and Determination of K_m and V_{max}
5. Enzyme Inhibition Studies (Competitive and Non-Competitive)
6. Isoenzyme Pattern by Gel Electrophoresis (e.g., LDH Isoforms)
8. Partial Purification of Enzyme Using Ammonium Sulfate Precipitation and Dialysis
9. Immobilization of Enzymes Using Alginate Beads
10. Effect of Immobilization on Enzyme Activity and Reusability
11. Production of Industrial Enzymes (e.g., Amylase from *Bacillus* sp.) via Fermentation
12. Demonstration of Enzyme-Based Biosensor (e.g., Glucose Oxidase)

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Suggested Readings

1. Dixon, M. and Webb, E.C. *Enzymes*, 3rd Edition, Academic Press, 1979. ISBN: 9780122183219
2. Trevan, M.D. *Immobilized Enzymes: An Introduction and Applications in Biotechnology*, 1st Edition, Wiley-Blackwell, 1980. ISBN: 9780471919780
3. Palmer, T. and Bonner, P.L. *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry*, 2nd Edition, Woodhead Publishing, 2007. ISBN: 9780857099922
4. Price, N.C. and Stevens, L. *Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins*, 3rd Edition, Oxford University Press, 1999. ISBN: 9780198502296
5. Sadasivam, S. and Manickam, A. *Biochemical Methods*, 3rd Edition, New Age International Publishers, 2008. ISBN: 9788122434384
6. Jayaraman, J. *Laboratory Manual in Biochemistry*, 1st Edition, New Age International Publishers, 1981. ISBN: 9788122408019
7. Gupta, R.C. *Practical Biochemistry*, 1st Edition, CBS Publishers & Distributors, 2005. ISBN: 9788123918500

Course Learning Outcomes: At the end of the course the student will be able to:

1. Estimate enzyme activity and specific activity using appropriate colorimetric and analytical methods.
2. Analyze the effect of pH, temperature, and substrate concentration on enzyme kinetics and determine K_m and V_{max} .
3. Investigate the nature of enzyme inhibition (competitive and non-competitive) through kinetic experiments.
4. Perform enzyme purification, electrophoretic separation of isoenzymes, and interpret enzyme profiles.
5. Apply enzyme immobilization techniques, evaluate enzyme stability, and demonstrate industrial applications such as fermentation and biosensors.

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II Year: II Semester (Practical)

Bioenergetics and Metabolism Lab

Code: MSB252

L	T	P	C
0	0	2	1

Course objective:

1. To understand the process of isolation of egg albumin from egg white and cholesterol from egg yolk.
2. To understand the process of isolation casein from milk.
3. To understand the isolation and estimation of lecithin.

Experiments

1. Estimation of pure glucose by Nelson-Somogyi method.
2. Total Reducing Sugar Estimation by Dinitrosalicylate.
3. Estimation of Keto sugar by Roe's resorcinol Method.
4. Isolation of Lecithin and its estimation.
5. Isolation of egg albumin from egg white.
6. Isolation of cholesterol from egg yolk.
7. Isolation of casein from milk and determination of its isoelectric point.
8. Isolation of starch from potatoes
9. Isolation of Mitochondria from rat liver.
10. Effect of inhibitors and uncouplers on ATP synthesis.

Suggest Readings:

1. Rao, B.S. and Deshpande, V. *Experimental Biochemistry: A Student Companion* I.K. International Publishing House Pvt. Ltd., 2005. ISBN: 9788188237119
2. Jayaraman, J. *Laboratory Manual in Biochemistry* Wiley Eastern Limited, New Delhi, 1981. ISBN: 9780852269882
3. Plummer, D.T. *An Introduction to Practical Biochemistry* 3rd Edition, McGraw-Hill Education, 1987. ISBN: 9780070994874
4. Wilson, K. and Walker, J. *Principles and Techniques of Biochemistry and Molecular Biology* 7th Edition, Cambridge University Press, 2010. ISBN: 9780521516358
5. Sadasivam, S. and Manickam, A. *Biochemical Methods* 3rd Edition, New Age International Publishers, 2008. ISBN: 9788122422039

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6. Tietz, N.W. (Edited by Burtis, C.A. and Bruns, D.E.) *Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics* 7th Edition, Elsevier, 2014. ISBN: 9788131231227

Course learning outcomes (CLO)

At the end of this course, students will be able to

1. Isolate egg albumin from egg white and cholesterol from egg yolk.
2. Do Isolation of casein from milk.
3. Do isolation and estimation of lecithin

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II Year: II Semester (Practical)
Clinical Biochemistry and Physiology Lab
Code: MSB253

L	T	P	C
0	0	2	1

Course Objective

1. To correlate hematological findings with those generated in other areas of the clinical laboratory, patient symptoms and clinical history, to make appropriate and effective on-the-job professional decisions.
2. To perform basic hematological laboratory testing, assess laboratory data and report findings according to laboratory protocol.
3. To train them to different biochemical test performed for identification of human diseases
4. To narrate the contribution of renal system physiology in the maintenance of homeostasis.
5. To list the physiological principles underlying pathogenesis and treatment of disease

Experiments

1. Assessing and estimation of Red Blood Cell Morphology.
2. Reticulocyte counts, Alkaline & Acid Hemoglobin Electrophoresis.
3. Quantification of fetal hemoglobin.
4. Hemoglobin F Acid Stain,
5. Diabetes and Blood glucose analysis (GOD/POD).
6. Renal Function Tests -Measurement of Serum urea, BUN, -Measurement of Serum Creatinine - Creatinine Clearance. Measurement of urine urea, BUN, -Measurement of urine Creatinine, urine protein.
7. Introduction to Clinical Laboratories - Laboratory Work Flow cycle - Phlebotomy equipment's -Identification of Blood Collection Tubes &Preparation of Blood Plasma and Serum.
8. Liver Function Tests -Measurement of Serum ALT &AST, Serum Bilirubin (Total, direct &indirect)
9. Measurement of pulse and blood pressure.
10. Elicitation of reflexes & jerks.
11. Identification of blood cells by study of peripheral blood smear.
12. Introduction to hemocytometry.
13. Enumeration of white blood cell (WBC) count.
14. Enumeration of total red blood corpuscles (RBC) count.
15. Determination of bleeding time and clotting time.
16. Estimation of hemoglobin content.

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Suggested readings:

1. Mondal, Santosh Kumar *Laboratory Manual of Clinical Pathology and Hematology* 1st Edition, CBS Publishers & Distributors, 2022. ISBN: 9789354664890
2. Vasudevan, D.M. and Sree kumari, S. *Practical Textbook of Biochemistry for Medical Students* 2nd Edition, Jaypee Brothers Medical Publishers, 2005. ISBN: 9788180614048
3. McPherson, R.A. and Pincus, M.R. *Henry's Clinical Diagnosis and Management by Laboratory Methods* 23rd Edition, Elsevier, 2016. ISBN: 9780323295688
4. Al-Ghamdi, Sharifa A. *Clinical Biochemistry Lab Manual (BIOC-416)*, King Abdulaziz University, Saudi Arabia, 2020.
5. Lab Manual - Human Anatomy and Physiology II.pdf (jru.edu.in)
6. HumanAnatomy.pdf (sarajapharmacycollege.com)
7. Hesse, D. and McNabney, D. *Anatomy and Physiology I Lab Manual*
8. Marieb, E.N. *Essentials of Human Anatomy & Physiology Laboratory Manual*, Spiral-bound, 10 January 2008.

Course Learning Outcome

At the end of the course the student will be able to:

1. Perform basic hematological laboratory testing, assess laboratory data and report findings according to laboratory protocol.
2. Collect, handle, and transport the pathological specimen.
3. Accomplish different biochemical tests for identification of human diseases.
4. Distinguish between normal and abnormal data derived as a result of tests which he/she has performed and observed in the laboratory.
5. Perform experiments designed either primarily for the study of physiological phenomena or for assessment of function.

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Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

M. Sc. Biochemistry

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSB301	Plant Biochemistry	4	0	0	30	70	100	4	Core	Own faculty
2	MSB302	Microbiology	3	0	0	30	70	100	3	Core	Own faculty
3	MSB303	Immunology	4	0	0	30	70	100	4	GE-2	Own faculty
4	MSB321SE	Genomics, Proteomics and Bioinformatics	3	0	0	30	70	100	3	SEC	Other faculty
5	-----	DSE-2	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSB351	Microbiology and Immunology Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSB352	Bioinformatics lab	0	0	2	30	70	100	1	Core	Own faculty
8	MSB352ST	Summer Training / Internship	0	0	2	30	70	100	1	Core	Own faculty
Total			17	0	6	240	560	800	20		
OR											
MSB3101PJ		Dissertation			40	30	70	100	20		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-2 (DSE-2)	
Code	Subject Name
MSB3101	IPR, Bioethics and Biosafety
MSB3102	Environmental Toxicology
MSB3103	Pharmacovigilance
MSB3104	Nanobiochemistry
MOOCs/SVAYAM/NPTEL Courses	
MSB302 Immunology	https://onlinecourses.swayam2.ac.in/cec20_bt05/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024.

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II Year: III Semester (Theory)

Plant Biochemistry

Code: MSB301

L	T	P	C
4	0	0	4

Course objective:

1. To provide detailed knowledge of key plant-specific biochemical pathways including photosynthesis and nitrogen fixation.
2. To familiarize students with the biosynthesis and physiological roles of primary and secondary plant metabolites.
3. To understand the biochemical responses and adaptations of plants to various biotic and abiotic stresses.
4. To introduce the molecular basis of plant defense mechanisms and photobiology through enzymatic and regulatory networks.

Unit-1 Structure and function of plant cell, cell wall, plasmodesmata, vacuoles, peroxisomes. Isolation of cell organelles, mechanism of the transport of water, inorganic and organic substances, Seed dormancy, growth and development.

Unit -2 Photosynthesis – Photosynthetic apparatus, photosystems I and II; Hill reaction, light harvesting complexes, photosynthetic electron transport and generation of NADPH & ATP, cyclic and noncyclic photophosphorylations, C₃ and C₄ pathway and its regulation, RUBISCO, PEP carboxylase. Photorespiration. Bacterial photosynthesis Electron transport system in plants: oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, ATP synthase and mechanism of ATP synthesis.

Unit- 3 Nitrogen metabolism: assimilation of nitrate, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Biological nitrogen fixation by free living and in symbiotic association; structure, function, and regulation of the enzyme nitrogenase. nitrogen cycle.

Unit-4 Plant interactions: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress. Stress avoidance. Relationship between stress and adaptation. Antioxidative defense system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.

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Unit- 5 Plant hormones: Biosynthesis, storage, breakdown and transport. Physiological effects and mechanisms of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, jasmonic acid. Toxins of plant origin – mycotoxins, phytohemagglutinins, lathyragens, nitriles, protease

Suggested Readings

1. Buchanan, B.B., Gruissem, W., and Jones, R.L. *Biochemistry and Molecular Biology of Plants* 2nd Edition, American Society of Plant Biologists / Wiley-Blackwell, 2015. ISBN: 9780470714214
2. Heldt, H.-W. and Piechulla, B. *Plant Biochemistry* 5th Edition, Academic Press (Elsevier), 2021. ISBN: 9780128186336
3. Goodwin, T.W. and Mercer, E.I. *Introduction to Plant Biochemistry* 2nd Edition, Pergamon Press, 1983. ISBN: 9780080302888
4. Dey, P.M. and Harborne, J.B. (Eds.) *Plant Biochemistry* Academic Press, 1997. ISBN: 9780122146749
5. Taiz, L., Zeiger, E., Møller, I.M., and Murphy, A. *Plant Physiology and Development* 6th Edition, Sinauer Associates / Oxford University Press, 2015. ISBN: 9781605352558
6. Nelson, D.L. and Cox, M.M. *Lehninger Principles of Biochemistry* 8th Edition, W.H. Freeman, 2021. ISBN: 9781319381493
7. Salisbury, F.B. and Ross, C.W. *Plant Physiology* 4th Edition, Wadsworth Publishing (Thomson Learning), 1992. ISBN: 9780534151621
8. Verma, S.K. and Verma, Mohit *Plant Physiology* S. Chand Publishing, India, 2006. ISBN: 9788121926095
9. Purohit, S.S. *Biochemistry: Fundamentals and Applications* Student Edition, Agrobios (India), 2014. ISBN: 9788177540732
10. Bendre, R.C. and Kumar, Ashok *Principles of Plant Physiology* Himalaya Publishing House, Latest Edition. ISBN: 9789350247936

Course Learning Outcomes (CLOs)

1. Students will be able to describe the mechanisms of light-dependent and light-independent reactions in photosynthesis and explain carbon fixation pathways (C_3 , C_4 , CAM).



2. Students will gain the ability to explain nitrogen assimilation and the enzymatic and genetic regulation of nitrogen metabolism in plants.
3. Students will demonstrate understanding of the biosynthesis and function of secondary metabolites like alkaloids, terpenoids, and phenolics, and their role in plant defense.
4. Students will be able to analyze plant stress physiology, including responses to drought, salinity, pathogens, and light, and describe molecular mechanisms involved in systemic acquired resistance and hormonal signalling



II Year: III Semester (Theory)

Microbiology

Code: MSB302

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To study the taxonomy, morphology and genetics of bacteria.
2. To study the microbial growth and identification of bacteria.
3. To state microbial genetics and the mechanisms of genetic variations in bacteria.
4. To study the microbial nutrition and control of microorganisms.

Unit-1 Introduction to Microbiology

History of Microbiology, biogenesis vs abiogenesis theory, germ theory of disease, Koch's postulates, contribution of various researchers to the field of Microbiology, scope of Microbiology, distinctive characteristics of eubacteria, blue green algae, mycoplasma, viruses, bacteriophages. The Fungi (Eumycota): Introduction, Importance, Structure, Nutrition and metabolism, reproduction and characteristics of fungal divisions.

Unit-2 Structure of Microbial Cell

Morphological and ultrastructure of microbial cell (Shape, size, arrangement), Gram positive and Gram-negative cell wall structure, capsule, cytoplasmic membrane, cytoplasm, nucleoid, mesosomes, ribosomes, fimbriae (pili), flagella, plasmids, endospores. General principle of bacterial classification, polyphasic taxonomy, molecular approaches (16S rDNA sequencing).

Unit-3 Microbial Nutrition and Growth

Basic concepts of Nutrition, Culture media: types of media, natural and synthetic media, chemically defined media, complex media, selective, differential and enrichment media, Pure culture technique. Microbial Growth: growth/ reproduction in bacteria, factors affecting microbial growth, the growth curve, measurement of microbial growth. Microbial control: major physical and chemical methods.

Unit-4 Gene Expression and its Regulation in Prokaryotes

Genome organization in microbes (bacteria, viruses and eukaryotes), DNA and RNA structure and functions, DNA replication, transcription and translation, its regulation in prokaryotes.

Unit-5 Genetic variations in Prokaryotes

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Mutations- types, detection and isolation methods of mutants. DNA Damage and repair, transposons, plasmids. Bacterial recombination- conjugation, transformation and transduction.

Suggested Readings

1. Prescott, L.M., Harley, J.P., and Klein, D.A. Microbiology 7th Edition, McGraw Hill Education, 2008. ISBN: 9780071267274
2. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. Microbiology: Application Based Approach 5th Edition, McGraw Hill Education, 2010. ISBN: 9780074623206
3. Tortora, G.J., Funke, B.R., and Case, C.L. Microbiology: An Introduction 12th Edition, Pearson Education, 2016. ISBN: 9781292099149
4. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R. General Microbiology 5th Edition, Macmillan Press, 1986. ISBN: 9780333984009
5. Cappuccino, J.G. and Welsh, N. (Sherman) Microbiology: A Laboratory Manual 11th Edition, Pearson Education, 2019. ISBN: 9780135188997
6. Aneja, K.R. Experiments in Microbiology, Plant Pathology and Biotechnology 5th Edition, New Age International Publishers, 2020. ISBN: 9788122433233
7. Maheshwari, D.K. Practical Microbiology 1st Edition, Ane Books Pvt. Ltd., 2007. ISBN: 9788180521841
8. Atlas, R.M. Principles of Microbiology 2nd Edition, Wm. C. Brown Publishers, 1995. ISBN: 9780697135287

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Study the taxonomy, morphology and genetics of bacteria.
2. Study nutrition required for micro-organisms and introduction of sterilization.
3. State microbial genetics and mechanisms of genetic variation among microorganisms.

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II Year: III Semester (Theory)

Immunology

Code: MSB303

L	T	P	C
4	0	0	4

Course objective:

1. To compare and contrast the innate versus adaptive immune systems.
2. To compare and contrast humoral versus cell-mediated immune responses.
3. To understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation.

Unit-1: Introduction and definition of Immunology

Introduction- immunity- types-innate, acquired. Ontogeny and Physiology of immune system, Primary and Secondary lymphoid organs, lymphoid tissues. Immunoreactive cells- structure and functions-macrophages, granulocytes, NK cells, T and B lymphocytes – origin, development, differentiation, lymphocyte subpopulation in humans.

Unit-2: Humoral immunity and Cell Mediated Immunity

Antigen-antibody interactions, primary and secondary immune modulation. Affinity and avidity, high and low affinity antibodies, complement fixing antibodies and complement cascade.

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC in antigen processing and presentation, structure of T-cell antigen receptors, TCR, BCR, cell mediated effector functions.

Unit-3: Major Histocompatibility molecules

Structure functions, classifications and synthesis of immunoglobulins, antigen – antibody reaction, mechanisms and regulation of immune responses. Complement system, immune tolerance, immunity to infection, tumor immunity, genetics of immune response, major histocompatibility complex, transplantation, vaccination and immunization strategies, hybridoma technology. Apoptosis, telomeres and telomerase, cytokine network.

Unit-4: Immunological Disorders

Inflammation, hypersensitivity, Types of hypersensitivity reactions, autoimmune disorders, their underlying molecular mechanism, etiology, diagnostic, prognostic and prophylactic aspects, immunodeficiency disorders: congenital and acquired, AIDS, immune response during bacterial (tuberculosis), parasitic (malaria), and viral (HIV) infections. Autoimmune

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disorders like systemic Lupus Erythematosus. Organ transplantation: Immunological basis of reaction angraft versus host reaction.

Unit-5: Immunodiagnostic Procedures

Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Various types of immunodiffusions and immunoelectrophoretic procedure, Immunoblot, agglutination of pathogenic bacteria, hemagglutination and hemagglutination inhibition, cellular technique.

Suggested Readings

1. Kindt TJ, Osborne BA and Goldsby RA (2007) Immunology, 6 th Edition, WH Freeman and Company, NY.
2. Owen JA, Punt J and Stranford SA (2013) Kuby Immunology, 7th Edition, WH Freeman and Company, NY.
3. Male D., Brostoff J., Roitt I and Roth D (2012) Immunology, WB Saunders Co. USA.
4. Parham P (2012). The Immune System, 3rd Edition, Garland Sciences, London and New York.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Compare and contrast the innate versus adaptive immune systems.
2. Compare and contrast humoral versus cell-mediated immune responses.
3. Discuss the significance of the Major Histocompatibility Complex in terms of immune response and transplantation.
4. Describe the different types of immunological disorder.
5. Discuss about immunodiagnostic procedures to study the immune response.

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II Year: III Semester (Theory)

Genomics, Proteomics and Bioinformatics

Code: MSB321SE

L	T	P	C
3	0	0	3

Course objective:

1. To know the detailed knowledge about genomics of an organism.
2. To analysis of genome sequencing and different diseases. and its applications.
3. To teach analysis total proteins using ultramodern techniques.
4. To know the applications of proteomics.

Unit- 1: Genomics:

Genetic and physical maps, physical mapping and map-based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, chromosome microdissection, molecular markers in genome analysis; RAPD and AFLP analysis, molecular markers linked to disease resistant genes, application of RFLP in forensic, disease prognosis, genetic counselling, pedigree, Human genome project.

Unit- 2: Genome Sequencing and Application:

Genome sizes, organelle genomes, genomic libraries, strategies for genome sequencing, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes. Pharmacogenetics, genetics of globin triplet repeat disorders, cancer genetics; immunogenetics biochemical genetics; polygenic inheritance, Microarray

Unit- 3: Proteomics:

Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale isoelectric focusing in solution, Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; Differential display proteomics, Methods of studying Protein-protein interactions: GST Pull-down assay, Coimmunoprecipitation, Yeast two-hybrid system and structural proteomics

Unit- 4: Basics of Bioinformatic and Tools:

Introduction to Bioinformatics, use of Internet and search engines (WWW, HTML, URLs, Netscape, Explorer, Google, PUBMED), database management system, database browsing, data retrieval, sequence and genome database, databases such as GenBank, EMBL, DDBJ, Swissprot, PIR, TIGR, TAIR BLAST, phylogenetic analysis and detection of open reading frames (ORFs).

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Unit-5: Application of Bioinformatics: Molecular evolution and phylogenetic tree, Gene predictions, Introduction to computational structural biology, in-silico methods for structural predictions, Homology threading and modeling, ab-initio modelling; Validation of in-silico determined 3D structures of proteins, Computer aided drug design-tools and applications.

References/ Text Book:

1. Brown, T.A. Genomes 4, Garland Science, 2018.
2. Lesk, A.M. Introduction to Genomics, Oxford University Press, 2013.
3. Mishra, N.C. Introduction to Proteomics: Principles and Applications, Wiley-Blackwell, 2017.
4. Pennington, S.R. and Dunn, M.J. Proteomics: From Protein Sequence to Function, Viva Books, 2002.
5. Mount, D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2004.
6. Pevsner, J. Bioinformatics and Functional Genomics, Wiley, 2015.
7. Zvelebil, M. and Baum, J.O. Understanding Bioinformatics, Garland Science, 2008.
8. Ewens, W.J. and Grant, G.R. Statistical Methods in Bioinformatics, Springer, 2005.
9. Rastogi, S.C., Mendiratta, N. and Rastogi, P. Bioinformatics: Concepts, Skills & Applications, Tata McGraw-Hill Education, 2008.
10. Attwood, T.K. and Parry-Smith, D.J. Introduction to Bioinformatics, PHI Learning Pvt. Ltd., 2009.
11. Kumar, A. Genomics and Proteomics: Fundamentals and Applications, New India Publishing Agency

Course Learning Outcomes (CLOs): On completion of this course, the students will be:

1. Understanding, remembering of and analysing the different tools of molecular biology used in genome analysis.
2. Remembering, understanding and analysing the basics principles of genome sequence analysis and its applications.
3. Remembering and understanding basics of different techniques involved in proteome analysis.
4. Remembering and understanding the principles and applications of proteomics.
5. Remembering and understanding the principles and applications Bioinformatics in different research fields.

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II Year: III Semester (Theory)

Discipline Specific Elective-2 (DSE-2)

IPR, Bioethics & Biosafety

Code: MSB3101

L	T	P	C
3	0	0	3

Course objective:

1. To provide basic knowledge on intellectual property rights and their implications in biological research and product development.
2. To become familiar with India's IPR Policy.
3. To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products.
4. To become familiar with ethical issues in biological research.

Course Objectives (CO)

1. To understand about biosafety measures to be taken during trials of biotechnological products.
2. To learn about requirements, steps of patenting.
3. To understand the bioethical guidelines followed during experiments.
4. To understand the safety of transgenic organisms.
5. To get familiarize with major acts and amendments related to IPR

Unit-1: Intellectual Property Rights (IPR)

Intellectual properties, copyrights, trademarks, trade secret, patents, geographical indications, etc. International framework for the protection of IP; IPs of relevance to biological sciences; introduction to GATT, WTO, WIPO and TRIPS.

Unit-2: Biosafety and Risk Management

Biosafety and risk assessment issues, regulatory framework, National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety; Cross border movement of germplasm; Risk management issues-containment.

Unit-3: Bioethics

General principles for the laboratory and environmental biosafety; health aspects; toxicology, allergenicity, antibiotic resistance etc. Impact on the environment; gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/super viruses etc.



Unit-4: Transgenics and their Safety

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-isotopic procedures; Benefits of transgenics to human health, society and the environment.

Unit-5: Acts and Amendments related to IPR

Indian Patent Act and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

References/ Text Book:

1. Singh, B.D. *Biotechnology: Expanding Horizons* Kalyani Publishers, 2007. ISBN: 9789327244473
2. Sibi, G. *Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology* 1st Edition, Saras Publication, 2018. ISBN: 9789387054943
3. Goel, D. and Parashar, S. *IPR, Biosafety & Bioethics* Pearson Education, 2013. ISBN: 9788131788318
4. Cornish, W.R. and Llewelyn, D. *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* 7th Edition, Sweet & Maxwell, 2010. ISBN: 9780421960303
5. Anderson, B. *Intellectual Property Rights: Innovation, Governance and the Institutional Environment* Edward Elgar Publishing, 2006. ISBN: 9781845426608
6. Dutfield, G. *Intellectual Property Rights and the Life Science Industries: Past, Present and Future* 2nd Edition, Ashgate Publishing, 2009. ISBN: 9780754645829
7. WIPO (World Intellectual Property Organization) *WIPO Intellectual Property Handbook: Policy, Law and Use* 2nd Edition, WIPO Publication, Geneva, 2004. ISBN: 9789280513370. <https://www.wipo.int/about-ip/en/iprm/>
8. Fleming, D.O. and Hunt, D.L. (Eds.) *Biological Safety: Principles and Practices* 4th Edition, ASM Press, 2006. ISBN: 9781555813390

Course Learning Outcomes (CLOs): On completion of this course, the students will be:

1. Remembering and understanding the rationale for and against IPR and especially patents.
2. Remembering and understanding why India has adopted an IPR Policy and be familiar with broad outline of patent regulations.



3. Remembering, understanding and analysis the biosafety and risk assessment of products derived from recombinant DNA research and environmental release of genetically modified.
4. Remembering, understanding and analysis of the ethical aspects related to biological, biomedical, health care and biotechnology research.



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II Year: III Semester (Theory)
Discipline Specific Elective -2 (DSE-2)
Environmental Toxicology

Code: MSB3102

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To understand environment, its composition and different types of pollution.
2. To study the chemical toxicity of important environmental pollutants.
3. To study the effect of environmental pollutants on health and some case history.
4. To study the waste disposal and role of bioremediation.

Unit-1: Introduction of Environmental Science

Environmental Pollution: Classification of pollutants, Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles. Air, Water, Soil, Noise and Thermal pollution: Their source, Effect and biotechnology-based control measures.

Unit-2: Chemical Toxicology

Biochemical effects of heavy metals (Pb, As, Hg, Cd), pesticides, insecticides, herbicides, weedicides, larvicides. Risk of environmental Genotoxicants such as bisphenols, mycotoxins, combusted carbonaceous fuels as carcinogen.

Unit-3: Effect of Environmental pollutants and case history

Effect of climate change on public health, Ozone depletion, UV-B, Green-house effect, acid rain, CITES etc. Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath

Unit-4: Waste disposal and Bioremediation

Biomedical waste handling and disposal, nuclear waste handling and disposal, Waste from thermal power plants. Bio feasibility, Bioremediation: Introduction and types of bioremediations, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ & Ex-situ technologies, and phytoremediation.

Unit-5: Environmental quality Assessment, Monitoring and Environmental Legislations

Biosensors and biochips, Recent environmental legislation and international agreement on environment. Environmental Quality Assessment and Monitoring, Quality of environment for

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life on earth and man; Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality, short term studies/surveys, Rapid assessment, Continuous short- and long-term monitoring, Environmental Impact Assessment (EIA), Need of EIA, Scope and objectives, Types of environmental impacts, Steps involved in conducting the EIA Studies and its drawback.

Suggested Readings

1. Rittmann, B.E. and McCarty, P.L. *Environmental Biotechnology: Principles and Applications* 2nd Edition, McGraw-Hill Education, 2000. ISBN: 9780071181846
2. Wainwright, M. *An Introduction to Environmental Biotechnology* Kluwer Academic Publishers, Boston, 1999. ISBN: 9780792355739
3. Mukerji, K.G., Chamola, B.P., and Upadhyay, R.K. *Biotechnological Approaches in Biocontrol of Plant Pathogens* Kluwer Academic/Plenum Publishers, 1999. ISBN: 9780306460803
4. Evans, G.M. and Furlong, J.C. *Environmental Biotechnology: Theory and Application* Wiley-Blackwell, 2003. ISBN: 9780470843563
5. Singh, A. and Ward, O.P. (Eds.) *Biodegradation and Bioremediation* 2nd Edition, Springer, 2004. ISBN: 9783540204900
6. Rao, M.N. and Dutta, A.K. *Wastewater Treatment: Rational Methods of Design and Industrial Practices* 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd., 2007. ISBN: 9788120416672
7. Thakur, I.S. *Environmental Biotechnology: Basic Concepts and Applications* 1st Edition, I.K. International Publishing House Pvt. Ltd., 2006. ISBN: 9788188237492

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand environment, its composition and different types of pollution.
2. Discuss the chemical toxicity of important environmental pollutants.
3. Describe the effect of environmental pollutants on health and some case history.
4. Discuss the waste disposal and role of bioremediation.



II Year: III Semester (Theory)

Discipline Specific Elective-2 (DSE-2)

Pharmacovigilance

Code: MSB3103

L	T	P	C
3	0	0	3

Course Objectives (CO)

This paper will provide an opportunity for the student

11. To learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance.
12. Train students on establishing pharmacovigilance programme in an organization,
13. Various methods that can be used to generate safety data and signal detection.
14. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

Unit-1 Introduction to Pharmacovigilance

Overview of Pharmacovigilance. Brief History of Pharmacovigilance. Thalidomide's Impact on Regulations. Scope, definition and aims of Pharmacovigilance. Pharmacovigilance Database. International collaboration on pharmacovigilance- WHO, ICH, CIOMS and ISO. Case Processing- Global Perspective of Pharmacovigilance. Case Narrative Writing

Unit-2 Adverse Drug Reactions (ADRs)

Adverse Drug Reactions (ADRs) - Classification, mechanism, predisposing factors, causality assessment for ADRs. ICH Definition of Adverse Drug Reaction. Medical Evaluation of Adverse Events in Pharmacovigilance. Diagnosis and Managements of ADRs.

Unit-3 Pharmacovigilance Systems and Signal Management

Reporting Database, Role of clinical pharmacist in Pharmacovigilance. Pharmacovigilance indicators. Rationale and objectives and Classification of pharmacovigilance indicators. Signal Detection, Managements and Risk Assessments & Evaluation in Pharmacovigilance. Regulator Guideline & laws in Pharmacovigilance. Regulatory body, Institutional Review board, Independent Ethic Committee involvement and submissions. Data privacy, informed consent Forms and Adverse Events Forms.

Unit-4 Regulatory, Quality, and Safety Aspects

ICH GCP, Regulatory Aspects in Pharmacovigilance. Pharmacovigilance- Auditing and Inspection. Quality System in Pharmacovigilance. SOPs in Pharmacovigilance. Medical

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Dictionary for Drug Regulatory Activities MedDRA. Unexpected therapeutic effects, Misuse, Abuse, Rebound effects, Medication errors, treatment non-Compliance with AEs, Overdose/Underdose, Technical complaints or Product Quality Complaints (PQC) and Off Label Uses

Suggested Readings

1. Gupta, S.K. *Textbook of Pharmacovigilance* Jaypee Brothers Medical Publishers Pvt. Ltd., 2011. ISBN: 9789350255108
2. Medhi, B. and Prakash, A. *Practical Manual of Experimental and Clinical Pharmacology* Jaypee Brothers Medical Publishers Pvt. Ltd., 2010. ISBN: 9788184489048
3. Talbot, J. and Waller, P. *Stephens' Detection of New Adverse Drug Reactions* 5th Edition, John Wiley & Sons, 2004. ISBN: 9780470845523
4. Cobert, B. *Cobert's Manual of Drug Safety and Pharmacovigilance* 2nd Edition, Jones & Bartlett Learning, 2011. ISBN: 9780763774059
5. Andrews, E.B. and Moore, N. *Mann's Pharmacovigilance* 3rd Edition, Wiley-Blackwell, 2014. ISBN: 9780470671047
6. Orleans-Lindsay, J. *Pharmacovigilance Medical Writing: A Good Practice Guide* John Wiley & Sons, 2022. ISBN: 9781119756225
7. Waller, P. *An Introduction to Pharmacovigilance* 2nd Edition, Wiley-Blackwell, 2017. ISBN: 9781119289747
8. ICH E6 (R2) *Guideline for Good Clinical Practice (GCP)* International Conference on Harmonisation (ICH) of Technical Requirements for Registration of Pharmaceuticals for Human Use. <https://database.ich.org>
9. Indian Council of Medical Research (ICMR) *Ethical Guidelines for Biomedical Research on Human Participants*, ICMR, New Delhi, 2000 (Updated in 2017). <https://ethics.ncdirindia.org>
10. World Health Organization (WHO) *Handbook: Good Laboratory Practice (GLP): Quality Practices for Regulated Non-clinical Research and Development* 2nd Edition, WHO, 2009. ISBN: 9789241547550

Course Learning Outcomes (CLO)

Upon completion of this course the student should be able to:

1. Understand the Adverse Drug Reactions
2. Understand the Reporting Database.
3. Eligible to understand the role of clinical pharmacist in Pharmacovigilance.



II Year: III Semester (Theory)

Discipline Specific Elective-2 (DSE-2)

Nanobiochemistry

Code: MSB3104

L	T	P	C
3	0	0	3

Course Objectives:

1. To provide foundational knowledge of nanostructures and their physicochemical properties relevant to biological systems.
2. To introduce bioconjugation strategies and surface modification techniques used in nanobiomaterials.
3. To explore the applications of nanomaterials in biosensing, diagnostics, catalysis, and drug delivery.
4. To develop awareness of current trends, ethical considerations, and safety concerns in the use of nanobiochemical tools.

Unit-1 Introduction to Nanobiochemistry

Overview of nanobiochemistry and its interdisciplinary nature; classification and types of nanomaterials – metallic, polymeric, carbon-based; unique properties of nanostructures relevant to biological systems; interactions of nanoparticles with proteins, nucleic acids, membranes, and enzymes; fundamentals of thermodynamics and kinetics at the nanoscale; concept of the bio-nano interface and its significance in biological applications.

Unit-2 Bioconjugation and Surface Modification

Principles of bioconjugation and biofunctionalization of nanoparticles; covalent and non-covalent attachment strategies; chemical linkers such as EDC/NHS, thiol–gold interactions, and click chemistry; surface modification techniques including PEGylation and silanization for stability and targeting; purification and characterization methods: UV-Visible spectroscopy, FTIR, DLS, zeta potential, and surface plasmon resonance (SPR).

Unit 3: Nanobiosensors and Diagnostics

Introduction to biosensors and their components; types of nanobiosensors – electrochemical, optical, and FRET-based systems; advantages of nanomaterials in biosensing (signal amplification, miniaturization); role of nanoparticles in molecular recognition and signal transduction; diagnostic applications in infectious disease detection, cancer markers, and point-of-care testing; examples of nanoparticle-enhanced ELISA and rapid diagnostics.

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Unit-4 Nanocatalysis and Drug Delivery

Nanozymes and catalytic nanostructures: principles and biomedical relevance; enzyme-nanoparticle hybrids for catalysis and diagnostics; smart drug delivery systems using nanocarriers – liposomes, dendrimers, micelles, and polymeric nanoparticles; drug loading techniques and release mechanisms (pH, temperature, ligand-based targeting); case studies on cancer therapy, gene delivery, and controlled release systems.

Unit-5 Recent Trends and Safety Aspects

Emerging technologies in nanobiochemistry: CRISPR/Cas delivery using nanoparticles, DNA and RNA nanostructures, and nanovaccine platforms; evaluation of nanoparticle toxicity – cellular uptake, ROS generation, immune responses; biocompatibility and biodegradability considerations; ethical, legal, and regulatory frameworks for nanomedicine; future directions and translational potential of nanobiochemical tools in healthcare and diagnostics.

Course Learning Outcomes:

1. Understand the fundamentals of nanobiochemistry including the classification, properties, and biomolecular interactions of nanomaterials at the bio-nano interface.
2. Apply bioconjugation strategies and surface modification techniques for the development and characterization of functional nanobiomaterials for biological applications.
3. Evaluate the working principles and applications of nanobiosensors and nano-enabled diagnostic tools used in medical and environmental monitoring.
4. Analyze modern drug delivery platforms and nanozyme-based catalysis, and critically assess the ethical, toxicological, and regulatory aspects of nanobiotechnology.

Suggested readings:

1. Niemeyer, C.M. and Mirkin, C.A. (Eds.) Nanobiotechnology: Concepts, Applications and Perspectives, Wiley-VCH, 2004. ISBN: 9783527306582
2. Hermanson, G.T. Bioconjugate Techniques, 3rd Edition, Academic Press, 2013. ISBN: 9780123822390
3. Bhushan, B. (Ed.) Springer Handbook of Nanotechnology, 4th Edition, Springer, 2017. ISBN: 9783662543561
4. Gupta, R.B. and Kompella, U.B. (Eds.) Nanoparticle Technology for Drug Delivery, CRC Press, 2006. ISBN: 9781574448626
5. Khan, I., Saeed, K., and Khan, I. Nanoparticles: Properties, Applications and Toxicities, Elsevier, 2019. ISBN: 9780128198315
6. Poole, C.P. and Owens, F.J. Introduction to Nanotechnology, Wiley-Interscience, 2003. ISBN: 9780471079354



Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

II Year: III Semester (Practical) Microbiology and Immunology Lab Code: MSB351

L	T	P	C
0	0	2	1

Course Objectives

1. To have a knowledge of common immunological disorders and their resultant effects on the human body.
2. To have an understanding of the common hematological disorders and the investigations necessary to diagnose them and determine their prognosis.
3. To perform and interpret in a proper manner the basic clinico-pathological procedures.
4. To know the principles of collection, handling and dispatch of clinical samples from patients in a proper manner.

Experiments

1. Use and Care of the Microscope and Examination of Living Microorganisms
2. Isolation of Bacteria by Dilution Techniques
3. Special Media for Isolating Bacteria
4. Preparation of Smears and Simple Staining
5. Negative Staining, Gram Staining, Acid-Fast Staining
6. Structural Stains (Endospore, Capsule, Flagella)
7. Sputum for AFB and Basics of DOT, MycoDot, Mantoux
8. Immunoprecipitation
9. Ouchterlony Double Diffusion
10. Counter Current Immunelectrophoresis
11. Rocket Immunelectrophoresis
12. Staining Techniques: Gram Stain, Ziehl–Neelsen (ZN) Stain
13. Enzyme Linked Immunosorbent Assay (ELISA) – DOT
14. Enzyme Linked Immunosorbent Assay (ELISA) – Plate
15. Western Blotting

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Suggested Readings

1. Talwar, G.P. and Gupta, S.K. *Laboratory Techniques in Modern Biochemistry*, 2nd Edition, Vikas Publishing House, 2001. ISBN: 9780706926686
2. Roitt, I.M., Brostoff, J., Male, D.K. *Immunology*, 8th Edition, Mosby/Elsevier, 2001. ISBN: 9780323044017
3. Abbas, A.K., Lichtman, A.H., Pillai, S. *Cellular and Molecular Immunology*, 10th Edition, Elsevier, 2021. ISBN: 9780323757481
4. Channarayappa *Laboratory Manual for Biotechnology*, 1st Edition, Universities Press, 2007. ISBN: 9788173715842
5. Shetty, Nandini *Immunology: A Laboratory Manual*, 1st Edition, New Age International Publishers, 2015. ISBN: 9788122430591
6. Turgeon, Mary Louise *Clinical Hematology: Theory and Procedures*, 6th Edition, Lippincott Williams & Wilkins, 2017. ISBN: 9781496322566
7. Kuby, J. (Judy Owen, Jenni Punt, Sharon Stranford) *Kuby Immunology*, 9th Edition, Macmillan Learning, 2022. ISBN: 9781319114725

Course Learning Outcomes

At the end of the course the student will be able to:

1. Have a knowledge of common immunological disorders and their resultant effects on the human body.
2. Have an understanding of the common hematological disorders and the investigations necessary to diagnose them and determine their prognosis.
3. Perform and interpret in a proper manner the basic clinico-pathological procedures.
4. Know the principles of collection, handling and dispatch of clinical samples from patients in a proper manner.



Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

II Year: III Semester (Practical) Bioinformatics Lab Code: MSB352

L	T	P	C
0	0	2	1

Course objective:

1. To study and execute various bioinformatic tools and techniques
2. To gain knowledge about retrieve protein, gene and genome sequences
3. To perform sequence alignment
4. To study and visualize 3D structure of proteins.

Practicals:

1. Exploration of online databases: Journal articles – NCBI-Pubmed; Protein and Nucleotide sequences – NCBI-Protein, NCBI-Nucleotide; EMBL-EBI, DDBJ, OMIM, GEO, ZINC,
2. Sequence retrieval from Databases, Sequence Similarity search - Blast: Blastn, Blastp, Blastx.
3. Multiple Sequence Alignment (Ex: CLUSTAL-OMEGA, MAFFT, K-ALIGN) and Construction of phylogenetic tree.
4. Expasy tools: Protparam, Translate, SWISS-MODEL
5. Primer design using NCBI-Primer-BLAST and Primer Dimer check.
6. ORF finder in NCBI
7. Calculation of %GC content and molecular weight of a gene using MBCF Oligo calculator.
8. Making a restriction map of a gene sequence using restriction mapper.
9. Whole genome sequence database – NCBI – Genome
10. Search for conserved domains and identification of motifs in proteins.
11. How to find out transmembrane regions in a protein using TMHMM server.
12. Retrieval of 3D structure and protein sequence from Protein Data Bank and Protein 3D Structure visualization using Pymol / Rasmol

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13. Protein ligand docking using AutoDock Vina – PyMOL interphase. Preparation of protein-ligand complex after docking and identification of ligand interacting amino acid residues using LigPlot software.
14. Prediction of 3D structure of proteins using MODELLER and test the quality of the structure using Ramachandran plot.
15. Pathway analysis using Cytoscape.

Suggested reading:

1. Baxevanis, A.D., & Ouellette, B.F.F. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, Wiley-Interscience, 2005. ISBN: 9780471478782
2. Pevsner, J. Bioinformatics and Functional Genomics, 3rd Edition, Wiley-Blackwell, 2015. ISBN: 9781118581780
3. Xiong, J. Essential Bioinformatics, Cambridge University Press, 2006. ISBN: 9780521600828
4. Mount, D.W. Bioinformatics: Sequence and Genome Analysis, 2nd Edition, Cold Spring Harbor Laboratory Press, 2004. ISBN: 9780879697129
5. Bourne, P.E., & Weissig, H. Structural Bioinformatics, 2nd Edition, Wiley-Blackwell, 2009. ISBN: 9780470181058
6. Kumar, S. Molecular Docking for Computer-Aided Drug Design, Springer, 2023. ISBN: 9789819911282
7. Ignacimuthu, S. Basic Bioinformatics, Narosa Publishing House, 2005. ISBN: 9788173196664
8. Mathura, V., & Pandey, V.N. Bioinformatics: Principles and Applications, 1st Edition, Oxford University Press India, 2008. ISBN: 9780195692303

Course Learning Outcomes (CLOS):

At the end of the course the student will be able to:

1. Execute various bioinformatic tools and techniques
2. Gain knowledge about retrieve protein, gene and genome sequences
3. Perform sequence alignment
4. Determine and visualize the 3D structure of proteins.

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Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

II Year: III Semester (Practical) Summer Training/Internship Code: MSB352ST

L	T	P	C
0	0	2	1

Course Learning Objectives: The overall objective of the industrial training is to expose the student to the work environment in the field of biochemistry. In particular, the industrial training program will:

1. Enable the students to gain valuable practical experience, and test the students' career interests.
2. Provide the students with in depth knowledge about career fields.
3. Develop the students' job-related skills.
4. Enhance the students' biochemistry knowledge acquired in class through lab experience.
5. Teach the students on how to deal with the society outside the university.
6. Provide the training organizations with a better assessment of the quality of future human resources, and suggest improvements.

Summer Training /Internship

Summer Training /Internship are an essential part of the academic curriculum. It is a bridge the widen gap between theoretical learning and practical exposure by giving students the first-hand exposure to identify the inputs and outputs for different Industrial operations and processes performed at the workplace.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to

1. Analyze the different career prospects available in biochemistry -related establishments
2. Understand the technology implemented in the manufacturing of products in real-world scenario
3. Understand the entrepreneurial skills required to establish biochemistry -related manufacturing units
4. Understand the cost-cutting strategies adopted by manufacturing units

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Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

M. Sc. Biochemistry

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

II Year: IV Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSB401	Research Methodology	4	0	0	30	70	100	4	Core	Own faculty
2	MSB402	Industrial Biochemistry	4	0	0	30	70	100	4	Core	Own faculty
3	MSB403	Molecular Diagnostics	3	0	0	30	70	100	3	GE-2	Own faculty
4	MSB421SE	Genetic Engineering	4	0	0	30	70	100	4	SEC	Other faculty
5	-----	DSE -3	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSB451	Industrial Biochemistry Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSB452	Molecular Diagnostic and Genetic Engineering Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			18	0	4	210	490	700	20		
OR											
	MSB4101PJ	Project Dissertation			40	30	70		20		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-3 (DSE-3)	
Code	Subject Name
MSB4101	Pharmacogenomics
MSB4102	Cancer Biology
MOOCs/SWAYAM/NPTEL Courses	
MSB401 Research Methodology	https://onlinecourses.swayam2.ac.in/cec24_ge02/preview
MSB403 Molecular Diagnostics	https://onlinecourses.nptel.ac.in/noc24_ge36/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC, 2024.

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Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

II Year: IV Semester (Theory)

Research Methodology

Code: MSB401

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To understand a general definition of research design.
2. To know why educational research is undertaken, and the audiences that profit from research studies.
3. To study the methods of data collection, data processing and analysis strategies in research.
4. To gain knowledge on ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.
5. To distinguish a purpose statement, a research question or hypothesis, and a research objective.

Unit- 1 Research formulation and Design

Motivation and objectives, Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

Unit-2 Data collection and analysis

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

Unit-3 Computer in Research

Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Unit-4 Research ethics, IPR and scholarly publishing

Date: _____
Volume No.: _____



Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Unit-5 Interpretation and Report writing

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports and Conclusions.

Suggested Readings

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand a general definition of research design.
2. Describe why educational research is undertaken, and the audiences that profit from research studies.
3. Explain the methods of data collection, data processing and analysis strategies in research.
4. Describe ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.



II Year: IV Semester (Theory)

Industrial Biochemistry

Code: MSB402

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To study and understand various manufacturing methods of industrially significant biomolecules
2. To explain the various biochemical methods to treat waste water and environment pollutants
3. To have knowledge in plant and animal tissue culture techniques

Unit-1: Manufacturing methods of carbohydrates

Manufacturing methods of carbohydrates: Cane sugar and bye products of sugar industry; Production of starch, Maltodextrins, cyclodextrins, dextrose and other sweeteners, inulin; Manufacture of pectin & cellulose; Manufacturing of Plat polysaccharides (Gum Arabic) and Microbial polysaccharides; Modified carbohydrates – modified starches, modified celluloses, Agarose, Sepharose.

Unit-2: Manufacturing of lipids

Industrially Significant Lipids: Vegetable Oils: The process of extraction for groundnut oil, palm oil, olive oil, coconut oil, soy oil and animal fats; Refining processes for oils and fats; Extraction processes and applications; Essential Oils; Extraction and industrial applications of essential oils (Eucalyptus, Wintergreen, Thyme, Clove, Cinnamon); Oleochemicals: Production and application of fatty acids, glycerol, sterols, squalene, lecithin, microbial lipids, surfactants and bio surfactants; the production of Biodiesel (Biofuel) from Jatropha;

Unit-3 Bioremediation and treatment of pollutants

Introduction and types of bioremediations, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, Phytoremediation; Biochemical effects of heavy metals (Pb, As, Hg, Cd), pesticides, insecticides, herbicides, weedicides, larvicides. Sources and effects of water pollutants on human health, quality standards for drinking water, waste water treatment and recycling; Concept and significance of BOD,COD and dissolved oxygen.



Unit-4 Drug development

Development of new drugs and understand their modes of action, including pharmacokinetics and pharmacodynamics, factors affecting efficacy, resistance, and biotransformation. Definition and preparation procedures for nano-bioparticles. Applications in protein engineering, drug design, and medication delivery.

Unit-5 Plant and animal tissue culture

Plant tissue culture: Principles, Procedures, and Applications; Micropropagation and Protoplast Fusion; Suspension Cultures for Secondary Metabolite Production; Transgenic and gene transfer for improved crop yields. Animal tissue culture: The principles, techniques, methodology, and application of animal tissue culture; transfection for the creation of transgenic animals utilizing eggs, cultured stem cells, and nuclei; Research frontiers related to contraception, cryopreservation of sex gametes and embryos; Ethical issues in embryo research

Suggested Readings:

1. Patel, A.H. Industrial Microbiology, 1st Edition, Macmillan India Ltd., New Delhi. ISBN: 9780333905326
2. Hilditch, J.P. The Industrial Chemistry of the Fats and Waxes, 1st Edition, Chapman and Hall, London.
3. Guenther, Ernst. Essential Oils, Volume I, D. Van Nostrand Company Inc., USA.
4. Ratner, M. & Ratner, D. Nanotechnology: A Gentle Introduction to the Next Big Idea, 1st Edition, Pearson Education, 2003. ISBN: 9788131705198
5. Kirk-Othmer. Encyclopedia of Chemical Technology, 3rd Edition, John Wiley & Sons, New York. ISBN (Vol 1): 9780471899600 (multi-volume set)
6. Shrivastava, A.K. (Ed.) Animal Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2005. ISBN: 9788120416818
7. Chawla, H.S. Introduction to Plant Biotechnology, 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2002. ISBN: 9781578082285
8. De, A.K. Environmental Chemistry, 4th Edition, New Age International Publishers, 2000. ISBN: 9788122419466

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain various manufacturing methods of industrially significant biomolecules
2. Determine the various biochemical methods to treat waste water and environment pollutants
3. Discuss diverse plant and animal tissue culture techniques

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II Year: IV Semester (Theory)

Molecular Diagnostics

Code: MSB403

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To study the various less time consuming and more accurate modern diagnostics methods
2. To explain and discuss diverse immunological techniques for various diseases.
3. To study and understand about molecular markers

Unit-1 Introduction

Introduction and History of diagnostics of diseases, mode of infection, types of infectious diseases, philosophy and general approach to clinical specimens. General diagnostic methods: Diagnosis of infectious diseases caused by bacteria, fungi, viruses, protozoa and Helminthes

Unit-2 Monoclonal antibodies and immunological techniques

Monoclonal antibodies for tumor diagnostics, myeloid leukemia, thyroid carcinoma, and western blotting; Enzymes in clinical analysis and marker enzymes. Immunological techniques Types [RIA, ELISA, Chemiluminescent IA, FIA] and specific applications; Immunohistochemistry – principle and techniques. Different Levels of Biosafety, Containment

Unit-3 Diagnosis techniques for viruses

Molecular diagnostic of various viral diseases- HIV type -1, HIV type –II, HPV, Various hepatitis strains, Influenza (H1N1), sample preparation, various steps required for viral infection analysis and Viral load monitoring

Unit-4 Molecular Markers

DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR); amplification of mRNA. Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemochromatosis, thalassemia, sickle cell diseases)

Unit-5 Genetic basis of diagnosis

Connecting genes with diseases. Detection of genetic defects- tracking disease genes using linked markers, direct tests for disease genes, expression screening, oligonucleotide

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Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

screening, cloning of chromosome breakpoints, identification of candidate genes. Cloning disease genes. Karyotyping.

Suggested readings:

1. Textbook of Medical Laboratory Technology, II Godkar P.B. and Godkar D.P. Edition, Bhalani Publishing House
2. Lab Manual on Blood Analysis and Medical Diagnostics, Prakash, G. (2012), S. Chand and Co. Ltd.
3. Carl, A., Burtis, C.A., Bruns, D.E. (2014) Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, Saunders Philadelphia, USA.
4. Molecular Basis of inherited diseases.;Davies and Read, IRL Press.
- 5.Molecular diagnostics; Rapley and Walker. Blackwell Scientific. 1997.
- 6.Molecular Biotechnology; Glick and Pasternak. PanimaPub. 2002.
- 7.Molecular Diagnosis of genetic diseases. Elles and Roger Mountford, Humana Press. 2004.

Course Learning Outcomes (CLOs):

On completion of this course, the students will be able to:

1. Understand about various molecular diagnostic methods
2. Have the knowledge in diverse immunological techniques.
3. Discuss about molecular markers and unveil genetics basis of diseases.

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II Year: IV Semester (Theory)

Genetic Engineering

Code: MSB421SE

L	T	P	C
4	0	0	4

Course Objectives:

1. To understand the fundamental principles and tools of genetic engineering, including the roles of restriction enzymes and cloning vectors.
2. To apply knowledge of molecular cloning techniques for gene insertion, transformation, and screening of recombinant organisms.
3. To gain theoretical and practical insights into DNA sequencing, gene mapping, and molecular marker techniques.
4. To explore genetic manipulation strategies in animals, including transgenics, gene knockouts, and genome editing technologies such as CRISPR-Cas9.
5. To evaluate the applications and ethical concerns of genetic engineering in medicine, agriculture, and industry.

Unit-1 Introduction to genetic engineering:

Introduction to genetic engineering: Enzymes: restriction endonucleases, DNA polymerases, DNA and RNA nucleases, kinases, phosphatases, ligases - types, properties and applications. 2hrs b. Vectors: Plasmids-construction of plasmid vectors; structures, properties and functions of - Shuttle, expression; Viral vectors: vectors for E. coli - lambda vectors-insertion, replacement; cosmids-pJB8; M13; Vectors for animal cells; simian virus, SV40, CMV.

Unit-2 Molecular cloning strategies:

Molecular cloning strategies: Vector preparation; Insert preparation- restriction digest, PCR with adaptor primer. Ligation – cohesive end, blunt end, homopolymer tailing and linker. Transformation: biological – Phage; non-biological – heat shock, bombardment, electroporation, microinjection. Screening techniques for identification of transformed host cells: genetic, immunological, recombination, fluorescent tagging.

Unit-3 DNA sequencing and genome mapping

DNA Sequencing & Genome Mapping Concept of Gene Library, C-DNA library, Methods for DNA sequencing, Genetic maps Linkage maps, Cytogenetics map & Physical map. Concept & Application of Genetic Markers-Naked eye polymorphism (NEP), Protein based markers, DNA markers, Application of molecular markers. Linkage mapping of DNA

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markers- Restriction Fragment Length polymorphism (RFLP), Random Amplified Polymorphic DNAs (RAPDs), Amplified Fragment Length Polymorphism (AFLP), Sequence Tagged Sites (STSs), Linkage Mapping of RFLP markers, Map Based Cloning. VNTRS (Variable Numbers of Tandem Repeats), minisatellite & microsatellite, Simple Sequence Repeats & ribosomal DNA.

Unit- 4 Genetic Manipulation of Animals:

Genetic Manipulation of Animals: Principles of production of transgenic animals: retrovirus, DNA microinjection and, stem cell methods. Knockout animals: integration of construct into chromosome - negative and positive selection, Cre-loxP system, antisense RNA and RNAi. 6hrs c. CRISPR-Cas 9 gene editing system

Unit-5 Protein replacement and therapies

Protein replacement: insulin, human growth hormone, factor VIII; Therapies: tissue plasminogen activator, interferon; Gene therapy, applications in agriculture medicine, industry. GM foods, terminator gene, negative impact of genetic engineering.

Suggested readings:

1. Brown, T.A. Gene Cloning and DNA Analysis: An Introduction, 6th Edition, Wiley-Blackwell, 2010. ISBN: 9781444123432
2. Glick, B.R. and Pasternak, J.J. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, ASM Press / Panima Publishing, 2010. ISBN: 9781555814984
3. Watson, J.D., Myers, R.M., Caudy, A.A., and Witkowski, J.A. Recombinant DNA: Genes and Genomes – A Short Course, 3rd Edition, W.H. Freeman & Co., 2006. ISBN: 9780716749838
4. Old, R.W. and Primrose, S.B. Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Publishing, 2006. ISBN: 9781405135443
5. Channarayappa Molecular Biotechnology: Principles and Practices, 1st Edition, Universities Press, Hyderabad, 2006. ISBN: 9788173715804
6. Dubey, R.C. A Textbook of Biotechnology, Revised Edition, S. Chand & Company Ltd., New Delhi, 2014. ISBN: 9788121926095
7. Sathyanarayana, U. and Chakrapani, U. Biotechnology, 1st Edition, Books & Allied Pvt. Ltd., Kolkata, 2017. ISBN: 9788187134990



Course Learning Outcomes (CLO)

At the end of the course student will be able to

1. Describe the properties and functions of enzymes and vectors used in genetic engineering.
2. Demonstrate knowledge of cloning strategies, including insert/vector preparation, transformation methods, and screening techniques.
3. Interpret DNA sequencing methods, genome mapping approaches, and the use of molecular markers in gene tracking and mapping.
4. Analyze various genetic manipulation techniques in animal models, including gene editing tools like CRISPR.
5. Evaluate the impact and applications of genetic engineering in therapeutic development, agriculture, and ethical/regulatory contexts.



Mahayogi Gorakhnath University Gorakhpur

Faculty of Health and Life Sciences

Department of Biochemistry, Session- 2025-26

Second Year (Semester-IV)
Discipline Specific Elective-3 (DSE-3)
Pharmacogenomics
Subject Code: MSB4101

L	T	P	C
3	0	0	3

Course objective:

1. To provide knowledge about pharmacogenomics.
2. To teach human genetics.
3. drug design using genomic applications for drug action and toxicity.
4. To understand how individualization of drug therapy can be achieved based on a person's genetic makeup while reducing unwanted drug effects.

Unit I: Human Genome:

Human and microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions, Protein coding genes, DNA variation, biological complexity. Single nucleotide polymorphisms (SNP's) in Pharmacogenomics - approaches, number and types of SNPs, Study design for analysis, Analytical issues, Development of markers.

Unit II: Pharmacogenomics and Personalized Medicine:

Pharmacogenetics-Roots of pharmacogenomics and it is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, Drivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy, Barriers.

Unit III: Association Studies in Pharmacogenomics:

Viability and Adverse drug reaction in drug response, Multiple inherited genetic factors influence the outcome of drug treatments, Association studies in pharmacogenomics, Strategies for pharmacogenomics Association studies, Benefits of Pharmacogenomics in Drug R & D.

Unit IV: Genomics Applications for Drug Action:

Platform technologies and pharmaceutical process, its applications to the pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization,

Unit V: Pharmacogenomics:

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Faculty of Health and Life Sciences

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Study of pharmacogenomics of human P-Glycoprotein, drug transporters, lipid lowering drugs, chemotherapeutic agents for cancer treatment.

References/ Text Book:

1. Zdanowicz, M.M. Concepts in Pharmacogenomics, 2nd Edition, American Society of Health-System Pharmacists, 2017. ISBN: 9781585285180.
2. Licinio, J. and Wong, M.-L. Pharmacogenomics: The Search for the Individualized Therapies, Wiley-Blackwell, 2009. ISBN: 9783527317462.
3. Yan, Q. Pharmacogenomics in Drug Discovery and Development, 2nd Edition, Humana Press, 2014. ISBN: 9781627039253.
4. Brazeau, D.A. and Brazeau, G.A. Principles of the Human Genome and Pharmacogenomics, American Pharmacists Association, 2011. ISBN: 9781582121382.
5. Werner, K., Meyer, U.A. and Tyndale, R.F. Pharmacogenomics, 2nd Edition, Taylor and Francis, 2005. ISBN: 9780824753339.
6. Langman, L.J. and Dasgupta, A. Pharmacogenomics in Clinical Therapeutics, Wiley-Blackwell, 2012. ISBN: 9780470922764.

Course Learning Outcomes (CLOs): On completion of this course, the students will be:

1. Understanding and remembering the effect of genetic differences between individuals in the outcome of drug therapy.
2. Remembering and understanding the role of single nucleotide polymorphism as a biomarker for the prediction of risk, therapeutic response and prognosis of malignancies.
3. Remembering and understanding the applications of genome in drug delivery.
4. Remembering, Understanding and analysing the new genomics-based tools.

Date: _____
Volume No.: _____



II Year: IV Semester (Theory)
Discipline Specific Elective-3 (DSE-3)

Cancer Biology

Code: MSB4102

L	T	P	C
3	0	0	3

Course Objectives:

1. To acquire basic knowledge about cancer formation and progression
2. To gain glimpses of current progress in basic concepts of cell cycle related cancer research.
3. To gain insights about stems cells and their role in cancer.

Unit-1 Introduction to cancer

Definition and classification of cancer, Hallmarks of cancer: Basic hallmarks and emerging hallmarks with enabling characteristics. Global impact and prevalence of cancer: causative factors such as environmental, environment, reproductive life, diet, alcohol and smoking. Carcinogenic agents-radiation, chemicals, biological agents, and endogenous reactions.

Unit-2 Cell cycle and regulation

Overview of cell cycle, check - points in cell cycle regulation. S-phase, mitotic phase and cytokinesis, control of cell division and cell growth. Programmed cell death or Apoptosis; mechanism, regulation, pro-apoptotic factors, Pro-apoptotic regulators. Benign and malignant tumors.

Unit-3 Cancer transformation and types of cancers

Cancer transformation, Metastatic tumor cells - Alteration in cell - cell interaction -blood vessel formation - Tumor micro environment influence cancer development - Isolation of DNA from tumor cells - Transformation of normal cultured cells. Types of cancer cells and their morphological architecture.

Unit-4 Molecular oncology

Carcinogenesis: Aberrant metabolism in cancer, paraneoplastic syndrome. Tumor markers, stages in chemical carcinogenesis; Initiation, promotion and progression. Oncogenes, proto - oncogenes and viral oncogenes - mechanism of oncogene activation. Growth factors – EGF,



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TNF α and TNF β and growth factor receptors. Tumor suppressor genes: Loss of heterozygosity, Over expression of glycoproteins, P53 & Bcl2 role in carcinogenesis, Retinoblastoma.

Unit-5 Stem cells

Stem cells: Types and self-renewal mechanisms; cancer stem cell models: hierarchical and stochastic models; cancer stem cell pathways: Wnt and Hedgehog pathways.

Suggested readings:

1. Pecorino, L. *Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics*, 5th Edition, Oxford University Press, 2021. ISBN: 9780198833024
2. Bower, M. and Waxman, J. *Lecture Notes: Oncology*, 2nd Edition, Wiley-Blackwell, 2011. ISBN: 9781118293003
3. Weinberg, R.A. *The Biology of Cancer*, 3rd Edition, W.W. Norton & Co., 2023. ISBN: 9780393887662
4. Gabriel, J. (Ed.) *The Biology of Cancer*, 2nd Edition, Wiley, 2007. ISBN: 9780470057599
5. Muralidhar, K.R. and Ahalya, P. *Cell and Molecular Biology and Cancer Biology*, 1st Edition, Universities Press, 2010. ISBN: 9788173717174
6. Satyanarayana, U. *Essentials of Biochemistry including Cancer Biology*, 1st Edition, Elsevier India, 2014. ISBN: 9788131236013
7. Rangnekar, S. *Introduction to Cancer Biology*, 1st Edition, Dominant Publishers & Distributors, 2011. ISBN: 9789380607195

Course Learning Outcomes:

At the end of the course, the student should be able to:

1. Acquire basic knowledge about cancer formation and progression
2. Gain glimpses of current progress in basic concepts of cell cycle related cancer research.
3. Gain insights about stems cells and their role in cancer.

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II Year: IV Semester (Practical)

Industrial Biochemistry Lab

Code: MSB451

L	T	P	C
0	0	2	1

Course objective:

1. To impart practical knowledge on standard biochemical parameters used in food, pharmaceutical, and industrial product testing.
2. To train students in the analysis of oils, fats, drugs, preservatives, and bioactive compounds relevant to industrial processes.
3. To develop analytical and quantitative skills through hands-on experiments in biochemical quality assessment.
4. To familiarize students with safety standards, regulatory norms, and protocols used in industrial biochemistry labs.
5. To bridge theoretical understanding with real-world industrial applications using standard chemical and biochemical assays.

Experiments:

1. Qualitative analysis of lipids
2. Determination of saponification value of fats
3. Determination of iodine number of oils
4. Determination of peroxide value of fats and oils
5. Acid value determination of oils
6. Estimation of reducing sugars by DNS method
7. Analysis of artificial sweetener stability under heat/pH conditions
8. Stability and solubility analysis of a model drug (e.g., paracetamol or aspirin)
9. Preservative stability analysis (e.g., benzoate or sorbate under storage conditions)
10. Antibiotic sensitivity test using disc diffusion (Ampicillin)
11. Alcohol content estimation using potassium dichromate method
12. Protein estimation in industrial samples by Biuret/Lowry method

Course Learning Outcomes (CLOs):

By the end of this lab course, students will be able to:

1. Analyze the chemical properties and quality parameters of fats, oils, and industrial sweeteners using classical and modern methods.



2. Perform and interpret stability studies on drugs, preservatives, and additives under various environmental conditions.
3. Evaluate the antibiotic sensitivity of microbial samples using standard assays (e.g., Kirby-Bauer method).
4. Apply biochemical methods such as protein, sugar, or alcohol quantification in the context of food, fermentation, and pharmaceutical industries.
5. Demonstrate awareness of standard operating procedures (SOPs), safety protocols, and regulatory standards used in industrial laboratories.



II Year: IV Semester (Practical)

Molecular Diagnostic and Genetic Engineering Lab

Code: MSB452

L	T	P	C
0	0	2	1

Course Objectives (COs)

1. To provide students with practical training in key molecular biology techniques such as PCR, electrophoresis, and nucleic acid analysis.
2. To develop skills in molecular diagnostics including pathogen detection and gene variation analysis using PCR, RFLP, and Western blotting.
3. To train students in gene cloning, transformation of microbial systems, and plasmid DNA handling.
4. To encourage analytical thinking through the design, execution, and interpretation of genetic engineering experiments.

Experiments

1. Transformation of *E. coli* with plasmid DNA; calculation of transformation efficiency
2. Cloning of Genomic DNA into plasmid vectors – preparation and ligation setup
3. Blue-White Screening or Colony PCR (optional/demonstration only)
4. Mini-prep of recombinant plasmid DNA and insert confirmation by restriction digestion
5. Transformation of *Saccharomyces cerevisiae* (yeast) – preparation and plating
6. Polymerase Chain Reaction (PCR) using standard 16S rRNA or housekeeping primers
7. RFLP Analysis of PCR-amplified products using restriction digestion
8. Real-Time PCR (qPCR) – result interpretation or software-based demo
9. Western Blotting – protein transfer and immunodetection

Course Learning Outcomes (CLOs)

By the end of the course, students will be able to:

1. Perform and interpret Polymerase Chain Reaction (PCR) and Real-Time PCR (qPCR) for the amplification and detection of nucleic acids in diagnostic settings.
2. Conduct restriction digestion and RFLP analysis to identify genetic variations or confirm molecular clones.
3. Execute microbial transformation procedures in both prokaryotic (*E. coli*) and eukaryotic (*S. cerevisiae*) models and calculate transformation efficiency.

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4. Isolate and confirm recombinant plasmids using mini-preparation and restriction enzyme mapping.
5. Apply techniques such as Western blotting for diagnostic evaluation and protein detection.



II Year: IV Semester

Dissertation

Code: MSB4101PJ

L	T	P	C
0	0	40	20

Course objective:

1. To understand the process of recognizing a biological question,
2. To learn how to create and validating a hypothesis by executing experiments in the laboratory.
3. To understand the compiling, analysis and interpretation the data.
4. To learn how to write the project and give seminar.

Project Work: Each student shall have to do a project work during his/her tenure in 4th Semester in the field of Biochemistry and related areas in reputed Organizations/ Companies/ Laboratories etc. The candidate shall submit the project work towards partial fulfilment of M.Sc. degree in Biochemistry under the supervision of a faculty member.

Seminar: Each student shall give seminar on project work/dissertation before the external examiners at the time of general Viva voce examination.

Course Learning Outcomes (CLOs): On completion of this course, the students will be:

1. Understand the basic knowledge of research ethics and biosafety Level.
2. Create research plans/ideas with the help of relevant literature and execute and achieved it in limited time frame.
3. Analyzing the research data and find significance by correlating it with the present problems/challenges.
4. Apply the knowledge and capability required for independent work as a Master of Science in Biochemistry.
5. Survey the changes and updating of selected topic to know the current research of particular area.
6. Analyze and compile the data of selected topic and interpret the impact on the society and environment.
7. Compile the report of the study and present to the audience with following the ethics.
8. Develop an understanding to review, and compile the data and also developed the presentation skills.

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