Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Biochemistry

Programme Structure
Batch: 2025-27
AY: 2025-26

MSc. in Biochemistry
Programme Code: SBR0109

1.1 Vision, Mission and Core Values of the University

Vision of the University

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

Mission of the University

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

Core Values

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

1.2 Vision and Mission of the School

Vision of the School

Achieving academic excellence in the realm of basic and engineering sciences to address the global challenges and to become global leaders.

Mission of the School

- To impart basic, advanced and transformative knowledge and skills in science and technology.
- To strengthen capacity and capabilities in cutting-edge technology and research.
- To nurture multidisciplinary research and entrepreneurship temperament for developing innovative solutions to global, societal and environmental challenges.
- To foster multi-dimensional partnerships and collaborations for skill development and global employability.

1.3 Vision and Mission of Department of Chemistry & Biochemistry

Vision of Chemistry & Biochemistry

Strive to achieve excellence in teaching and research in the field of Chemistry and Biochemistry and to build human resource for solving contemporary problems.

Mission of Chemistry & Biochemistry

- **Providing distinctive and relevant education in Chemistry and Biochemistry to students.**
- **Motivating young minds through innovative teaching methods, to acquire theoretical knowledge and practical skills in different disciplines of chemistry and empowering them with problem solving skills.**
- **Nurturing innovation by carrying out world class research and scholarly work**
- **Promoting interdisciplinary research in collaboration with national/international laboratories/Institutions.**

1.3 Programme Educational Objectives (PEO)

PEO1: To provide in-depth knowledge in the core areas of life sciences for industries, clinical research, pharmaceutical labs, and academia.

PEO2: To gain proficiency in laboratory techniques of various aspects of biochemistry and be able to apply processes of experimentation and hypothesis testing to biochemical methods.

PEO3: To demonstrate analytical and problem-solving skills to combat human diseases and resolve problems in the field of agriculture.

PEO4: To learn to work independently and as a team for retrieving information from various e-resources, carry out research investigations, and interpret.

PEO5: To equip a skillful attitude promoting lifelong learning to meet the ever-evolving professional demands by developing ethical, interpersonal, and team skills.

1.3.2 Map PEOs with Mission Statements:

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

Correlation levels 1, 2, or 3 as defined below:

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

1.3.3 Program Outcomes (PO's)

PO1: Apply the knowledge of theoretical and experimental approaches in Biochemistry in research-oriented endeavours to unravel problems in health care with a scientific basis of life processes and provide solutions to new problems **(Disciplinary Knowledge).**

PO2: Provide students with a comprehensive grasp of fundamental biochemistry ideas and to impart knowledge of current advancements, enabling them to independently evaluate the many opportunities within the area **(General, technical, and professional skills).**

PO3: Educate students in the application of biochemical concepts, both theoretically and empirically, to comprehend intricate biological processes while offering biotechnology solutions to address diverse medical conditions **(Application of knowledge and skills)**

PO4: Apply the knowledge of experimental approaches on designing experiments, analyzing, interpreting data, and synthesizing information to provide valid conclusions **(Generic learning outcomes).**

PO5: Communicate the knowledge of Biochemistry to address environmental, intellectual, societal, and ethical issues through case studies with effective communication **(Ethics).**

PO6: Motivate students for higher education, especially research, and provide trained manpower for the biochemistry industry **(Employability and job-ready skills).**

1.3.4 Programme-Specific Outcomes (PSOs)

PSO1: Apply modern research techniques to investigate complex biochemical phenomena and solve real-world problems in the health and agriculture sectors.

PSO2: Acquire skills to prepare for doctoral studies, competitive exams, and demonstrate competence in quality assurance and laboratory techniques essential for industry.

1.3.4 Mapping of Programme Outcome Vs Programme Educational Objectives

PO & PSO statements	PEO1	PEO2	PEO3	PEO4
PO1	3	3	3	2
PO2	2	3	3	1
PO3	2	3	3	3
PO4	1	1	3	3
PO5	2	2	2	3
PO6	1	1	1	3
PSO1	1	2	2	3
PSO2	2	2	2	1

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High)**

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

1-YEAR PG PROGRAMME (AFTER 4-YEAR UG PROGRAMME) **Through Coursework (CW) + Research Work (RW) (Course level:500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** I **Batch:** 2025-26

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5201	Forensic Biochemistry	4	0	0	4	Core
2	CHT5202	Recombinant DNA Technology	4	0	0	4	Core
3	CHT5203	Fundamentals of Biostatistics*	2	0	0	2	DSE
4	CHT5108	RM & IPR	1	0	0	1	SEC
PRACTICAL COURSES							
5	CHP5201	Forensic Biochemistry Lab	0	0	2	1	Core
6	CHP5202	Recombinant DNA Technology Lab	0	0	2	1	Core
7	CHP5203	Fundamentals of Biostatistics Lab*	0	0	2	1	DSE
8	CHR5101	Dissertation I-(RBL-1)	0	0	12	6	Research Projects
TOTAL CREDITS						**20**	

**** Courses shall be Research based / Lab based training / Hands on training evaluation will be made as per Rubrics made by the Department/School an duly approved by DAA/Committee constituted for the purpose.***

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

1-YEAR PG PROGRAMME (AFTER 4-YEAR UG PROGRAMME) **Through Coursework (CW) (Course level: 500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** I **Batch**: 2025-26

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5201	Forensic Biochemistry	4	0	0	4	Core
2	CHT5202	Recombinant DNA Technology	4	0	0	4	Core
3	CHT5203	Fundamentals of Biostatistics Lab	2	0	0	2	DSE
4	CHT5205	Bioethics & Biosafety	2	0	0	2	DSE
5	CHT5206	Clinical Biochemistry/MOOC	2	0	0	2	SEC
6	CHT5108	RM & IPR	1	0	0	1	SEC
PRACTICAL COURSES							
7	CHP5201	Forensic Biochemistry Lab	0	0	2	1	Core
8	CHP5202	Recombinant DNA Technology Lab	0	0	2	1	Core
9	CHP5203	Fundamentals of Biostatistics Lab	0	0	2	1	DSE
10	CHR5101	Dissertation I-(RBL-1)	0	0	4	2	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

1-YEAR PG PROGRAMME (AFTER 4-YEAR UG PROGRAMME) **Research Work (RW)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** I **Batch**: 2025-26

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5203	Fundamentals of Biostatistics*	2	0	0	2	DSE
2	CHT5108	RM & IPR	1	0	0	1	SEC
PRACTICAL COURSES							
3	CHP5203	Fundamentals of Biostatistics Lab*	0	0	2	1	DSE
4	CHR5103	Dissertation I-(RBL-1)	0	0	32	16	Research Projects
TOTAL CREDITS						**20**	

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SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

1-YEAR PG PROGRAMME (AFTER 4-YEAR UG PROGRAMME) **Through Coursework (CW) + Research Work (RW) (Course level: 500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** II **Batch**: 2025-26

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5204	Genomics and Proteomics	4	0	0	4	Core
PRACTICAL COURSES							
2	CHP5204	Genomics & Proteomics Lab	0	0	4	2	Core
3	CHR5104	Dissertation II-(RBL-2)	0	0	28	14	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

1-YEAR PG PROGRAMME (AFTER 4-YEAR UG PROGRAMME) **Through Coursework (CW) (Course level: 500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** II **Batch**: 2025-26

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5204	Genomics and Proteomics	4	0	0	4	Core
2	CHT5205	Advance Cell Biology	4	0	0	4	Core
3	CHT5207	Pharmaceutical Biochemistry	4	0	0	4	DSE
PRACTICAL COURSES							
4	CHP5204	Genomics & Proteomics Lab	0	0	4	2	Core
5	CHP5206	Advance Cell Biology Lab	0	0	2	1	Core
6	CHP5205	Pharmaceutical Biochemistry Lab	0	0	4	2	DSE
7	CHR5105	Dissertation I-(RBL-2)	0	0	6	3	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

1-YEAR PG PROGRAMME (AFTER 4-YEAR UG PROGRAMME) **Research Work (RW)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** II **Batch**: 2025-26

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHP5204	Pharmaceutical Biochemistry	4	0	0	4	DSE
PRACTICAL COURSES							
2	CHR5106	Dissertation I-(RBL-2)	0	0	32	16	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **PG Diploma after exit from 1st Year**

(Entry & Exit Option) (Course level: 400)

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** I **Batch**: 2025-2027

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT4201	Essentials of Biochemistry	4	0	0	4	Core
2	CHT4202	Bioanalytical Techniques	4	0	0	4	Core
3	CHT4203	Bioenergetics and Metabolism	4	0	0	4	Core
4	CHT4204	Advanced Enzymology	4	0	0	4	Core
PRACTICAL COURSES							
5	CHP4201	Essentials of Biochemistry Lab	0	0	2	1	Core
6	CHP4202	Bioanalytical Techniques Lab	0	0	2	1	Core
7	CHP4203	Bioenergetics and Metabolism Lab	0	0	2	1	Core
8	CHP4204	Advanced Enzymology Lab	0	0	2	1	Core
9	CCXXX	Community Connect (Audit)	0	0	2	0	SEC
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **PG Diploma after exit from 1st Year**

(Entry & Exit Option) (Course level: 400)

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** I **Batch:** 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT4201	Essentials of Biochemistry	4	0	0	4	Core
2	CHT4210	Advance Molecular Biology	3	1	0	4	Core
3	CHT4203	Bioenergetics and Metabolism	4	0	0	4	Core
4	CHT4204	Advanced Enzymology	4	0	0	4	Core
5	CHT4202	Bioanalytical Techniques	4	0	0	4	SEC
PRACTICAL COURSES							
6	CHP4201	Essentials of Biochemistry Lab	0	0	2	1	Core
7	CHP4202	Bioanalytical Techniques Lab	0	0	2	1	Core
8	CHP4203	Bioenergetics and Metabolism Lab	0	0	2	1	Core
9	CHP4204	Advanced Enzymology Lab	0	0	2	1	Core
10	CCXXX	Community Connect (Audit)	0	0	2	0	SEC
TOTAL CREDITS						**24**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **PG Diploma after exit from 1st Year**

(Entry & Exit Option) (Course level: 400)

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** II **Batch:** 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT4206	Advanced Immunology	3	1	0	4	DSE
2	CHT4211	Developmental Biology	3	1	0	4	DSE
3	Open Elective	XXXX	4	0	0	4	DSE / Multi disciplinary Course
4	CHT4209	Molecular Bioinformatics	3	0	0	3	SEC
PRACTICAL COURSES							
5	CHP4205	Molecular Bioinformatics Lab	0	0	2	1	SEC
6	CHR4101	Project-1	0	0	4	4	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **PG Diploma after exit from 1st Year**

(Entry & Exit Option) (Course level: 400)

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** II **Batch**: 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT4206/XXX	Advanced Immunology/Forensic	3	1	0	4	DSE/ Multi disciplinary
2	CHT4211/ CHT4208	Developmental Biology/Human physiology	3	1	0	4	DSE
3	Open Elective	XXXXXX	4	0	0	4	Multi disciplinary
4	CHT4209	Molecular Bioinformatics	3	0	0	3	SEC
PRACTICAL COURSES							
5	CHP4205	Molecular Bioinformatics Lab	0	0	2	1	SEC
TOTAL CREDITS						**16**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **2 Year PG degree by CW + RW (Course level:500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** III **Batch:** 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5201	Forensic Biochemistry	4	0	0	4	Core
2	CHT5202	Recombinant DNA Technology	4	0	0	4	Core
3	CHT5203	Fundamentals of Biostatistics*	2	0	0	2	DSE
4	CHT5108	RM & IPR	1	0	0	1	SEC
PRACTICAL COURSES							
5	CHP5201	Forensic Biochemistry Lab	0	0	2	1	Core
6	CHP5202	Recombinant DNA Technology Lab	0	0	2	1	Core
7	CHP5203	Fundamentals of Biostatistics Lab*	0	0	2	1	DSE
8	CHR5101	Dissertation I-(RBL-1)	0	0	12	6	Research Projects
TOTAL CREDITS						**20**	

**Courses shall be Research based / Lab based Training / Hands on Training Evaluation will be made as per Rubrics made by the Department*

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **2 Year PG degree by CW (Course level: 500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** III **Batch**: 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5201	Forensic Biochemistry	4	0	0	4	Core
2	CHT5202	Recombinant DNA Technology	4	0	0	4	Core
3	CHT5203	Fundamentals of Biostatistics	2	0	0	2	DSE
4	CHT5205	Bioethics & Biosafety	2	0	0	2	DSE
5	CHT5206	Clinical Biochemistry/MOOC	2	0	0	2	SEC
6	CHT5108	RM & IPR	1	0	0	1	SEC
PRACTICAL COURSES							
7	CHP5201	Forensic Biochemistry Lab	0	0	2	1	Core
8	CHP5202	Recombinant DNA Technology Lab	0	0	2	1	Core
9	CHP5203	Fundamentals of Biostatistics Lab	0	0	2	1	DSE
10	CHR5102	Dissertation I-(RBL-1)	0	0	4	2	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **2 Year PG degree by RW***

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** III **Batch**: 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5203	Fundamentals of Biostatistics*	2	0	0	2	DSE
2	CHT5108	RM & IPR	1	0	0	1	SEC
PRACTICAL COURSES							
6	CHP5203	Fundamentals of Biostatistics Lab*	0	0	2	1	DSE
7	CHR5103	Dissertation I-(RBL-1)	0	0	32	16	Research Projects
TOTAL CREDITS						**20**	

Courses shall be Research based / Lab based Training / Hands on Training Evaluation will be made as per Rubrics made by the Department

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **2 Year PG degree by CW + RW (Course level:500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** IV **Batch**: 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5204	Genomics and Proteomics	4	0	0	4	Core
PRACTICAL COURSES							
2	CHP5204	Genomics & Proteomics Lab	0	0	4	2	Core
3	CHR5104	Dissertation II-(RBL-2)	0	0	28	14	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **2 Year PG degree by CW (Course level: 500)**

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** IV **Batch**: 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHT5204	Genomics and Proteomics	4	0	0	4	Core
2	CHT5205	Advance Cell Biology	4	0	0	4	Core
3	CHT5207	Pharmaceutical Biochemistry	4	0	0	4	DSE
PRACTICAL COURSES							
4	CHP5204	Genomics & Proteomics Lab	0	0	4	2	Core
5	CHP5206	Advance Cell Biology Lab	0	0	2	1	Core
6	CHP5205	Pharmaceutical Biochemistry Lab	0	0	4	2	DSE
7	CHR5105	Dissertation I-(RBL-2)	0	0	6	3	Research Projects
TOTAL CREDITS						**20**	

SHARDA UNIVERSITY

Sharda School of Engineering & Science (Science Division)

Department of Chemistry & Bio-Chemistry

2-YEAR PG PROGRAMME (AFTER 3-YEAR UG PROGRAMME) **2 Year PG degree by RW***

Program / Branch/Specialization: M.Sc. Biochemistry **Sem.:** IV **Batch**: 2025-27

S. No.	Course Code	Course Name	Teaching Load			Credits	Remarks (if any)
			L	T	P		
THEORY COURSES							
1	CHP5204	Pharmaceutical Biochemistry	4	0	0	4	DSE
PRACTICAL COURSES							
7	CHR5106	Dissertation I-(RBL-2)	0	0	32	16	Research Projects
TOTAL CREDITS						**20**	

**** Courses shall be Research based / Lab based Training / Hands on Training Evaluation will be made as per Rubrics made by the Department***

Course Modules

CHT4201 Essentials of Biochemistry

School: SSES		**Batch:** 2025-27		
Program: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHT4201		
2	**Course Title**	Essentials of Biochemistry		
3	**Credits**	4		
4	**Contact hours**	4-0-0		
	Course Type	Compulsory	Major	Theory
5	**Course Objectives**	1. To understand about the basic concepts of biochemistry 2. To understand the structure and properties of carbohydrates, proteins, and lipids. 3. To study the stereochemistry of biomolecules. 4. To study the biological roles and its interrelations among all 5. To give idea about the structure, functions, and role of nucleic acid. 6. To give the knowledge of structure, functions and role of vitamins and minerals.		
6	**Course Outcome**	**CO1:** Describe in-depth knowledge about the structure, chemistry, and function of carbohydrates. **CO2:** Debate structure, function and acid base properties of amino acids, peptides and concepts of the proteins structure, their related functions. **CO3:** Introduce the structure, properties, and roles of lipids in humans and plants, its importance as energy storage and biological membranes. **CO4:** Execute knowledge about the salient features of nucleic acids and how DNA carries genetic information. **CO5:** Understand the importance of molecular and ionic interactions in membrane. **CO6:** Understand the importance of all macromolecules and their impact on human beings		
7	**Course Description**	This module is an overall introduction to the basic concepts of biochemistry which goals to deliver students with an understanding of biomolecules, the basic building blocks of living organisms.		
8	**Outline Syllabus**			CO mapping
	Unit 1	**Saccharide Chemistry**		
	A	Definition, classification, Monosaccharide's -structure of aldoses and ketoses, Ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers; Structure of biologically important sugar derivatives (glucosamine, galactosamine, muramic acid, N- acetyl neuromeric acid)		CO1, CO6

	B	Disaccharides-concept of reducing and nonreducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose	CO1, CO6
	C	Polysaccharides-Storage polysaccharides, starch and glycogen, Structural Polysaccharides, cellulose, peptidoglycan and chitin, Structure and role of glycoconjugates-proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides), Carbohydrates as informational molecules.	CO1, CO6
	Unit 2	**Chemistry of Amino acids, Peptides and Protein**	
	A	**Amino acids-** Classification, structural features, physical properties and optical properties (Stereoisomerism), Chemical properties (acid base properties, titration curve) of amino acids, isoelectric point, p K values of ionizable groups, modified amino acids	CO2, CO6
	B	Organization of protein structure into primary, secondary, tertiary and quaternary structures, fibrous and globular proteins, elementary ideas on protein denaturation and renaturation, structure and function of hemoglobin and myoglobin, green fluorescent protein	CO2,CO6
	C	Determination of state of tertiary structure; characteristic balance in rigidity and flexibility; Domain concept (α-, β-, α/β- and α+β-domains) and interacting motifs. Quaternary structure: Geometry, Symmetry and intermolecular interfaces, protein sequencing and protein evolution	CO2,CO6
	Unit 3	**Lipid Chemistry**	
	A	Definition and major classes of storage and structural lipids, Storage lipids, Fatty acids structure and storage lipids, Fatty acids structure and functions, Essential fatty acids, Triacyl Glycerols structure, functions and properties, Saponification,	CO3,CO6
	B	Structural lipids, Phosphoglycerides: Building blocks, General structure, functions and properties of membrane lipids, structure of phosphatidylethanolamine and phosphatidylcholin, Sphingolipids: building blocks, structure of sphingosine, ceramide, Special mention of sphingomyelins, cerebrosides and gangliosides, membrane fluidity, sol gel state of membrane Lipids: General Reaction and Properties	CO3, CO6
	C	Carrier of lipid molecules, Lipoproteins, chylomicrons, LDL, HDL and VLDL, steroids, prostaglandins and bile acids, rancidity, saponification, Formation of micelles, monolayers, bilayer, liposomes, Lipid functions: cell signals, cofactors and pigments	CO3, CO6
	Unit 4	**Chemistry of Nucleic acids**	
	A	Nucleotides - structure and properties of bases, pentoses, nucleosides, Nucleic acid structure – Watson-Crick model of DNA, forms of DNA (A, B and Z forms), DNA denaturation and renaturation	CO4, CO6

	B	DNA as genetic material: experimental evidence, Structure of major species of RNA - mRNA, tRNA and rRNA; Nucleic acid chemistry- UV absorption, effect of acid and alkali on DNA			CO4,CO6
	C	Structure and stability of nucleic acids (DNA and RNA), topologicalstructure and fine structure of DNA and its organization in genome			CO4, CO6
	Unit 5	**Bimolecular Interactions**			
	A	Passive and active transport, mechanism of transport, thermodynamics of transport			CO5, CO6
	B	Ionophores, porins, ion channels, aquaporins and their structure and functions			CO5, CO6
	C	Sodium -potassium - ATPase, Calcium-ATPase, ABC transporters, primary and secondary active transport			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text book/s*	1. M D. Rafi (2020). Textbook of Biochemistry. India: Orient Blackswan Pvt Limited. 2. Nelson, I. f. M. G. D. L., Cox, M. M. (2008). Lehninger Principles of Biochemistry. United States: W.H. Freeman.			
	Other References	1. Voet, D., Pratt, C. W., Voet, J. G. (2013). Principles of Biochemistry. Philippines: Wiley. 2. Uzman, A., Johnson, J., Widger, W., Voet, D., Eichberg, J ., Voet, J. G., Pratt, C. W. (2012). Student Companion to Accompany Fundamentals of Biochemistry. United Kingdom: Wiley.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4201.1	3	1	1	1	1	2	3	3
CHT4201.2	3	1	2	2	2	1	3	3
CHT4201.3	3	2	2	2	2	1	3	3
CHT4201.4	3	2	1	2	1	2	3	3
CHT4201.5	3	1	1	1	1	2	3	3
CHT4201.6	3	1	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT4202 Bioanalytical Techniques

School: SSES		**Batch 2025-27**		
Programme: MSc		**Current Academic Year: 2025-26**		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHT4202		
2	**Course Title**	Bioanalytical Techniques		
3	**Credits**	4		
4	**Contact Hours**	4-0-0		
5	**Course Type**	Compulsory	Major	Theory
6	**Course Objective**	1. To develop the skills to understand the theory and practice of bio analytical techniques. 2. To provide scientific understanding of analytical techniques and detail interpretation of results. 3. To understand the theoretical principles involved in bioinstrumentation which may be used for the determination of nutrients, major ions and trace elements, biological samples together with the analytical techniques. 4. To introduce student with some of the experimental techniques used in biochemistry and molecular biology. 5. To get hands-on- experience to develop their laboratory skills expected of any biochemist working in a research lab.		
7	**Course Outcomes**	**CO1**: Students will learn about the principle and applications of microscopy and various cell biology techniques. **CO2**: Students will learn various chromatographic and electrophoretic techniques. **CO3**: Students will also be exposed to various methods of labeling DNA, proteins and whole cells and their applications in research. **CO4**: Students will be able to learn methods for purifying proteins, expressing recombinant proteins in bacterial cells, and analyzing biological molecules by electrophoresis, Western blotting, and enzyme activity assays. **CO5:** Students will acquire knowledge about the principles and applications of latest methods used to analyze nucleic acids and proteins. **CO6:** Students will be able to characterize certain functionalities of biomolecules by using spectroscopic technique.		

8	**Course Description**	This course begins with a review of basic bio analytical technique and an introduction to general terminologies which contains bio analytical techniques along with their theory, working principal, common instrumentation, and possible applications. It will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.	
9	**Outline Syllabus**		CO Mapping
	Unit 1	**Microscopy and Cell biology Techniques**	
	A	Fluorescence microscopy, Scanning electron microscopy, Transmission electron microscopy, Confocal microscopy	CO1, CO6
	B	Cell culture and transfection, Immunohistochemistry, Immunofluorescence, Flow cytometry, FACS	CO1, CO6
	C	TUNEL assay, Non-invasive scanning of soft tissue	CO1, CO6
	Unit 2	**Chromatographic and Electrophoretic Techniques**	
	A	Principles and Applications of Paper, Column, TLC, Adsorption, Ion exchanges, Gel filtration, Affinity, GLC, Chromato focusing, HPLC, FPLC.	CO2, CO6
	B	Polyacrylamide gel electrophoresis, SDS-PAGE, 2D-PAGE, Isoelectric focusing, Visualizing protein bands-CBB &Silver staining. Agarose gel Electrophoresis, pulse field electrophoresis, high voltage electrophoresis	CO2, CO6
	C	Polyacrylamide gel electrophoresis, SDS-PAGE, 2D-PAGE, Isoelectric focusing, Visualizing protein bands-CBB &Silver staining. Agarose gel Electrophoresis, pulse field electrophoresis, high voltage electrophoresis, Capillary Electrophoresis, Isotachophoresis, RFLP, FISH.	CO2, CO6
	Unit 3	**Methods for Analysis of Proteins**	
	A	Protein-Protein Interaction: Immunoprecipitation, Co-Immunoprecipitation (Co-IP), Pull down assays, Yeast two hybrid, Protein fragment complementation assay	CO3, CO6
	B	Western blotting, Far western blotting, Protein microarrays. Protein Separation: Isoelectric focusing, 2D protein gel electrophoresis, 2D-DIGE, Pulse field Electrophoresis	CO3, CO6
	C	Structural Analysis: Mass Spectrometry, MS/MS, LC/MS.	CO3, CO6
	Unit 4	**Methods for Analysis of Nucleic Acids**	
	A	Hybridization methods: Southern blotting, Northern blotting; *In situ* hybridization, Colony hybridization; Binding of nucleic acids with protein: DNA pull down assays	CO4, CO6
	B	Electrophoretic Mobility Shift Assay (EMSA), DNA foot printing, Primer Extension, Chromatin immunoprecipitation (ChIP), ChIP on ChIP.	CO4, CO6
	C	Gene expression analysis: Reporter assays - example luciferase assay, DNA Microarrays, RNA seq.	CO4, CO6
	Unit 5	**Spectroscopic and Radio Isotope Techniques**	

	A	Colorimetry, spectrophotometry – UV &visible, Principle – Beer &Lambert's law, Extinction coefficient. Principle and application - AAS, Fluorimetry.	CO5, CO6
	B	Basic principle and application of mass spectra, NMR, ESR, ESI-MS, MALDI-TOF, CD, MRI, CT scans. Biochips (DNA chips, Protein chips and Sensor chips). Vibration Spectra – IR and Raman-Principles and Applications. X-ray crystallography – protein crystals, Bragg's law.	CO5, CO6
	C	Radioactive and Non-radioactive labelling methods	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MSE: 25% / ESE: 50%	
	Text Book/s *	1. Molecular Cloning: A Laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2. 2. Biophysical Chemistry (2013), Schimmel, C.R.C., Macmillan Higher Education, ISBN : 0716738619, 9780716738619.	
	Other references	1. Current Protocols in Protein Science (2013) Coligan, J.E., Dunn, B.M., Speicher, D.W., Wingfield, P.T., Lippincott-Schwartz, J. and Yamada, K.M., John Wiley and Sons (Somerset, NJ), Print ISSN: 1934-3655 / Online ISSN: 1934-3663. 2. Current Protocols in Cell Biology (2013) Bonifacino, J.S., Dasso, M., Harford, J.B., Lippincott-Schwartz, J. and Yamada, K.M., John Wiley and Sons (Somerset, NJ), ISBN: 1934-2500.	

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4202.1	3	2	1	1	1	2	3	3
CHT4202.2	3	2	2	2	2	1	3	3
CHT4202.3	3	2	2	2	2	1	3	3
CHT4202.4	3	2	1	2	1	2	3	3
CHT4202.5	3	2	1	1	1	2	3	3
CHT4202.6	3	2	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT4203 Bioenergetics and Metabolism

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHT4203		
2	**Course Title**	Bioenergetics and Metabolism		
3	**Credits**	4		
4	**Contact Hours (**	4-0-0		
5	**Course Type**	Compulsory	Major-I	Theory
6	**Course Objective**	1. To understand the basic concepts of bioenergetics. 2. To understand the metabolism of biomolecules and their regulation in living cells. 3. To understand how the cells extract and utilize energy through numerous enzyme-catalyzed reactions. 4. The students will learn both the interrelated aspects.		
7	**Course Outcomes**	**CO1**: The student will be able to learn the fundamental energetics of biochemical processes, chemical logic of metabolic pathways. Knowing in detail about concepts to illustrate how enzymes and redoxcarriers and the oxidative phosphorylation machinery occur. **CO2**: The student will be able to learn Carbohydrate metabolism, and its association with cellular energy production, and carbohydrate anabolism in plants and animal cells. **CO3**: The student will be able to learn protein metabolism, and its association with cellular energy production in plants and animal cells **CO4**: The student will be able to learn Lipid biosynthesis, Degradation of fatty acids and cholesterol, ketone bodies, acidosis, ketosis **CO5**: The student will learn and understand about the Biosynthesis of Purines and pyrimidine nucleotides, degradation of nucleotides, Salvage pathways, biosynthesis, and biodegradation of amino acids. **CO6**: Understand the importance of all macromolecules and their impact on human beings.		
8	**Course Description**	The objectives of the course are to learn and understand the fundamentals of cellular metabolism of carbohydrates, lipids, amino acids, and nucleic acids and their association with various metabolic diseases.		
9	**Outline Syllabus**			CO Mapping
	Unit 1	**Bioenergetics**		

	A	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.	CO1, CO6
	B	Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials & free energy change (derivations and numericals included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG. Energy charge.	CO1, CO6
	C	Role and mechanism of action of NAD+ /NADP+, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B12 coenzymes and metal ions with specific examples.	CO1, CO6
	Unit 2	**Carbohydrates**	
	A	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.	CO2, CO6
	B	Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, anaplerotic reactions,	CO2, CO6
	C	Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle.	CO2, CO6
	Unit 3	**Amino Acids**	
	A	General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids.	CO3, CO6
	B	Special metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines.	CO3, CO6
	C	Urea cycle and its regulation.	CO3, CO6
	Unit 4	**Lipids**	
	A	Introduction, hydrolysis of tri-acylglycerols, α-, β-, ω- oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids.	CO4, CO6
	B	Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, ACP structure and function, Lipid biosynthesis, biosynthetic pathway for tri-acylglycerols, phosphoglycerides	CO4, CO6
	C	Biosynthetic pathway for sphingomyelin and prostaglandins. Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle.	CO4, CO6
	Unit 5	**Nucleotides**	
	A	Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway.	CO5, CO6

	B	Role of ribonucleotide reductase. Biosynthesis of deoxyribonucleotides and polynucleotides including inhibitors of nucleic acid biosynthesis.	CO5, CO6
	C	Porphyrins- Biosynthesis and degradation of porphyrins.Production of bile pigments.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25%	MSE: 25% / ESE: 50%
	Text Book/s *	1. Skulachev, V. P., Bogachev, A. V., Kasparinsky, F. O. (2013). Principl es of Bioenergetics. Germany: Springer Berlin Heidelberg. 2. Juretic, D. (2021). Bioenergetics: A Bridge Across Life and Universe. United States: CRC Press.	
	Other References	3. Burgot, J. (2019). Thermodynamics in Bioenergetics. United Kingdom: CRC Press.	

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4203.1	3	2	1	1	1	2	3	3
CHT4203.2	3	2	2	2	2	1	3	3
CHT4203.3	3	2	2	2	2	1	3	3
CHT4203.4	3	2	1	2	1	2	3	3
CHT4203.5	3	2	1	1	1	2	3	3
CHT4203.6	3	2	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT4204 Advanced Enzymology

School: SSES		**Batch 2025-27**		
Programme: M.Sc.		**Current Academic Year: 2025-26**		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHT4204		
2	**Course Title**	Advanced Enzymology		
3	**Credits**	**4**		
4	**Contact hours**	**4-0-0**		
	Course Status	Compulsory	Core	Theory
5	**Course Objectives**	1. To introduce the concept and importance of enzyme in the human body and living cell 2. To have a deep understanding of the classification and identification of enzyme 3. To familiarize with the factors effecting the enzyme velocity, like the temperature, pH and substrate 4. To introduce the concept of enzyme kinetics and the equation given by Michaelis and Menton 5. To introduce the various enzyme isolation and purification techniques from various sources		
36	**Course Outcome**	**CO1**: Understand the mechanism of action of enzyme. **CO2**: Understand the various enzyme kinetics and will be able to correlate theVmax, Km in the Michaelis-Menten equation. **CO3**: Correlate the isolation technique of plant cell from that of animal andmicrobial cells. **CO4**: Explain the regulation strategies of allosteric enzyme and the mechanism of various inhibition process. **CO5**: Elaborate the various application of enzyme in differentfields. **CO6**: Apply the overall concepts of enzymology in different field of biochemistry.		
7	**Course Description**	This course describes various theoretical practical concept of enzyme and theirapplication in various fields of industry.		
8	**Outline Syllabus**			**CO mapping**
	Unit 1	**Introduction to Enzymes**		
	A	Enzyme: History and perspectives, enzyme classification; nomenclature and EC number of enzymes, Co-enzyme, andCo-factors		CO1, CO6
	B	NAD/NADH, FAD/FADH2, pyridoxal phosphate, thymine pyrophosphate		CO1, CO6
	C	Isoenzymes-Lactate dehydrogenase and alkaline phosphatase, Allosteric enzymes: positive and		CO1, CO6

		negative regulation, different metallo enzymes with examples			
	Unit 2	**Enzyme Kinetics**			
	A	Enzyme substrate complex and mechanism of enzyme action: Lock and key hypothesis, induced fit theory andacid catalysis and base catalysis			CO2, CO6
	B	Factors affecting ratesof enzymatic reactions (pH, temperature, substrate concentration			CO2, CO6
	C	Overview of Michaelis- Menten equation its derivation, Line Weaver Burk equation and their derivations			CO2, CO6
	Unit 3	**Enzyme Inhibitions**			
	A	Enzyme inhibition and types: Irreversible inhibition with examples, reversible inhibition with examples			CO3, CO6
	B	Competitive, non-competitive, and un-competitive inhibition, Methanol poisoning			CO3, CO6
	C	Transpeptidase inhibition in bacteria and nerve gas inhibition, active site investigations: kinetics study, detection ofintermediates			CO3, CO6
	Unit 4	**Isolation of Enzymes**			
	A	Isolation of enzymes from plant, animal and microbial, Homogenization and centrifugation techniqueused in enzyme isolation			CO4, CO6
	B	Different purification techniques of enzymes: Ammonium sulphate precipitation, dialysis, Gel filtrationchromatography,			CO4, CO6
	C	Ion exchange chromatography, affinity chromatography, enzyme activity and specific activity			CO4,CO6
	Unit 5	**Applications of Enzyme Technology**			
	A	Enzyme therapy, application of enzyme in Medicine/drug, health, and biosensor industry.			CO5,CO6
	B	Applications of enzyme in beverage industry (soft drinks, fruit drinks and hard drinks			CO5,CO6
	C	Food processing industry and dairy industry, pharmaceutical industry			CO5,CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text book/s*	1. Bhatt, S. M. (2022). Enzymology and Enzyme Technology. India: S Chand & Company Limited. 2. Bisswanger, H. (2019). Practical Enzymology. Germany: Wiley.			
	Other References	1. Devasena, T. (2010). Enzymology. India: Oxford University Press.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4204.1	3	1	1	1	1	2	3	3
CHT4204.2	3	1	2	2	2	1	3	3
CHT4204.3	3	2	2	2	2	1	3	3
CHT4204.4	3	2	1	2	1	2	3	3
CHT4204.5	3	1	1	1	1	2	3	3
CHT4204.6	3	1	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP4201 Essentials of Biochemistry Lab

School: SSES		**Batch:** 2025-27		
Program: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHP4201		
2	**Course Title**	Essentials of Biochemistry Lab		
3	**Credits**	1		
4	**Contact hours**	0-0-2		
	Course Status	Compulsory	Core	Practicle
5	**Course Objectives**	1. To prepare and standardize buffer solutions 2. Quantify biomolecules (proteins, nucleic acids, metabolites) using spectrophotometric techniques 3. To Analyze enzyme kinetics by determining kinetic parameters 4. To Evaluate antioxidant activity through assays 5. To estimate vitamin C in food samples via titration		
6	**Course Outcomes**	**CO1:** Learn preparation of buffer solutions for biological experiments **CO2:** Apply Beer's Law and isoelectric point determination principles to analyze biomolecules using spectrophotometry and pH-dependent separation techniques. **CO3:** Demonstrate the principles and techniques of protein estimation using colorimetric and spectrophotometric methods **CO4:** Apply enzyme kinetics principles to determine Km and Vmax **CO5:** Demonstrate the principles and techniques of antioxidant assays and antioxidant estimation using spectrophotometric and titrimetric methods **CO6:** Apply biochemical techniques for biomolecular analysis and quantification.		
7	**Course Description**	Learn essential biochemical methods such as buffer preparation, protein quantification, enzyme kinetics, and antioxidant assays using spectrophotometry and titration. Gain practical skills in biomolecular analysis through lab experiments and data-driven applications.		

8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Buffers & Solutions**	
	A	Preparation of buffers solutions and determination of pH	CO1, CO6
	B	Preparation of Acetate Buffer, Phosphate buffer	CO1, CO6
	C	Preparation of molecular grade buffers (TAE buffer, TBE buffer and TE buffer)	CO1, CO6
	Unit 2	**Protein analysis**	
	A	Beer's law and calculation of molar extinction coefficient	CO2, CO6
	B	Scanning of proteins using UV-Visible spectrophotometer	CO2, CO6
	C	Protein Isoelectric point determination	CO2, CO6
	Unit 3	**Protein Estimation**	
	A	Extraction of proteins from Moong beans	CO3, CO6
	B	Biuret method	CO3, CO6
	C	Lowry's method	CO3, CO6
	Unit 4	**Enzyme analysis**	

	A	Extraction of salivary amylase from saliva			CO4, CO6
	B	Determination of Km of salivary amylase			CO4, CO6
	C	Determination of Vmax of salivary amylase			CO4, CO6
	Unit 5	**Antioxidant Assays**			
	A	Analysis of food samples			CO5, CO6
	B	Determination of ascorbic acid content in fruit juice			CO5, CO6
	C	Determination of Total anti-oxidant activity			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE Viva	ESE	
		30%	30%	40%	
	Text book/s*	1. Rajendiran, S., Dhiman, P. (2019). Biochemistry Practical Manual - E-Book. India: Elsevier Health Sciences. 2. K, G. D. (2016). Practical Biochemistry. India: Jaypee Brothers Medical Publishers Pvt. Limited.			
	Other References	1. Vasudevan, D., Das, K. S. (2019). Practical Textbook of Biochemistry for Medical Students. India: Jaypee Brothers Medical Publishers Pvt. Limited.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP4201.1	3	2	1	1	1	2	3	3
CHP4201.2	3	2	2	2	2	1	3	3
CHP4201.3	3	2	2	2	2	1	3	3
CHP4201.4	3	2	1	2	1	2	3	3
CHP4201.5	3	2	1	1	1	2	3	3
CHP4201.6	3	2	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP4202 Bioanalytical Techniques Lab

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic:** Year: 2025-26		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHP4202		
2	**Course Title**	Bioanalytical Techniques Lab		
3	**Credits**	1		
4	**Contact Hours**	0-0-2		
5	**Course Type**	Major Course	Core Course	Practical
6	**Course Objective**	The course is designed to impart laboratory skills in the form of practical exercises so that students can apply this knowledge to augment their research acumen and improve their understanding of the subject		
7	**Course Outcomes**	**CO1**: Students will learn about the principle and applications of microscopy and various cell biology techniques. **CO2**: Students will acquire knowledge about the principles and applications of chromatographic & electrophoretic techniques **CO3**: Students will acquire knowledge about the principles and applications of latest methods used to analyse nucleic acids and proteins. **CO4**: Students will also be exposed to various methods of labelling DNA, proteins and whole cells and their applications in research. **CO5**: Combine different spectroscopic methods to address a complex biological question **CO6**: The course will also provide them an opportunity for hands-on-experience to develop their laboratory skills expected of any biochemist working in a research lab		
8	**Course Description**	This lab course provides hands-on experience with bioanalytical techniques, including spectroscopy, microscopy, electrophoresis, and chromatography, essential for analyzing biomolecules, cells, and tissues in biological and biomedical research		
9	Outline Syllabus			CO Mapping
	Unit 1	**Microscopy & Cell Biology Techniques**		
	A	Virtual Lab on Electron Microscopy		CO1, CO6
	B	Virtual Lab on Confocal Microscopy		CO1, CO6
	C	Virtual Lab on Fluorescence Activated Cell Sorting		CO1, CO6
	Unit 2	**Chromatographic & Electrophoresis Techniques**		
	A	Separation and identification of fats by thin layer chromatography		CO2, CO6
	B	Demonstration of HPLC for separation of biomolecules		CO2, CO6
	C	To perform SDS-PAGE & Virtual Lab on Isoelectric Focusing		CO2, CO6
	Unit 3	**Methods For Analysis of Proteins**		
	A	Virtual Lab on 2D-DIGE		CO3, CO6
	B	Virtual Lab on Western Blotting		CO3, CO6
	C	Virtual Lab on Protein fragment Complementation Assay		CO3, CO6
	Unit 4	**Methods for Analysis of Nucleic Acids**		

	A	Virtual lab on Microarrays	CO4, CO6
	B	Virtual Lab on EMSA	CO4, CO6
	C	Virtual Lab on Next Generation Sequencing	CO4, CO6
	Unit 5	**Spectroscopic Techniques**	
	A	Estimation of biomolecules by UV-Visible Spectroscopy	CO5, CO6
	B	Demonstration of FTIR	CO5, CO6
	C	Virtual Lab on GC-MS	CO5, CO6
	Mode of examination	Practical/Viva	
	Weightage Distribution	CA: 25%	CE Viva: 25%	ESE: 50%
	Text Book/s *	1. Wilson, K. & Walker J (2010) Principles and Techniques of Biochemistry and Molecular Biology, (7th ed.), Cambridge University Press; ISBN 978-0-521-51635 2. Talluri, S. (2012). Bioanalytical Techniques. India: Krishan Makhijani.
	Reference Book	1. Green, M. R., & Sambrook, J. (2012). Molecular cloning: A laboratory manual (4th ed., Vol. 1-3). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2. Sheehan, D. (2010). Physical biochemistry: Principles and applications (2nd ed.). Chichester: Wiley-Blackwell

Mapping: CO Vs POs and PSOs

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP4201.1	3	2	1	1	1	2	2	3
CHP4201.2	3	2	2	1	2	1	2	3
CHP4201.3	2	2	2	1	2	1	1	3
CHP4201.4	2	2	1	1	1	2	2	3
CHP4201.5	3	1	1	1	1	2	2	3
CHP4201.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP4203 Bioenergetics & Metabolism Lab

School: SSES		**Batch**: 2025-27		
Programme: M.Sc.		**Current Academic Year**:2025-26		
Branch: Biochemistry		**Semester**: I		
1	**Course Code**	CHP4203		
2	**Course Title**	Bioenergetics & Metabolism Lab		
3	**Credits**	01		
4	**Contact Hours(L-T-P)**	0-0-2		
5	**Course Type**	Major Course	Core Course	Practical
6	**Course Objectives**	1. Understand the fundamental concepts of bioenergetics and metabolic pathways. 2. Perform laboratory techniques used to analyze metabolism, including spectrophotometry, chromatography, and respirometry. 3. Analyze and interpret experimental data related to energy production and metabolic regulation. 4. Develop critical thinking skills through hypothesis testing and troubleshooting in laboratory experiments. 5. Work effectively in a laboratory setting, maintaining accurate records and following safety guidelines.		
7	**Course Outcomes**	CO1: Understand the principles of bioenergetics and mitochondrial metabolism. CO2: Perform assays for ATP production, oxygen consumption, and redox state. CO3: Analyze enzyme kinetics of metabolic enzymes. CO4: Assess mitochondrial respiration and glycolytic flux. CO5: Interpret bioenergetic data for research applications CO6: Explore experimental methods to evaluate energy metabolism in cells and tissues through biochemical and biophysical techniques.		
8	**Course Description**	This laboratory course provides hands-on experience in the study of bioenergetics and metabolism. Students will explore key biochemical pathways, mitochondrial function, ATP production, enzyme kinetics, and metabolic regulation through experimental techniques and data analysis.		
9	**Outline Syllabus**			CO Mapping
	Unit 1	**Introduction to Bioenergetics**		
	A	Overview of energy metabolism pathways		CO1, CO6
	B	Calculation of ΔG and ΔG^0 for metabolic reactions		CO1, CO6
	C	Calculation of ATP under different physiological conditions		CO1, CO6
	Unit 2	**Biological Energy Transformations**		
	A	First Law of Thermodynamics: Case Study in Biological Systems		CO2, CO6
	B	Second Law of Thermodynamics: Case Study in Biological Systems		CO2, CO6
	C	Numerical problem of free energy and equilibrium constant		CO2, CO6
	Unit 3	**ATP Synthesis & Measurement**		
	A	Calculation of ATP from glycolysis		CO3, CO6

	B	Calculation of ATP from TCA cycle	CO3, CO6
	C	Calculation of ATP from fatty acid oxidation	CO3, CO6
	Unit 4	**Tracking ATP Utilization (^{32}P-Tracer Study): Case Study**	
	A	Use of **^{32}P-labeled ATP** to study phosphorylation in glycolysis	CO4, CO6
	B	Incubation with enzymes **(hexokinase, phosphofructokinase, pyruvate kinase)**	CO4, CO6
	C	Separation of **^{32}P-labeled products** by **polyacrylamide gel electrophoresis (PAGE): Demonstration**	CO4, CO6
	Unit 5	**Enzyme Kinetics using Radiolabeled Substrates: Case Study**	
	A	Study hexokinase activity using ^{32}P-ATP	CO5, CO6
	B	Study phosphofructokinase activity using ^{32}P-ATP	CO5, CO6
	C	Measurement of enzyme kinetics (Km, Vmax) with radioactive incorporation assays	CO5, CO6
	Mode of examination	Practical/Viva	
	Weightage Distribution	CA: 25% / CE Viva: 25% / ESE: 50%	
	Text Book/s *	1. Nelson, D.L., Cox, M.M. (2021). Lehninger: Principles of Biochemistry (8th ed.). New York, WH: Freeman and Company. ISBN: 13: 978-1319381493 / ISBN-10:1319381499. 2. Voet, D., Voet. J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd. ISBN: 978-1-11809244-6.	
	Other References	1. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K.C., Yaffe, M., Amon, A. (2021). Molecular Cell Biology (9th ed.). New York, WH: Freeman & Company. ISBN-13: 978-1319208523, ISBN-10:1319208525. 2. Berg, J. M., Tymoczko J. L. and Stryer L. (2011) 7th Edition. Biochemistry. New York, USA: W. H. Freeman and Co. ISBN-13: 978142927635.	

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP4203.1	3	1	1	1	1	2	3	3
CHP4203.2	3	1	2	2	2	1	3	3
CHP4203.3	3	2	2	2	2	1	3	3
CHP4203.4	3	2	1	2	1	2	3	3
CHP4203.5	3	1	1	1	1	2	3	3
CHP4203.6	3	1	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP4204 Advanced Enzymology Lab

School: SSES		**Batch:** 2025-27		
Program: M.Sc.		**Current** Academic Year: 2025-26		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHP4204		
2	**Course Title**	Advanced Enzymology Lab		
3	**Credits**	1		
4	**Contact hours**	0-0-2		
	Course Status	Compulsory	Core	Practical
5	**Course Objectives**	The main objective of an enzymology lab course is to provide practical skills and hands-on experience in studying enzymes, their kinetics, and mechanisms, enabling students to confidently work with enzyme systems in both academic and industrial settings.		
6	**Course Outcomes**	**CO1**: The course is designed to make students learn and appreciate the importance of enzymes and enzyme catalyzed reactions **CO2**: Students will acquaint with mechanism and regulation of various biochemical reactions taking place in living systems **CO3**: Students will learn different techniques pertaining to enzymology **CO4**: Understand the biochemical reactions and methods associated enzyme activity **CO5**: Analyse biochemical reactions and methods associated with factors affecting enzyme activity **CO6**: Students will receive hands on experience of various biochemical assays to estimate activities of various enzymes		
7	**Course Description**	The objective of the course is to provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life, so as to develop an understanding of enzyme kinetics, mechanism of enzyme action and their regulation.		

8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Enzyme isolation and purification**	
	A	Enzyme isolation from plant and animal source	CO1, CO6
	B	Partial purification of an enzyme using Ammonium sulfate fractionation.	CO1, CO6
	C	Enzyme purification and concentration using dialysis	CO1, CO6
	Unit 2	**Enzyme activity**	
	A	Determination of the salivary α-amylase activity	CO2, CO6
	B	Determination of β-amylase of germinated seeds	CO2, CO6
	C	Study of time course of reaction catalyzed by alkaline phosphatase	CO2, CO6
	Unit 3	**Effect of various factors on enzyme activity**	
	A	Effect of substrate concentration of amylase activity	CO3, CO6
	B	Effect of different pH on the activity of alkaline phosphatase	CO3, CO6
	C	Effect of temperature on enzyme activity	CO3, CO6
	Unit 4	**Role of enzyme in medicine-case study**	
	A	Enzyme therapy-case study	CO4, CO6
	B	Enzyme as therapeutic molecules -case study	CO4, CO6

	C	Enzyme in pharmaceutical industry-case study			CO4, CO6
	Unit 5	**Role Enzyme in food**			
	A	Determine the effect of chemical treatment on enzymatic browning in potato			CO5, CO6
	B	Lipase activity on milk			CO5, CO6
	C	Papain activity on Gelatin			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE Viva	ETE	
		25%	25%	50%	
	Text book/s*	1. Holdgate, G. A., Turberville, A., Lanne, A. (2024). Laboratory Guide to Enzymology. United Kingdom: Wiley. 2. Maire, M. l., Chabaud, R., Hervé, G. (2012). Laboratory Guide to Biochemistry, Enzymology, and Protein Physical Chemistry: A Study of Aspartate Transcarbamylase. Switzerland: Springer US.			
	Other References	1. Buxbaum, E. (2010). Biophysical Chemistry of Proteins: An Introduction to Laboratory Methods. Germany: Springer US.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP4204.1	3	2	1	3	1	2	2	3
CHP4204.2	2	2	2	2	2	1	2	2
CHP4204.3	2	2	2	1	2	1	1	1
CHP4204.4	2	2	1	1	1	2	2	1
CHP4204.5	2	1	1	1	1	2	2	1
CHP4204.6	2	1	2	1	2	2	2	1

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High)**

CHT4206 Advanced Immunology

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** I		
1	**Course Code**	CHT4206		
2	**Course Title**	Advanced Immunology		
3	**Credits**	**4**		
4	**Contact Hours (L-T-P)**	**4-0-0**		
	Course Status	Compulsory	Core	Theory
5	**Course Objective**	2. To understand the basic framework in immunology. 3. To know the innate and adaptive immunity, antibodies, and antigen's structure. 4. To gain the knowledge molecular events leading to the generation of antibody, humoral and cell mediated adaptive immune response. 5. To describe the hypersensitivity, self-tolerance, autoimmunity, and vaccines development. 6. 5To discuss about the immunological testing.		
6	**Course Outcomes**	**CO1**: Describe cells and organs of the immune system. **CO2**: Explain innate immunity, cell adhesion molecules, and cytokines and complement system. **CO3**: Define the structure of antibody, B-cell development, receptordiversity and humoral immune response. **CO4**: Execute knowledge about significance of the T-cell biology andMHC restriction. **CO5**: Acquire the insight into mucosal immune system. **CO6:** Describe the importance, organization, diversity, and basic functions of an immune systems and various cells to apply the basic concepts to enhancetheir research skills.		
7	**Course Description**	This course describes the molecular and cellular basis of the development and function of the immune system.		
8	**Outline syllabus**			**CO Mapping**
	Unit 1	**Cells and Organs of Immune System**		
	A	Introduction to Immune system: Hematopoiesis and the role of Stromal cells in blood cell formation, Basic concept of immune system, cells and organs of immune system, lymphoid cells (B-lymphocytes, T- lymphocytes and Null cells), mononuclear cells (phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils, and basophils), mast cells and dendritic cell		CO1, CO6
	B	Structure and function of primary and secondary lymphoid tissues and organs		CO1, CO6

	C	TLR receptors and sensing of PAMPs. Opsonization, Fc Receptors, prostaglandins, and leukotrienes. Antigen, super antigens, immunogens, adjuvants	CO1, CO6
	Unit 2	**Innate and Adaptive Immunity**	
	A	Cells and soluble mediators of innate immunity, induced innate, Complement system,	CO2, CO6
	B	Biological consequences regulatory proteins of activation and complement	CO2, CO6
	C	Adaptive immunity: salient features, clonal selection theory, collaboration between adaptive and innate immunity	CO2, CO6
	Unit 3	**Cell Mediated Immune Response**	
	A	B and T cell Immunology- B and T cell development, differentiation, maturation, clonal energy, humoral immune response, B cell differentiation, antibody engineering, BCR and pre-BCR, Receptor editing	CO3, CO6
	B	Complement system, classical and alternative pathways, concept of histocompatibility, structure and function of class I and class II MHC molecules, structure of HLA complexes. T cell receptors	CO3, CO6
	C	antibody structure and function, classification of immunoglobulins, concept of variability, cross reactivity, isotypes, allotypes and idiotype markers, class switching, receptor and soluble form of immunoglobulin	CO3, CO6
	Unit 4	**Transplantation Immunology and Vaccines**	
	A	Typing of tissues, characteristics of graft rejection, transplantation biochemistry	CO4, CO6
	B	Vaccines - active and passive immunization, types of vaccines, traditional vaccines and modern vaccines	CO4, CO6
	C	Autoimmunity and immunosuppressive therapy	CO4, CO6
	Unit 5	**Techniques in Immunology**	
	A	ELISA, RIA, antigen-antibody interaction	CO5, CO6
	B	Immunofluorescence and immunoprecipitation	CO5, CO6
	C	Hypersensitivity and autoimmune response	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MSE: 25% / ESE: 50%	
	Text book/s*	1. Punt, J., Stranford, S., Jones, P., Owen, J. A. (2018). Kuby Immunology. United Kingdom: Macmillan Learning. 2. Latha, P. M. (2012). A Textbook of Immunology. India: S. Chand & Company.	
	Other References	1. Flajnik, M. (2022). Paul's Fundamental Immunology. United States: Wolters Kluwer Health.	

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4206.1	3	2	1	1	1	2	3	3
CHT4206.2	3	2	2	2	2	1	3	3
CHT4206.3	3	2	2	2	2	1	3	3
CHT4206.4	3	2	1	2	1	2	3	3
CHT4206.5	3	2	1	1	1	2	3	3
CHT4206.6	3	2	2	1	2	2	3	3

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High)**

CHT4211 Developmental Biology

School: SSES		**Batch: 2025-2027**		
Program: M.Sc.		**Current Academic Year: 2025-26**		
Branch: Biochemistry		**Semester:** II		
1	**Course Code**	CHT4211		
2	**Course Title**	Developmental Biology		
3	**Credits**	4		
4	**Contact hours**	4-0-0		
	Course Type	Compulsory	Major	Theory
5	**Course Objectives**	A typical developmental biology course aims to provide a comprehensive understanding of how organisms develop, from fertilization to the formation of a complex, functional organism, encompassing molecular, cellular, and organismal processes.		
6	**Course Outcomes**	**CO1:** Understand advantages and disadvantages of different model organisms used in research **CO2:** Learn the processes of organogenesis. **CO3:** Acquire the knowledge of embryonic development in animals **CO4:** Acquire the knowledge of embryonic development in plants **CO5:** Acquire the knowledge of post embryonic development such as apoptosis, aging, and senescence **CO6:** Understand importance of environmental cues in normal animals and plant development.		
7	**Course Description**	A developmental biology course explores organisms grow and develop from a single cell to a complex adult, examining the molecular, cellular, and genetic mechanisms underlying processes like cell differentiation, morphogenesis, and pattern formation		

8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Model systems**	
	A	Invertebrates: *Drosophila melanogaster* Pisces: Zebra fish -*Danio rerio*	CO1, CO6
	B	Amphibians: African clawed frog -*Xenopus laevis* Birds: Chicken	CO1, CO6
	C	Mammals: Mouse Plants: *Arabidopsis thalaina*	CO1,CO6
	Unit 2	**Basic concepts of developmental biology**	
	A	Differentiation, morphogenesis, growth, reproduction, evolution, environmental integration	CO2, CO6
	B	Key processes in development: growth, cell division, differentiation, pattern formation, and morphogenesis	CO2, CO6
	C	Evolution of developmental patterns	CO2, CO6
	Unit 3	**Gametogenesis in animals**	
	A	Production of gametes, Spermatogenesis, Structure of mammalian sperm, oogenesis, structure of mammalian egg	CO3, CO6
	B	Fertilization- External and Internal Fertilization. Fast block and slow block to polyspermy	CO3,CO6
	C	Early development: Zygote formation, cleavage, blastula formation, gastrulation, and formation of germ layers in animals.	CO3,CO6

	Unit 4	**Gametogenesis in plants**			
	A	Plant Life Cycles, Gamete Production in Angiosperms, Pollination, Fertilization, Embryonic Development, Dormancy, Germination, Vegetative Growth, Vegetative-to-Reproductive Transition			CO4,CO6
	B	Megasporogenesis & female gametophyte, Structure and development of ovules, Types and parts of ovules			CO4,CO6
	C	Structure and development of female gametophyte, Types of female gametophytes, Structure of Mature Embryosac, Embryo sac haustoria, Senescence			CO4,CO6
	Unit 5	**Programmed cell death, aging, and senescence**			
	A	Apoptosis, Pathways of apoptosis, Intrinsic and extrinsic.			CO5,CO6
	B	Aging and senescence, Programmed theory, telomeric theory, free radical theory			CO5,CO6
	C	Promoting longevity, Cellular Longevity, Role of telomerase, Age-Related Diseases			CO5,CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text book/s*	1. Gilbert, S. F., Barresi, M. J. F. (2020). Developmental Biology. United Kingdom: Oxford University Press. 2. Wolpert, L., Tickle, C., MartinezArias, A. (2015). Principles of Development. United Kingdom: Oxford University Press.			
	Other References	1. Wolpert, L., Tickle, C. (2011). Principles of Development. United Kingdom: OUP Oxford. 2. Carlson, B. M. (2014). Human Embryology and Developmental Biology. United Kingdom: Elsevier/Saunders.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4211.1	3	1	1	1	1	2	3	3
CHT4211.2	3	1	2	2	2	1	3	3
CHT4211.3	3	2	2	2	2	1	3	3
CHT4211.4	3	2	1	2	1	2	3	3
CHT4211.5	3	1	1	1	1	2	3	3
CHT4211.6	3	1	2	1	2	2	3	3

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High**

CHT4210 Advanced Molecular Biology

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** II		
1	**Course Code**	CHT4210		
2	**Course Title**	Advanced Molecular Biology		
3	**Credits**	4		
4	**Contact Hours (L-T-P)**	4-0-0		
5	**Course Type**	Compulsory	Major-I	Theory
6	**Course Objective**	1. Student will understand basic concepts as well as cutting edge advancement in the field of Molecular Biology 2. To demonstrate knowledge and understanding of the molecular machinery of living cells. 3. Student will learn the principles that govern the synthesis of macromolecules: DNA, RNA and protein and chromatin organization. 4. Student will get introduce with applications of Molecular Biology to prepare highly trained and skilled workforce for teaching, research and entrepreneurship.		
7	**Course Outcomes**	**CO1:** Understand different steps in the central dogma of molecular biology, enzymes involved in synthesis of DNA, RNA and protein. **CO2:** Learn the basic steps involved in DNA replication in prokaryotes and eukaryotes, emphasizing the enzymes involved in different types of replication. **CO3:** Describe the in vitro replication of DNA by PCR. **CO4:** Understand and explain the different damages caused to DNA, the mechanisms involved in repairing DNA (direct and indirect methods) and DNA repair defects diseases. **CO5:** Understand the importance of genetic material and their impact on human beings. **CO6:** Capable of becoming successful academicians/researchers and/or entrepreneurs		
8	**Course Description**	The course gives knowledge and understanding of the molecular machinery of living cells. This course will introduce the principles that govern the synthesis of macromolecules: DNA, RNA and protein and chromatin organization.		
9	**Outline Syllabus**			CO Mapping
	Unit 1	**Introduction to Molecular Biology**		

	A	History of 20th &21st century molecular biology, Genomics &'Post-Genomics.' DNA as the genetic material, supercoiling, hybridization. Hierarchy of Chromatin Organisation, Central Dogma.	CO1, CO6
	B	Unique sequence DNA, Repetitive DNA – SINEs, LINEs, Satellite, Minisatellite and Microsatellite DNAs, CValue Paradox. E.Coli Chromosome and plasmids, Mitochondrial and Chloroplast Genomes. Concept of genes.	CO1, CO6
	C	Structure of Protein-coding genes in prokaryotes and eukaryotes. structures of DNA/RNA components, the different forms ofnucleic acids (A, B, Z) and the types of amino acids that mediate backbone and sequence-specific binding.	CO1, CO6
	Unit 2	**DNA Replication**	
	A	Structure of DNA and RNA, Mechanism of replication, the replicons, origin, primosome & replisomes, properties of prokaryotic and eukaryotic DNA polymerases	CO2, CO6
	B	Synthesis of leading and lagging strand, difference betweenprokaryotic and eukaryotic replication.	CO2, CO6
	C	DNA damage and repair; Recombination: Homologous and non-homologous; Site specific recombination; transposable elements and retrotransposon;	CO2, CO6
	Unit 3	**Mechanisms of Transcription**	
	A	Prokaryotic and eukaryotic transcription - RNA polymerases -general and specific transcription factors- regulatory elements.	CO3, CO6
	B	Mechanism of Prokaryotic and Eukaryotic transcription	CO3, CO6
	C	Post-transcriptional Modification: Maturation of rRNA, mRNAand tRNA, RNA splicing, introns and exons, consensus sequence function. Poly A tail, 5' capping. Inhibitors of transcription	CO3, CO6
	Unit 4	**Translation in Prokaryotes and Eukaryotes**	
	A	Ribosomes, structure, functional domain and subunit assemply, genetic code, cell-free protein synthesis, direction of protein synthesis (Dintzis experiment), adaptor role of tRNA, formation of initiation complex.	CO4, CO6
	B	Chain elongation, translocation & termination and the role of respective factors involved therein. Inhibitors of protein biosynthesis. Comparison of protein biosynthesis in prokaryotes with eukaryotes.	CO4, CO6
	C	Post-translational processing: Proteolytic cleavage, covalentmodifications, glycosylation of proteins, disulfide bond formation, ER bound ribosome, co- and post-translational protein synthesis,PRE and PRO proteins, Signal hypothesis.	CO4, CO6
	Unit 5	**Regulation of Transcription and Translation**	
	A	Positive and negative control, Repressor & Inducer, concept of operon, lac-, ara-, trp operons, attenuation, catabolite repression, autogenous regulation, lytic cycle of bacteriophage.	CO5, CO6

	B	Stringent response of rRNA synthesis. Hormonal control, transcription factors, steroid receptors.		CO5, CO6
	C	DNA binding motifs in pro- and eukaryotes – Helix turn, helix,zinc fingers, leucine zippers/ b zip, helix loop helix motifs.		CO5, CO6
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		25%	25%	50%
	Text Book/s *	1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2014) Molecular Biology of Gene. Cold Spring harbor, New York. 2. Nelson, D.L. and Cox, M.M. (2012) Lehninger's Principle of Biochemistry. W.H. Freeman, New York.		
	Other References	1. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., Martin, K.C. (2016) Molecular Cell Biology. W.H. Freeman, New York. 2. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. (2014) Lewin's Gene XI. Jones and Bartlett Learning, Massachusetts.		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4210.1	3	2	1	1	1	2	3	3
CHT4210.2	3	2	2	2	2	1	3	3
CHT4210.3	3	2	2	2	2	1	3	3
CHT4210.4	3	2	1	2	1	2	3	3
CHT4210.5	3	2	1	1	1	2	3	3
CHT4210.6	3	2	2	1	2	2	3	3

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High)**

CHT4209 Molecular Bioinformatics

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** II		
1	**Course Code**	CHT4209		
2	**Course Title**	Molecular Bioinformatics		
3	**Credits**	3		
4	**Contact Hours (L-T-P)**	3-0-0		
5	**Course Type**	Compulsory	Major-I	Theory
6	**Course Objective**	1. To acquire a fundamental knowledge of basic computational biology. 2. To study, design and analyze in silico experiments. 3. To learn the procedure of sequence alignment and its application in molecular phylogenetics. 4. To understand different techniques used for gene prediction and creation of biological databases.		
7	**Course Outcomes**	CO1: Review different tools and softwares required for computational biology. CO2: Understanding the functioning of biological databases accessible on the internet for literature relating to biotechnology CO3: Design and predict the function of proteins and genes by different algorithms, apply different techniques for gene prediction and motifs identification and design experiments to find ESTs and SNPs. CO4: Predict protein structure, function and folding, Compute DNA-protein interaction and apply the information in drug designing. CO5: Analyze DNA and protein sequences similarity and evolution using programs available on the internet CO6: Understanding the role of bioinformatics in various aspects of biological research		
8	**Course Description**	This course is designed to give students a theoretical background of the techniques employed in bioinformatics. Emphasis will be placed on biological sequence (DNA, RNA, protein) analysis and its applications		
9	**Outline Syllabus**			**CO Mapping**
	Unit 1	**Introduction to Bioinformatics**		
	A	Definition, scope, importance and applications of bioinformatics or computational biology		CO1,CO6
	B	Introduction to various tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB) and softwares (RASMOL, Ligand explorer) used in bioinformatics		CO1,CO6
	C	Data generation; Generation of large-scale molecular biology data; Quality of data; metadata; Summary and reference systems		CO1,CO6
	Unit 2	**Biological Databases**		

	A	Introduction to types and sources of data; Classification and presentation of data; Private and public data sources; General introduction of Biological Databases	CO2,CO 6
	B	Nucleic acid databases (NCBI, DDBJ, and EMBL); Protein databases (Primary, Composite, and Secondary); Specialized Genome databases: (SGD, TIGR, and ACeDB) and Structure databases (CATH, SCOP, and PDBsum)	CO2, CO 6
	C	Macromolecular structures; Chemical Compounds; Genetic variability; Methods of presenting large quantities of biological data; Anatomical visualization and database driven websites	CO2, CO 6
	Unit 3	**Sequence alignment**	
	A	Sequence Alignments and Visualization: Introduction to sequences; alignments and dynamic programming, Local alignment and Globalalignment (algorithm and example)	CO3,CO 6
	B	Pairwise sequence alignment: Needleman–Wunsch algorithm, Smith- Waterman algorithm, pairwise alignment (BLAST and FASTA Algorithm)	CO3,CO 6
	C	Multiple sequence alignment: Multiple sequence alignment (Clustal W algorithm), 3D structures viewers (Cn3D and PyMol) Substitution matrices: PAM, BLOSUM	CO3,CO 6
	Unit 4	**Protein structure prediction**	
	A	GOR; Chou-fasman algorithm; Comparative Modeling; Molecular dynamics and simulations	CO4,CO 6
	B	Motif representation: consensus, regular expressions; PSSMs; Markov models; Regulatory sequence identification using Meme	CO4,CO 6
	C	Gene finding: composition-based finding, sequence motif-based finding	CO4, CO 6
	Unit 5	**Phylogenetic Analysis**	
	A	Phenotypic and Molecular Phylogeny	CO5, CO 6
	B	Tools for Phylogenetic Tree construction: Phylip, UPGMA, Maximum Parsimony	CO5,CO 6
	C	Basic concepts of Phylogenetics	CO 5,CO 6
	Mode of examination	Theory	

	Weightage Distribution	CA	MSE	ESE
		25%	25%	50%

	Text Book/s *	1. Aerni, S. J., Sirota, M. (2014). A Bioinformatics Guide for Molecular Biologists. United States: Cold Spring Harbor Laboratory Press. 2. Choudhuri, S. (2018). Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools. United States: Elsevier Science & Technology Books.
	Other References	1. Harisha, S. (2013). Fundamentals of Bioinformatics. India: I.K. International Publishing House Pvt. Limited.

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT4209.1	3	2	1	1	1	2	3	3
CHT4209.2	3	2	2	2	2	1	3	3
CHT4209.3	3	2	2	2	2	1	3	3
CHT4209.4	3	2	1	2	1	2	3	3
CHT4209.5	3	2	1	1	1	2	3	3
CHT4209.6	3	2	2	1	2	2	3	3

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High)**

CHP4205 Molecular Bioinformatics Lab

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** II		
1	**Course Code**	CHP4205		
2	**Course Title**	Molecular Bioinformatics Lab		
3	**Credits**	1		
4	**Contact Hours (L-T-P)**	0-0-2		
5	**Course Type**	Compulsory	Major	Practical
6	**Course Objective**	1. To provide hands-on experience with fundamental bioinformatics tools and databases. 2. To introduce students to sequence analysis, structure prediction, and molecular visualization. 3. To develop skills in data retrieval, analysis, and interpretation relevant to bioinformatics research.		
7	**Course Outcomes**	CO1: Understand the basic concepts of Bioinformatics and its significance in biological data analysis. CO2: Navigate and retrieve data from major bioinformatics databases. CO3: Perform sequence alignment and phylogenetic analysis. CO4: Conduct essential gene and protein annotation. CO5: Visualize and analyze molecular structures. CO6: Apply bioinformatics tools in biological research contexts.		
8	**Course Description**	This course emphasizes the hands-on application of bioinformatics methods to biological problems. Students will gain experience in using existing software and combining approaches to answer specific biological questions.		
9	**Outline Syllabus**			**CO Mapping**
	Unit 1	**Introduction to Bioinformatics Tools and Databases**		
	A	Exploring NCBI, EMBL, DDBJ, and UniProt databases		CO1,CO6
	B	Retrieval of nucleotide and protein sequences		CO1,CO6
	C	Understanding file formats (FASTA, GenBank, etc.)		CO1,CO6
	Unit 2	**Sequence Alignment and Analysis**		
	A	Pairwise sequence alignment using BLAST and FASTA		CO2,CO 6
	B	Multiple sequence alignment using Clustal Omega/ClustalW		CO2, CO 6
	C	Identifying conserved regions and sequence motifs		CO2, CO 6
	Unit 3	**Gene and Protein Annotation**		
	A	Using Ensembl, GeneCards, and KEGG for gene annotation		CO3,CO 6
	B	Functional annotation and domain prediction using InterProScan		CO3,CO 6
	C	Construction of phylogenetic trees		CO3,CO 6
	Unit 4	**Structural Bioinformatics**		
	A	Visualization of protein structures using PyMOL and Chimera		CO4,CO 6

	B	Analysis of secondary and tertiary structures		CO4,CO 6
	C	Designing primers using Primer3 and NCBI Primer-BLAST		CO4, CO 6
	Unit 5	**Molecular Docking (Introductory Level)**		
	A	Introduction to AutoDock for ligand-receptor interactions		CO5, CO 6
	B	Introduction to genome browsers (UCSC Genome Browser, Ensembl)		CO5, CO 6
	C	Exploring genetic variations and SNPs		CO5, CO 6
	Mode of examination	Practical/Viva		
	Weightage Distribution	CA	CE (Viva)	ETE
		30%	30%	40%
	Text Book/s *	1. Aerni, S. J., Sirota, M. (2014). A Bioinformatics Guide for Molecular Biologists. United States: Cold Spring Harbor Laboratory Press. 2. Benfey, P. N. (2014). Quickstart Molecular Biology: An Introductory Course for Mathematicians, Physicists, and Computational Scientists. United States: Cold Spring Harbor Laboratory Press.		
	Other References	1. Sofi, M. Y., Shafi, A., Masoodi, K. Z. (2021). Bioinformatics for Everyone. Netherlands: Academic Press.		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP4205.1	3	2	1	1	1	2	2	3
CHP4205.2	3	2	2	1	2	1	2	3
CHP4205.3	3	2	2	1	2	1	1	3
CHP4205.4	3	2	1	1	1	2	2	3
CHP4205.5	3	2	1	1	1	2	2	3
CHP4205.6	3	2	2	1	2	2	2	3

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial**

CHR4101 Project

School: SSES		**Batch:2025-27**		
Programme: M.Sc.		**Current Academic Year:2025-26**		
Branch: Biochemistry		**Semester:04**		
1	**Course Code**	CHR4101		
2	**Course Title**	Project		
3	**Credits**	4		
4	**Contact Hours (L-T-P)**	0-0-8		
5	**Course Type**	**Qualifying**	DSE	**Project**
6	**Course Objective**	This course will help to ensure that students are able to 1. Demonstrate advanced knowledge of the role of scientific research. 2. Analyze contribution to the disciplines related to the different fields of science and technology. 3. Able to take out optimal research methods by the content 4. Understands methodology by the character of cognitive activity 5. Aim of the scientific task		
7	**Course Outcomes**	The student will be able to CO1: Understand the main rules of handling scientific and technical literature CO2: To be able to understand different types of scientific research and hypothesis. CO3: Understand the advanced level of classification of methods by the level of investigation CO4: Extract the line of approach to overcome the research gap. CO5: Understand to improve their skills in establishing relations between complex topics. CO6: To acquire an overview of important characteristics within technological research and development		
8	**Course Description**	This course will deepen the student's understanding of research in general, and basic science and technological research in particular. The students are expected to apply knowledge of methodology, concepts, philosophical problems, and creative mapping in this course to their own fields of exploration to get optimal results.		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR4101.1	3	2	1	3	1	2	2	3
CHR4101.2	2	2	2	2	2	1	2	2
CHR4101.3	2	2	2	1	2	1	1	1
CHR4101.4	2	2	1	1	1	2	2	1
CHR4101.5	2	1	1	1	1	2	2	1
CHR4101.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5201 Forensic Biochemistry

School: SSES		**Batch:** 2025-2026		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHT5201		
2	**Course Title**	Forensic Biochemistry		
3	**Credits**	**4**		
4	**Contact Hours (L-T-P)**	**4-0-0**		
5	**Course Type**	Compulsory	Core	Theory
6	**Course Objective**	1. To Provide Knowledge about the basic principles of Forensic Science, different branches, functions, nature and scope of Forensic Science. 2. To Provide detail idea about different roles, Organizational setup and functions of various Government Departments such as FBI, CBI, RAW, BPRD, NCRB etc., Forensic laboratories and Police in Crime Scene investigations. 3. To develop the undergraduate level students with the specific knowledge of handling different types of evidences and their examinations. 4. To develop the laboratory skills in examining different types of evidences found at the crime scene. 5. To prepare the students to compete for employment in State and central level Organizations		
7	**Course Outcomes**	**CO1:** Students will learn the fundamental concepts and principles of forensic science and their significance. **CO2:** Students will understand how a forensic investigation is initiated through preservation of evidences, as well as chemical, physical and biological methods of their analysis including analysis of DNA and other bodily fluids. **CO3:** Students will learn how to establish identity of an individual by document evaluation, fingerprints, footprints, DNA analysis etc. **CO4:** Students will learn how to establish identity of an individual by fingerprints, footprints, DNA analysis etc. **CO5:** Students will obtain hands-on experience in some of the basic biochemical processes involved in forensic investigation. **CO6:** Student will able to get job in various government and forensic institutions.		
8	**Course Description**	This course is designed to develop professional, ethical graduates whose competence in problem-solving, legal analysis and application, quantitative reasoning, investigation, and scientific laboratory procedures can be applied to immediate employment or advanced study.		

9	**Outline Syllabus**				CO Mapping
	Unit 1	**Introduction to Forensic Sciences**			
	A	Basic Principles and Significance; History and Development of Forensic Science; Defining the scene of investigation; Collection,Packaging, Labelling and Forwarding of biological exhibits to forensic laboratories			CO1, CO6
	B	Preservation of biological evidence			CO1, CO6
	C	Importance of Health and Safety Protocols in sample collection and analysis.			CO1, CO6
	Unit 2	**Biological Science and its Application in Investigation**			
	A	Biochemical analysis of various biological evidence-like blood, semen & other biological fluids, viscera, bite marks, hair (animal and human), fibres & fabrics, pollen and soil			CO2, CO6
	B	Establishment of identity of individuals - fingerprints, footprints, blood and DNA analysis, anthropology – skeletal remains, Odontology; Time of death- rigor mortis, liver mortis, algor mortis, forensic entomology.			CO2, CO6
	C	Biochemical basis for determination of cause of death, case studies			CO2, CO6
	Unit 3	**Chemical Science and its Application in Investigation**			
	A	Detection of drugs of abuse and narcotics in biological samples			CO3, CO6
	B	Toxicological examination of viscera, detection of petroleum products, food adulteration			CO3, CO6
	C	Analysis of inks and their use in questioned documentidentification, blood splatter analysis, stain analysis, case studies.			CO3, CO6
	Unit 4	**DNA Fingerprinting**			
	A	DNA Finger Printing; DNA-Introduction, source of DNA in Forensic case work, Extraction of DNA.			CO4, CO6
	B	Techniques of DNA fingerprinting-RFLP, STR, PCR.			CO4, CO6
	C	DNA fingerprinting in paternity disputes, mass disaster and other forensic case work, case studies.			CO4, CO6
	Unit 5	**Recent Advances in Forensics**			
	A	*Narco analysis*: theory, forensic significance, future prospect, *Brain mapping:* introduction, EEG, P-3000 wave, forensic applications, limitation of technique.			CO5, CO6
	B	*Polygraph*: Principle and technique polygraph as forensic investigative tool, use of psychoactive drugs in forensic analysis. NHRC guidelines for polygraph test.			CO5, CO6
	C	*Facial reconstruction*: Method and technique, facial reconstruction in forensic identification.			CO5, CO6
	Mode of examination	Theory			
		CA	MSE	ESE	

	Weightage Distribution	25%	25%	50%
	Text Book/s *	1. Elkins, K. M. (2012). Forensic DNA Biology: A Laboratory Manual. Netherlands: Elsevier Science. 2. Lappas, N. T., Lappas, C. M. (2015). Forensic Toxicology: Principles and Concepts. Netherlands: Academic Press.		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5201.1	3	2	1	1	1	2	2	3
CHT5201.2	3	2	2	1	2	1	2	3
CHT5201.3	3	2	2	1	2	1	1	3
CHT5201.4	3	2	1	1	1	2	2	3
CHT5201.5	3	1	1	1	1	2	2	3
CHT5201.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5202 Recombinant DNA Technology

School: SSES		**Batch:** 2025-27	
Programme: M.Sc.		**Current Academic Year:** 2025-26	
Branch: Biochemistry		**Semester: II**	
1	**Course Code**	CHT5202	
2	**Course Title**	Recombinant DNA Technology	
3	**Credits**	**4**	
4	**Contact Hours (L-T-P)**	**4-0-0**	
	Course Status	**Core**	
5	**Course Objective**	1. To provide insight into restriction endonuclease and modifying enzymes. 2. To explain the different cloning methodologies. 3. To provide a thorough knowledge of genomic and cDNA-library preparation. 4. To discuss about various methods, concepts, and basic steps in gene cloning. 5. To explain to acquaint them with various vectors and enzymes usedin recombinant DNA technology, transformation, and screening techniques 6. To impart knowledge about PCR technology, Real-Time PCR, DNA fingerprinting etc.	
6	**Course Outcomes**	**CO1**: Explain the concept of recombinant DNA technology **CO2**: Elucidate the biology of plasmids, and phages and their uses in different cloning systems. **CO3**: Interpret different types of DNA libraries and their application to isolate genes. **CO4**: Illustrate the designing of expression vectors for prokaryotic and eukaryotic expression systems. **CO5**: Learn about genetic engineering and prospects of improving crop productivity, resistance, resistance to disease and environmentalstresses, and methods for production of transgenic animals. **CO6**: Gain knowledge about of various aspects of genetic engineering for human welfare.	
7	**Course Description**	The course is designed to make the students understand the concept andbasic steps in gene cloning, to acquaint them with various vectors and enzymes used in recombinant DNA technology, transformation and screening techniques.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**r-DNA Technology**	
	A	Restriction enzymes, restriction modification system, DNA ligase	CO1, CO6
	B	*E. coli* DNA polymerase I and Klenow enzyme, T4 DNA polymerase	CO1, CO6

	C	reverse transcriptase, polynucleotide kinase, alkaline phosphatase	CO1, CO6
	Unit 2	**Cloning Vectors and Methodologies**	
	A	Plasmids and plasmid vectors, new generation of plasmid cloning vectors, Lambda vectors - insertion and replacement vectors, cosmids	CO2, CO6
	B	High capacity cloning vectors – YACs, BACs and PACs. Shuttle vectors. Expression vectors - pMAL, GST, pET-based vectors. Eukaryotic expression vectors	CO2, CO6
	C	Prokaryotic expression vector: His-tag, GST-tag, MBP-tag Vector. Vectors used for cloning in animal cells: SV-40, bacculo and retroviral vector Plant-based vectors, Ti vectors	CO2, CO6
	Unit 3	**Genomic and cDNA library preparation**	
	A	Methods for construction of genomic and cDNA libraries – vectors used, generation of cDNAs, preparation of genomic DNA for library construction	CO3, CO6
	B	Lambda in vitro packaging. Methods used in the identification and analyses of recombinant DNA clones.	CO3, CO6
	C	Protein-protein interaction and yeast two-hybrid system. Phage display. Principles of maximizing protein expression	CO3, CO6
	Unit 4	**Transgenic Technology**	
	A	Gene knockout and knock-in, Generation of transgenic animals and its application, Gene isolation, gene transfer systems	CO4, CO6
	B	Ti plasmid, plant virus vectors, electroporation, microinjection, microprojectile technology, particle bombardment, Generation of transgenic plants and its application,	CO4, CO6
	C	Plant tissue culture, anther and pollen culture, protoplast culture, protoplast fusion, cybrid, somatic hybrid, somatic embryogenesis, application of recombinant DNA technology in photosynthetic efficacy, nitrogen fixation efficiency and resistance to environmental stresses.	CO4, CO6
	Unit 5	**RNA interference**	
	A	Introduction to siRNA, siRNA technology, microRNA, construction of siRNA vectors, Gene editing, CRISPR/Cas9	CO5, CO6
	B	Principle and application of gene silencing. Production of insulin, drug, vaccines, diagnostic probe of genetic diseases. Gene therapy	CO5, CO6
	C	Introduction to next generation sequencing (NGS)-Polymerase chain reaction and its application in research. Oligonucleotide synthesis, purification, and its application in screening of libraries, cloning and mutagenesis. Real time/quantitative PCR and its applications	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MSE: 25% / ESE: 50%	
	Text book/s*	1. Chaudhuri, K. (2013). Recombinant DNA Technology. India: Energy and Resources Institute. 2. Ijaz, S., Ul Haq, I. (2019). Recombinant DNA Technology. United Kingdom: Cambridge Scholars Publishing.	

	Other References	1. Jain, M. (2012). Recombinant DNA Techniques: A Textbook. United Kingdom: Alpha Science International.

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5202.1	3	2	1	1	1	2	2	3
CHT5202.2	3	2	2	1	2	1	2	3
CHT5202.3	3	2	2	1	2	1	1	3
CHT5202.4	3	2	1	1	1	2	2	3
CHT5202.5	3	2	1	1	1	2	2	3
CHT5202.6	3	2	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5203 Fundamentals of Biostatistics

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2026-27		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHT5203		
2	**Course Title**	Fundamentals of Biostatistics		
3	**Credits**	2		
4	**Contact Hours (L-T-P)**	2-0-0		
5	**Course Type**	Compulsory	DSE	Theory
6	**Course Objectives**	To make students familiar with the biological data analysis, interpretation & presentation of results, fundamental concepts of biostatistics and the statistical software's/tools.		
7	**Course Outcomes**	**CO1:** Learn the fundamental concepts of statistics and statistical inference, and find the measures of central tendency and dispersion of a data **CO2:** Determine descriptive statistics from experimental data. **CO3:** Apply hypothesis testing via some of the statistical distributions and understand the basics of statistical tool/software's. **CO4:** Explain probability, theorem on probability and conditional probability, and evaluate the probability of various events in random experiments. **CO5:** Discuss the concept of random variable and its distributions for evaluating relevant probabilities. **CO6:** Understanding statistical analysis of biological data		
8	**Course Description**	The purpose of the course is to teach fundamental concepts and techniques of descriptive and inferential statistics with applications in health care, medicine, public health, and epidemiology. Basic statistics, including probability, descriptive statistics, distribution, hypothesis, regression, and correlation methods are presented.		
9	**Outline Syllabus**			CO Mapping
	Unit 1	**Introduction**		
	A	Methods of data collection, processing and presentation, Frequency distribution		CO1, CO6
	B	Charts-Graph, Histogram, Bar and Pie charts		CO1, CO6
	C	Measures of central tendency & Dispersion- Mean, Median, and mode, Standard deviation		CO1, CO6
	Unit 2	**Descriptive Statistics**		
	A	Types of errors - type I and type II, Power of a test, Tests of significance, P-value testing, Levels of significance		CO2, CO6
	B	Skewness and Kurtosis		CO2, CO6
	C	Regression and correlation analysis		CO2, CO6
	Unit 3	**Testing of Hypothesis**		

	A	Null and alternate hypothesis, Formulation of hypothesis (one-tailed & two-tailed)			CO3, CO6
	B	Hypothesis Testing (students T-test, one sample t-test, two-sample t-test, paired sample t-test, Z-test, Chi-square test)			CO3, CO6
	C	One-way and two-way analysis of variance (ANOVA)			CO3, CO6
	Unit 4	**Probability**			
	A	Probability: basic concepts; basic theorems of probability, addition, and multiplication theorems			CO4, CO6
	B	Conditional probability of Bayes Theorems.			CO4, CO6
	C	Probability distribution definition and applications			CO4, CO6
	Unit 5	**Random Variable and its Distribution**			
	A	Random variable, expectations and variance of a random variable, Binominal distribution, Normal distribution			CO5, CO6
	B	Tests for mean based on normal distribution, Tests for variance based on normal distribution – one sample and two-sample problem			CO5, CO6
	C	Cumulative distribution function, Poisson distribution,			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text Book/s	1. Daniel, W. W., Cross, C. L. (2018). Biostatistics: A Foundation for Analysis in the Health Sciences. United Kingdom: Wiley. 2. Forthofer, R. N., Lee, E. S., Hernandez, M. (2006). Biostatistics: A Guide to Design, Analysis and Discovery. Netherlands: Elsevier Science.			
	Reference Book/s	1. Blum, A., Hopcroft, J., Kannan, R. (2020). Foundations of Data Science. India: Cambridge University Press. 2. Wasserman, L. (2013). All of Statistics: A Concise Course in Statistical Inference. Switzerland: Springer New York.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5203.1	3	2	1	1	1	2	2	3
CHT5203.2	3	2	2	1	2	1	2	3
CHT5203.3	3	2	2	1	2	1	1	3
CHT5203.4	3	2	1	1	1	2	2	3
CHT5203.5	3	1	1	1	1	2	2	3
CHT5203.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5108 RM & IPR

School: SSES		**Batch:** 2025-2027		
Program: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHT5108		
2	**Course Title**	RM & IPR		
3	**Credits**	1		
4	**Contact hours**	2-0-0		
	Course Status	Compulsory	SEC	Theory
5	**Course Objectives**	The course aims to equip students with the knowledge and skills to conduct research effectively and understand the importance of Intellectual Property Rights (IPR), including how to protect and utilize them.		
6	**Course Outcomes**	**CO1:** Know about types of publications, types of journals with their indexing & metrics, publication houses and academic social networking websites, and able to search relevant literatures to find research problems, gaps in research, research objectives & design research methodology. **CO2:** Identify the keywords for the search of different kinds of literatures on various search engines and get to know about various software's for the management of citations and references **CO3:** Learn about different components of research papers, review articles andsoftwares for formatting of papers, preparation of posters and slides. **CO4:** Understand basics of intellectual property rights. **CO5:** To learn about copyright for their innovative works. **CO6:** Understand the fundamentals of research, manuscript/research proposalwriting, communication and research ethics		
7	**Course Description**	This course will give an overview of basic concepts employed in quantitative and qualitative research. It focuses on ethical issues associated with research writing and publication. Also describes the use of various computer applications required for research.		

8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Introduction to Research**	
	A	Meaning and importance of Research – Types of Research – Selection and formulation of Research	CO1, CO6
	B	Developing a Research Plan – Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Designs	CO1, CO6
	C	Research Methods: Scientific method vs Arbitrary Method, Logical Scientific Methods: Deductive, Inductive, Deductive-Inductive, pattern of Deductive – Inductive logical process – Different types of inductive logical methods.	CO1, CO6
	Unit 2	**Importance of Literature Survey**	
	A	Planning a literature search, Identifying key concepts and key words, locating relevant literature, Reliability of a source.	CO2, CO6
	B	Introduction to literature review process, types of literature review:	CO2, CO6

		descriptive, systematic, state-of-the-art, etc. Literature review using different platforms like Google, PubMed, science direct, Elsevier, ACS etc.	
	C	Research ethics with respect to science and research, scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) and its implication	CO2, CO6
	Unit 3	**Academic Writing & Reference Management**	
	A	Structure and components of scientific reports, types of report, Significance	CO3, CO6
	B	Different steps in the preparation, layout, structure and language of typical reports, illustrations and tables, bibliography	CO3, CO6
	C	Citation styles: definition, components, types such as APA, Chicago, Harvard, IEEE, etc., reference management tools such as Mendeley, Zotero, Endnote, etc.	CO3, CO6
	Unit 4	**Intellectual Property Rights**	
	A	Introduction to intellectual property rights, concept of corporeal and incorporeal property	CO4, CO6
	B	Types of intellectual property rights, Introduction to patents, patent act 1970 – amendments of 1999, 2000, 2002 and 2005, patentable and non-patentable inventions, GMO patents in India and abroad	CO4, CO6
	C	IP Rights and regulatory concerns for genetically modified seeds/plants in India, patent registration process, restoration of lapsed patents, surrender and revocation of patents, infringement of patents	CO4, CO6
	Unit 5	**Patents, Copyrights, and Trademarks**	
	A	Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee	CO5, CO6
	B	Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.	CO5, CO6
	C	Indian copyright: definition, genesis, copyright laws etc., concept of trade mark and trademark laws-national and international, international regime related to IPR, TRIPS and other treaties (WIPO, WTO, GATTA)	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25% / MSE: 25% / ESE: 50%	
	Text book/s*	1. Kothari, C. R. (2004). Research Methodology: Methods and Techniques. India: New Age International (P) Limited. 2. Thomas, C. G. (2021). Research Methodology and Scientific Writing. Germany: Springer International Publishing. 3. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.	
	Other References	1. Mukherjee, S. P. (2019). A Guide to Research Methodology: An Overview of Research Problems, Tasks and Methods. United States: CRC Press. 2. Ramakrishna, B., Anil Kumar, H. S. (2017). Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers. India: Notion Press.	

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5108.1	3	2	1	1	1	2	2	3
CHT5108.2	3	2	2	1	2	1	2	2
CHT5108.3	3	2	2	1	2	1	1	1
CHT5108.4	3	2	1	1	1	2	2	1
CHT5108.5	3	1	1	1	1	2	2	1
CHT5108.6	3	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP5201 Forensic Biochemistry Lab

School: SSES		**Batch:** 2025-27		
Program: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHP5201		
2	**Course Title**	Forensic Biochemistry Lab		
3	**Credits**	1		
4	**Contact hours**	0-0-2		
	Course Status	Compulsory	Core	Practical
5	**Course Objectives**	This course will provide the knowledge about the questioned document analysis and its various portion. This will provide details of secret writing, indented writing, additions made in documents, erasures and examination of all above aspects in Questioned document. Student will learn about composition of ink , ink dating and		
6	**Course Outcomes**	**CO1**: Students learn to observe a crime scene for relevant evidence and understand the importance of proper collection, packaging, and preservation of samples. **CO2**: They learn and apply various biochemical techniques, such as spot testing, microscopy, and separation analyses, to identify and characterize evidence. **CO3**: Students gain proficiency in analyzing physical samples (e.g., glass, paper, soil, fibers) collected from crime scenes. **CO4**: They gain a comprehensive understanding of the different types of biological evidence, their degradation processes, and how they can be used in forensic investigations. **CO5**: Students gain proficiency in analyzing biological samples (e.g., blood, tissue, body fluids) collected from crime scenes. **CO6**: Students develop the ability to interpret biochemical data and draw conclusions relevant to forensic investigations.		
7	**Course Description**	The lab course would provide hands-on experience in applying biochemical principles to forensic investigations, including analyzing evidence, identifying substances, and interpreting results, often focusing on techniques like DNA analysis and toxicology		

8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Crime scene management**	
	A	Descriptive study of organizational structure of a forensic science laboratory	CO1, CO6
	B	Mock crime scene investigation and writing a report on evaluation of crime scene.	CO1, CO6
	C	Viva	CO1, CO6
	Unit 2	**Forensic Chemistry**	
	A	TLC and spot test of alkaloids of drugs of abuse and toxic substances	CO2, CO6
	B	UV-Visible Spectroscopic analysis of Drugs	CO2, CO6
	C	Viva	CO2, CO6
	Unit 3	**Forensic physics**	

	A	Examination of glass fractures and determination of refractive indices of glass & liquids	CO3, CO6
	B	Physical examination of soil for colour, moisture, organic matter, pH, presence of anthropogenic material and presence of biological material	CO3, CO6
	C	Viva	CO3, CO6
	Unit 4	**Forensic biology**	
	A	Morphological / Microscopic Examination of natural and synthetic fibres	CO4, CO6
	B	Morphological & Microscopic Examination of human and animal hairs	CO4, CO6
	C	Viva	CO4, CO6
	Unit 5	**Forensic serology**	
	A	Examination of blood and its stains: Chemical and crystal tests	CO5, CO6
	B	Examination of saliva and its stains: Chemical and crystal tests.	CO5, CO6
	C	Viva	CO5, CO6
	Mode of examination	Practical/Viva	
	Weightage Distribution	CA: 25% / CE: 25% / ESE: 50%	
	Text book/s*	3. Elkins, K. M. (2012). Forensic DNA Biology: A Laboratory Manual. Netherlands: Elsevier Science. 4. Thompson, R. B., Thompson, B. F. (2012). Illustrated Guide to Home Forensic Science Experiments: All Lab, No Lecture. United Kingdom: O'Reilly Media.	
	Other References	2. Khan, J. I., Christian, D. R., Kennedy, T. J., Christian, Jr., D. R. (2011). Basic Principles of Forensic Chemistry. United Kingdom: Humana Press.	

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP5201.1	3	2	1	1	1	2	2	3
CHP5201.2	3	2	2	1	2	1	2	3
CHP5201.3	3	2	2	1	2	1	1	3
CHP5201.4	3	2	1	1	1	2	2	3
CHP5201.5	3	1	1	1	1	2	2	3
CHP5201.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP5202 Recombinant DNA Technology Lab

School: SSES		**Batch:** 2025-27		
Program: M.Sc.		**Current Academic Year:** 2026-27		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHP5202		
2	**Course Title**	Recombinant DNA Technology Lab		
3	**Credits**	1		
4	**Contact hours**	0-0-2		
	Course Status	Compulsory	Core	Practical
5	**Course Objectives**	1. Understand the Principles of Recombinant DNA Technology 2. Learn DNA Extraction and Analysis Techniques 3. Master Restriction Enzyme Digestion and Ligation 4. Perform Bacterial Transformation and Selection 5. Study Expression of Recombinant Proteins		
6	**Course Outcomes**	**CO1:** Students will learn techniques for isolating and analyzing plasmid DNA **CO2:** To isolate genomic DNA and use restriction enzymes to cut DNA at specific sequences, creating fragments for cloning **CO3:** Students will gain expertise in isolating total RNA, synthesizing cDNA using RT-PCR, and amplifying target genes by PCR **CO4:** Students will master techniques for inserting DNA fragments into vectors, and transforming and screening of host cells **CO5:** To express cloned genes in host cells and analyze the resulting proteins **CO6:** Equip students with the skills to pursue careers in the biotechnology and pharmaceutical industries, specializing in genetic engineering and recombinant DNA research in advanced research laboratories.		
7	**Course Description**	Students will gain practical skills in genetic manipulation, gene expression analysis, and molecular cloning, preparing them for research and industry applications in biotechnology and pharmaceuticals.		

8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Plasmid DNA analysis**	
	A	Propagation of E. coli cells	CO1, CO6
	B	Plasmid DNA isolation	CO1, CO6
	C	Agarose gel electrophoresis of plasmid DNA	CO1, CO6
	Unit 2	**Analysis of DNA fragments**	
	A	Restriction digestion of plasmid DNA	CO2, CO6
	B	Determination of molecular size of DNA fragments	CO2, CO6
	C	Demonstration on purification of DNA fragments from agarose gel	CO2, CO6
	Unit 3	**RNA expression studies**	
	A	Isolation of total RNA from cell	CO3, CO6
	B	cDNA synthesis by RT-PCR	CO3, CO6
	C	Amplification of genes by PCR	CO3, CO6
	Unit 4	**Gene cloning studies**	
	A	Preparation of competent cells	CO4, CO6
	B	Transformation of competent cells	CO4, CO6

	C	Demonstration on Gene cloning experiments and selection of recombinant clones			CO4, CO6
	Unit 5	**Gene expression studies**			
	A	Analyze design of different expression vector			CO5, CO6
	B	Understand regulation of production of recombinant proteins			CO5, CO6
	C	Demonstration on the role of tags in purification of recombinant proteins			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*	1. Sambrook, J., Russell, D. W. (2003). Molecular Cloning: A Laboratory Manual. United States: Cold Spring Harbor Laboratory. 2. Zyskind, J. W., Bernstein, S. I. (2012). Recombinant DNA Laboratory Manual, Revised Edition. United Kingdom: Elsevier Science.			
	Other References	1. Brown, T. A. (2015). Gene Cloning and DNA Analysis: An Introduction. Germany: Wiley.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP5202.1	3	2	1	1	1	2	2	3
CHP5202.2	3	2	2	1	2	1	2	2
CHP5202.3	3	2	2	1	2	1	1	1
CHP5202.4	3	2	1	1	1	2	2	1
CHP5202.5	3	1	1	1	1	2	2	1
CHP5202.6	3	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP5203 Fundamentals of Biostatistics Lab

School: SSES		**Batch:** 2025-27	
Program: M.Sc.		**Current Academic Year:** 2026-27	
Branch: Biochemistry		**Semester:** III	
1	**Course Code**	CHP5203	
2	**Course Title**	Fundamentals of Biostatistics Lab	
3	**Credits**	1	
4	**Contact hours**	0-0-2	
	Course Status	Compulsory	
5	**Course Objectives**	Biostatistics lab course aims to develop competency and expertise in the application of statistical methods applied to biological data obtained in experimental techniques.	
6	**Course Outcomes**	**CO1:** Learn the fundamental concepts of statistics and statistical inference, and find the measures of central tendency and dispersion of a data **CO2:** Determine descriptive statistics from experimental data. **CO3:** Apply hypothesis testing via some of the statistical distributions and understand the basics of statistical tool/software's. **CO4:** To understand and apply basic concepts in biostatistics exemplifying measuring central tendencies & moments. **CO5:** Discuss the concept of ANOVA & the distributions for evaluating relevant probabilities. **CO6:** Understanding statistical analysis of biological data	
7	**Course Description**	This manual emphasizes to provide the learner insights into helpful areas of Statistics which plays an essential role in present, future use, and applications of Biology.	
8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Introduction to Sampling Methods**	
	A	Collection & tabulation of Data	CO1, CO6
	B	Sampling & Sampling Methods	CO1, CO6
	C	Frequency Distribution	CO1, CO6
	Unit 2	**Graphical Representation of Data**	
	A	Histogram	CO2, CO6
	B	Bar Graphs	CO2, CO6
	C	Pie Chart	CO2, CO6
	Unit 3	**Tests of Significance**	
	A	Z-test	CO3, CO6
	B	F-test	CO3, CO6
	C	Chi Square Test	CO3, CO6
	Unit 4	**Measurement of Central Tendency & Moments**	
	A	Quartiles	CO4, CO6
	B	Skewness	CO4, CO6
	C	Kurtosis	CO4, CO6
	Unit 5	**Biostatistics Applications**	
	A	One Way ANOVA	CO5, CO6
	B	Two Way ANOVA	CO5, CO6
	C	Fitting of Distributions	CO5, CO6

	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	50%	
	Text book/s*	1. McDonnell Sill, A. (2021). Statistics for Laboratory Scientists and Clinicians: A Practical Guide. United Kingdom: Cambridge University Press. 2. Bartolucci, A., Singh, K. P., Bae, S. (2015). Introduction to Statistical Analysis of Laboratory Data. United Kingdom: Wiley.			
	Other References	1. Goodman, M. S. (2017). Biostatistics for Clinical and Public Health Research. United Kingdom: Taylor & Francis. 2. Faizi, N., Alvi, Y. (2023). Biostatistics Manual for Health Research: A Practical Guide to Data Analysis. United Kingdom: Elsevier Science.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP5203.1	3	2	1	1	1	2	2	3
CHP5203.2	3	2	2	1	2	1	2	3
CHP5203.3	3	2	2	1	2	1	1	3
CHP5203.4	3	2	1	1	1	2	2	3
CHP5203.5	3	1	1	1	1	2	2	3
CHP5203.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHR5101 Dissertation-I (RBL-I)

School: SSBSR		**Batch: 2025-206**	
Program: M.Sc.		**Current Academic Year: 2025-26**	
Branch: Biochemistry		**Semester III**	
1	Course Code	**CHR5101**	
2	Course Title	Project	
3	Credits	6	
4	Contact Hours (L-T-P)	0-0-XXX	
	Course Status	Compulsory	
5	Course Objective	1. Develop knowledge of a specific area of specialization. 2. Develop research skills in project writing and oral presentation.	
6	Course Outcomes	**CO 1**: Able to learn about how to get information of research. **CO 2**: Learn about journal and article and research manuals **CO 3**: Able to know the role of primary, secondary and tertiary sources of information. **CO 4**: Gain knowledge about abstract and citation index. **CO 5**: Also know about digital web resources **CO 6**: Able to learn about basic computer application of research work.	
7	Course Description	This course is designed for students to study topics not offered in regularly available courses. This course encourages reading a field of special interest and gain in-depth update knowledge about it.	
8	Outline		CO Achievement
	Unit 1	**Theoretical foundations of scientific and research work**- To learn the theoretical concept of research; be able to explain what research is and what it is not, and the different definitions of research; introduce the objectives of research, and set the motivation in research	CO1, CO6
	Unit 2	**General methodology of scientific creative work**- Be able to discuss the criteria of good research and the different types of research methods	CO2, CO6
	Unit 3	**The logic of scientific research process**- Be able to formulate the problem of research, to discuss how a research problem is delimited, and evaluated, to acquire knowledge about logic of scientific research process	CO3, CO6
	Unit 4	**The model of research**- Be able to choose the research problem, formulate research topic (thesis) work, to show the relevance of the problems investigated, to set goals and objectives, object and subject of study	CO4, CO6
	Unit 5	**Planning the Research**- Be able to plan the research in the rational way	CO5, CO6
	Mode of examination	1. Rubric assessment 2. Monthly Presentation to be audited by supervisor	

		3. Mid Term Presentation and End Term Presentation		
	Weightage	CA	CE (Viva + PPT)	ETE
		25%	25%	50%
	Text book/s*	10 Recent International Journal Articles of repute.		
	Other References	-		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR5101.1	3	2	1	1	1	2	2	3
CHR5101.2	3	2	2	1	2	1	2	3
CHR5101.3	3	2	2	1	2	1	1	3
CHR5101.4	3	2	1	1	1	2	2	3
CHR5101.5	3	1	1	1	1	2	2	3
CHR5101.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5204 Genomics and Proteomics

School: SSBSR		**Batch:** 2025-2026		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** II		
1	**Course Code**	CHT5204		
2	**Course Title**	Genomics and Proteomics		
3	**Credits**	4		
4	**Contact Hours (L-T-P)**	4-0-0		
5	**Course Type**	Compulsory	Major-I	Theory
6	**Course Objective**	This course aims to provide students with a strong technical foundation and an overview of the fundamental technological concepts of genomics and proteomics methods. Students will learn how these omics approaches are advancing biomedical research. They will get a broad idea of the 'omics' field with an opportunity to go into more depth in future years.		
7	**Course Outcomes**	**CO1** Study organization, sequence, characteristics, and polymorphism of genome **CO2** Learn about traditional & next generation sequencing methods, and major genome sequencing projects **CO3** Understand the basics of databases and approaches to compare genomes, assign gene functions and get familiar with different methods/techniques for genome expression profiling **CO4** Understand the principle of techniques used for analysis of proteome, protein sequencing, localization, identification, and characterization of novel proteins **CO5** Discuss different techniques to study protein-protein interactions and role of proteins in disease diagnosis and drug discovery **CO6** Explain the basic concepts of current and latest techniques applied in genomics and proteomics		
8	**Course Description**	This course provides students some foundational skills in omics data analysis and broad overview on genomics and proteomics technologies and show how these are applied to real-life biomedical problems.		
9	**Outline Syllabus**			CO Mapping
	Unit 1	**Introductory Genomics**		
	A	Introduction to Genomics, prokaryotic and eukaryotic genome organization (intron, exon, promoter, intergenic region, ORF),		CO1, CO6

		content of genome, C value paradox, CoT curve analysis, repetitive DNA	
	B	Tools to study genome diversity (PCR/ RFLP), DNA polymorphism, types of DNA polymorphism,	CO1, CO6
	C	Single nucleotide polymorphism (SNPs), mining of SNPs, applications of SNP technology, use of SNPs for identification of genetic traits	CO1, CO6
	Unit 2	**Structural Genomics**	
	A	Codon biasing, codon-usage and gene expression, exon shuffling, prediction of genes, gene analysis and annotation	CO2,CO6
	B	Traditional methods of sequencing DNA/RNA (sanger method, dideoxy method), NGS methods (pyrosequencing, illumina sequencing, ion torrent etc.), advantages and disadvantages	CO2, CO6
	C	Strategies for major genome sequencing projects, approaches and assembly methods, Human genome project, ethical issues inhuman genome research, hapMap project	CO2, CO6
	Unit 3	**Comparative, Functional genomics & Transcriptomics and Expression Profiling**	
	A	Basic concepts and applications of BLAST2 and MegaBlast algorithms, applications of suffix tree in comparative genomics, pipmaker, comparative genomics databases: COG, VOG	CO3, CO6
	B	Application of sequence based and structure-based approaches to assignment of gene functions, pattern identification, use of various derived databases in function assignment	CO3, CO6
	C	Genome expression analysis, RNA content and profiling, genetic mapping, Microarray (cDNA and protein microarray), transcriptomics and omics study.	CO3, CO6
	Unit 4	**Proteomics**	
	A	Introduction of proteomics, Protein sequencing methods (Edman degradation, MALDI TOF/TOF), strategies in analysis of proteome: 2-D PAGE, Mass spectrometry	CO4, CO6
	B	Structure of proteins, Protein solubility and interaction with solvents and solutes, activity of proteins	CO4, CO6
	C	Strategies for identification and characterization of novel proteins, post translational protein modifications, protein localization, applications of proteome analysis to drug	CO4, CO6
	Unit 5	**Applied Proteomics**	
	A	Protein-protein interaction: Yeast two hybrid, Co-Precipitation, Phage Display, Phylogenetic Profile, Domain fusion	CO5, CO6
	B	Protein chips and functional proteomics, Protein engineering	CO5, CO6
	C	Clinical and biomedical application of proteomics, disease related proteins and drug discovery, disease diagnosis, Databases and search engines in proteomics, proteomics industry	CO5, CO6
	Mode of examination	Theory	

	Weightage Distribution	CA	MSE	ESE
		25%	25%	50%
	Text Book/s *	1. Xia, X. (2007). Bioinformatics and the Cell: Modern Computational Approaches in Genomics, Proteomics and Transcriptomics. United Kingdom: Springer. 2. Ahmad Mir, R., Shafi, S. M., Zargar, S. M. (2023). Principles of Genomics and Proteomics. Netherlands: Elsevier Science.		
	Reference Book/s	1. Saraswathy, N., Ramalingam, P. (2011). Concepts and Techniques in Genomics and Proteomics. United Kingdom: Woodhead Publishing.		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5204.1	3	2	1	3	1	2	2	3
CHT5204.2	2	2	2	2	2	1	2	2
CHT5204.3	2	2	2	1	2	1	1	1
CHT5204.4	2	2	1	1	1	2	2	1
CHT5204.5	2	1	1	1	1	2	2	1
CHT5204.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP5204 Genomics & Proteomics Lab

School: SSES		**Batch:** 2026-27	
Program: M. Sc		**Current Academic Year:** 2025-26	
Branch: Biochemistry		**Semester:** IV	
1	**Course Code**	CHP5204	
2	**Course Title**	Genomics & Proteomics Lab	
3	**Credits**	2	
4	**Contact hours**	0-0-4	
	Course Status	Compulsory	
5	**Course Objectives**	1. Develop comprehensive knowledge of genomic analysis tools such as PCR, RT-PCR, DNA sequencing, and microarray technologies. 2. Train students to use bioinformatics tools for sequence alignment, gene annotation, and structural prediction. 3. Develop skills in designing experiments, analyzing genomic/proteomic data, and interpreting results for biological insights. 4. Develop skills in designing experiments, analyzing genomic/proteomic data, and interpreting results for biological insights. 5. Foster critical thinking and problem-solving skills for addressing research questions in genomics and proteomics.	
6	**Course Outcomes**	**CO1**: demonstrate practical skills in performing genomic and proteomic experiments, including sample preparation, data collection, and analysis. CO2: analyze genomic and proteomic data using relevant computational tools and techniques. CO3: able to design and conduct experiments to investigate genetic variations, protein interactions, and molecular pathways. CO4: present experimental results clearly through reports, presentations, and scientific writing CO5: Analyse biochemical reactions and methods associated with factors affecting proteomics. CO6: apply their knowledge to address biological problems, particularly in fields such as disease research, drug discovery, and functional genomics.	
7	**Course Description**	This manual emphasizes advanced concepts, practical techniques, and data interpretation suitable for PG-level learning.	
8	**Outline Syllabus**		**CO mapping**
	Unit 1	**Basic Bioinformatics Tools**	
	A	Retrieval of Nucleotide sequence from GenBank, Retrieval of Protein sequence from GenBank	CO1, CO6
	B	Designing of primers	CO1, CO6
	C	In silico identification of SNPs.	CO1, CO6
	Unit 2	**Advanced Bioinformatics Tools**	
	A	*In silico* determination of exons and introns in a gene.	CO2, CO6

	B	BLAST and MEGABLAST: Sequence alignment and homology search			CO2, CO6
	C	Genome Annotation Tools: Identification of genes and regulatory elements			CO2, CO6
	Unit 3	**Protein Extraction and Quantification**			
	A	Isolation of total cellular protein			CO3, CO6
	B	Separation of proteins based on molecular weight by SDS-PAGE			CO3, CO6
	C	Protein identification through antibody binding			CO3, CO6
	Unit 4	**Protein-Protein Interaction Studies**			
	A	Yeast Two-Hybrid System			CO4, CO6
	B	Affinity Chromatography			CO4, CO6
	C	Co-immunoprecipitation (Co-IP)			CO4, CO6
	Unit 5	**Proteomics-based databases**			
	A	Predicting Physicochemical properties of protein sequence			CO5, CO6
	B	Predicting cleavage site of protein sequence			CO5, CO6
	C	Predicting secondary structure using SOPMA and CFSSP tool			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	50%	
	Text book/s*	1. Ahmad Mir, R., Shafi, S. M., Zargar, S. M. (2023). Principles of Genomics and Proteomics. Netherlands: Elsevier Science. 2. DeSalle, R., Yudell, M. (2020). Welcome to the Genome: A User's Guide to the Genetic Past, Present, and Future. United Kingdom: Wiley.			
	Other References	1. Primrose, S. B., Twyman, R. (2013). Principles of Gene Manipulation and Genomics. Germany: Wiley. 2. Taneri, B., Asilmaz, E., Delikurt, T., Savas, P., Targen, S., Esemen, Y. (2020). Human Genetics and Genomics: A Practical Guide. Germany: Wiley.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP5204.1	3	2	1	1	1	2	2	3
CHP5204.2	3	2	2	1	2	1	2	3
CHP5204.3	2	2	2	1	2	1	1	3
CHP5204.4	2	2	1	1	1	2	2	3
CHP5204.5	3	1	1	1	1	2	2	3
CHP5204.6	3	1	2	1	2	2	2	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHR5104 Dissertation-II (RBL-2)

School: SSBSR		**Batch: 2025-26**		
Program: M.Sc.		**Current Academic Year: 2025-26**		
Branch: Biochemistry		**Semester IV**		
1	Course Code	**CHR5104**		
2	Course Title	Project		
3	Credits	14		
4	Contact Hours (L-T-P)	0-0-28		
	Course Status	Compulsory		
5	Course Objective	• Develop knowledge of a specific area of specialization. • Develop research skills in project writing and oral presentation.		
6	Course Outcomes	**CO 1**: Able to learn about how to get information of research. **CO 2**: Learn about journal and article and research manuals **CO 3**: Able to know the role of primary, secondary and tertiary sources of information. **CO 4**: Gain knowledge about abstract and citation index. **CO 5**: Also know about digital web resources **CO 6**: Able to learn about basic computer application of research work.		
7	Course Description	This course is designed for students to study topics not offered in regularly available courses. This course encourages reading a field of special interest and gain in-depth update knowledge about it.		
8	Outline			CO Achievement
	Unit 1	**Theoretical foundations of scientific and research work**- To learn the theoretical concept of research; be able to explain what research is and what it is not, and the different definitions of research; introduce the objectives of research, and set the motivation in research		CO1, CO6
	Unit 2	**General methodology of scientific creative work**- Be able to discuss the criteria of good research and the different types of research methods		CO2, CO6
	Unit 3	**The logic of scientific research process**- Be able to formulate the problem of research, to discuss how a research problem is delimited, and evaluated, to acquire knowledge about logic of scientific research process		CO3, CO6
	Unit 4	**The model of research**- Be able to choose the research problem, formulate research topic (thesis) work, to show the relevance of the problems investigated, to set goals and objectives, object and subject of study		CO4, CO6
	Unit 5	**Planning the Research**- Be able to plan the research in the rational way		CO5, CO6
	Mode of examination	4. Rubric assessment 5. Monthly Presentation to be audited by supervisor 6. Mid Term Presentation and End Term Presentation		
	Weightage	CA	CE (Viva + PPT)	ESE

		25%	25%	50%
	Text book/s*	10 Recent International Journal Articles of repute.		
	Other References	-		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR5104.1	3	2	1	3	1	2	2	3
CHR5104.2	2	2	2	2	2	1	2	2
CHR5104.3	2	2	2	1	2	1	1	1
CHR5104.4	2	2	1	1	1	2	2	1
CHR5104.5	2	1	1	1	1	2	2	1
CHR5104.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5205 Bioethics & Biosafety

School: SSES		**Batch:** 2025-2027		
Programme: M.Sc.		**Current Academic Year:** 2026-27		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHT5205		
2	**Course Title**	Bioethics & Biosafety		
3	**Credits**	2		
4	**Contact Hours (L-T-P)**	4-0-0		
5	**Course Type**	Compulsory	DSE	Theory
6	**Course Objective**	1. Define the term "Bioethics," learn about gradation of moral and ethical norms from simpler to higher levels for initiating right actions to 'first do no harm' 2. To apprise the students of the various societal, governance and regulatory issues in biotechnology with special emphasis on ethics, safety. 3. Through this course, the students develop a perspective on the importance of these aspects in the success of biotechnology products and services in the market. 4. At the end of the course, they should be able to apply this perspective and the specific principles, laws, regulations etc., in academic and industrial settings for regulatory oversight and enforcement.		
7	**Course Outcomes**	**CO1**: Students should be able to identify and analyze a range of contemporary bioethical issues, including those related to genetic technologies, end-of-life care, reproductive technologies, and research ethics. **CO2**: Foundations of Bioethics aims to equip students with a comprehensive understanding of ethical principles, theories, and their application to real-world issues in healthcare, research, and public policy. **CO3**: Students should be able to understand and apply basic biosafety principles, identify biohazards, and implement appropriate safety procedures to protect themselves and others in laboratory and research settings. **CO4**: This course outcome will equip you with knowledge of both national and international regulatory mechanisms for Genetically Modified Organisms (GMOs), focusing on safety assessment, approval processes, and international agreements like the Cartagena Protocol **CO5**: students will be able to analyze ethical dilemmas and biosafety protocols in real-world scenarios, apply relevant principles, and critically evaluate potential risks and benefits **CO6**: Understand the fundamentals of research, manuscript/research proposal writing, communication and research ethics		
8	**Course Description**	This course provides a comprehensive introduction to bioethics and biosafety, exploring ethical considerations and safety practices within biochemical and related fields, including legal frameworks, risk assessment, and ethical dilemmas.		

9	**Outline Syllabus**		**CO Mapping**
	Unit 1	**Introduction to Bioethics**	
	A	Introduction to bioethics: Social and ethical issues in biotechnology.	CO1, CO6
	B	Principles of bioethics, Ethical conflicts in biotechnology-interference with nature	CO1, CO6
	C	Unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.	CO1, CO6
	Unit 2	**Foundation of Bioethics**	
	A	Definition, historic evolution, Codes and guidelines, Universal principles	CO2, CO 6
	B	Clinical ethics: Describe the sanctity of human life and the need to preserve human life	CO2, CO 6
	C	Explain about issues related to prenatal screening, clinical trials (Phase I/II/III/IV) studies	CO2, CO 6
	Unit 3	**Introduction to Biosafety**	
	A	Overview of Biosafety	CO3, CO 6
	B	Risk Assessment	CO3, CO 6
	C	Cartagena Protocol on Biosafety, Capacity Building	CO3, CO 6
	Unit 4	**National and International Regulatory Mechanism for GMO**	
	A	Introduction, International Regulatory Bodies, National Regulatory Bodies	CO4, CO 6
	B	Regulatory Measures for Biosafety, Biosafety Guidelines in India Evolved by DBT	CO4, CO 6
	C	Prevention Food Adulteration Act, Food and Safety Standard Bill and Seed Policy, Rules for the Manufacture and Storage of Hazardous Microorganism and GMO, Biosafety Management	CO4, CO 6
	Unit 5	**Case studies in Bioethics and Biosafety**	
	A	*Bt* Brinjal: A case study in biosafety risks to plant biodiversity	CO5, CO 6
	B	*Bt* Cotton: A case study in biosafety risks to plant biodiversity	CO5, CO 6
	C	Golden Rice: A case study in biosafety risks to plant biodiversity	CO 5, CO 6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25%	MSE: 25% / ESE: 50%
	Text Book/s *	1. Guidry-Grimes, L. K., Veatch, R. M. (2019). The Basics of Bioethics. United Kingdom: Taylor & Francis. 2. Vikraman, N. (2020). Best Textbook of Bioethics Biosafety and IPR: For Medical/Pharmacy/Nrusing/BE/B.TECH/BCA/MCA/ME/M. TECH/Diploma/B. Sc/M. Sc/Competitive Exams and Knowledge Seekers. (n.p.): Independently Published.	

	Other References	1. Sateesh, M. K. (2013). Bioethics and Biosafety. India: I.K. International Publishing House Pvt. Limited. 2. Joshi, R. (2006). Biosafety and Bioethics. India: Isha Books.1. Bioethics and Biosafety, 1st edition (2008), M. K Sateesh, I K International Pvt Ltd, ISBN13: 978-8190675703.

Mapping: CO Vs POs and PSOs

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5205.1	3	2	1	1	1	2	3	3
CHT5205.2	3	2	2	2	2	1	3	3
CHT5205.3	2	2	2	2	2	1	3	3
CHT5205.4	1	2	1	2	1	2	3	3
CHT5205.5	3	2	1	1	1	2	3	3
CHT5205.6	3	2	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5206 Clinical Biochemistry

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2026-27		
Branch: Biochemistry		**Semester:** III		
1	**Course Code**	CHT5206		
2	**Course Title**	Clinical Biochemistry		
3	**Credits**	2		
4	**Contact Hours (L-T-P)**	2-0-0		
5	**Course Type**	Compulsory	SEC	Theory
6	**Course Objectives**	1. To understand and apply knowledge of the theory and practice of clinical biochemistry. 2. To know how biochemical investigations are employed to develop a clinical diagnosis. 3. To promote research skills lifelong learning and career development.		
7	**Course Outcomes**	**CO1:** Understand the Basic concepts and principles of Clinical Biochemistry, detail on the various biological specimens including the process of collection, preservation and storage. **CO2:** Understand the pathophysiological processes responsible for common Biochemical disorders such as jaundice, Fatty liver etc. **CO3:** Gain understanding of the need for organ function tests. **CO4:** Detail the carbohydrate, protein, and nucleic acid metabolism disorders. **CO5:** Understand the molecular basis of Cancer and its diagnosis through various techniques. **CO6:** Review the information from each category of tests and develop a protocol for disease diagnosis		
8	**Course Description**	The course provides an overview of normal and abnormal metabolic functions, the impact of disorders on metabolic processes, an overall picture about the molecular basis of diseases and novel strategies to prevent the diseases.		
9	**Outline Syllabus**			CO Mapping
	Unit 1	**Introduction to Clinical Biochemistry**		
	A	Introduction to basic concepts and principles of Clinical Biochemistry. Specimen collection and Processing of blood and urine.		CO1, CO6
	B	Anticoagulants. Blood groups, Adverse reactions of blood transfusions.		CO1, CO6
	C	Amniotic fluid-origin, collection and composition		CO1, CO6
	Unit 2	**Liver Function Related Disorders**		
	A	Jaundice, Cirrhosis, Hepatitis		CO2, CO 6
	B	Serum enzyme activities in liver diseases.		CO2, CO 6
	C	Acute and chronic renal failure		CO2, CO 6
	Unit 3	**Gastric Function Disorders**		
	A	Assessment of Gastric function Tests.		CO3, CO 6
	B	Pancreatic function test		CO3, CO 6

	C	Intestinal function tests.			CO3, CO 6
	Unit 4	**Inborn Errors of Metabolism**			
	A	Glycogen storage diseases, Diabetes insipidus			CO4, CO 6
	B	Phenylketonuria, Alkaptonuria, Maple syrup urine disease			CO4, CO 6
	C	Gout, Hemoglobinopathies, Thalassemias, Hereditory methemoglobinemia.			CO4, CO 6
	Unit 5	**Cancer Diagnostics**			
	A	Cancer cells, difference between cancer and normal cells.			CO5, CO 6
	B	Tumor markers, classification, functions.			CO5, CO 6
	C	Medical imaging techniques – CT, MRI, PET			CO5, CO 6
	Mode of examination	Theory			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text Book/s	1. Gaw, A., Murphy, M., Srivastava, R., Cowan R.A., O'Reilly., D. St. J. (2013). Clinical Biochemistry: An Illustrated Colour Text. 5th Ed. Philadelphia: Churchill Livingstone 2. Basten, G., (2011). Introduction to Clinical Biochemistry, Interpreting Blood Results. 2nd edition. BookBoon.			
	Other references	1. Kaplan L.A., Pesce A.J. (2009). Clinical Chemistry: Theory, Analysis, Correlation. 5th Ed: Philadelphia Elsevier Health – US 2. Nessar Ahmed, N. (2011). Clinical Biochemistry. 1st Ed: Oxford University Press.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5206.1	3	1	1	1	1	2	3	3
CHT5206.2	3	1	2	2	2	1	3	3
CHT5206.3	3	2	2	2	2	1	3	3
CHT5206.4	3	2	1	2	1	2	3	3
CHT5206.5	3	1	1	1	1	2	3	3
CHT5206.6	3	1	2	1	2	2	3	3

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5205 Advanced Cell Biology

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** II		
Course Code		CHT5205		
Course Title		Advanced Cell Biology		
1	**Credits**	4		
2	**Contact Hour**	4-0-0		
	Course Status	Compulsory	Core	Theory
5	Course Objective	1. To gain detailed knowledge about cell biology. 2. To achieve an understanding of the various cellular organelles. 3. To understand signal transduction pathways associated with the cellular processes of the cells. 4. To identify active areas of cell biology research. 5. To read and discuss current scientific cell biology literature.		
6	Course Outcome	**CO1**: Learn about cell theory, cell cycle mechanisms, various cellular organelles, and their fractionation. **CO2**: Acquire insight into the processes of transport across cell membranes, process of endocytosis and protein sorting/translocation to various organelles. **CO3**: Gain knowledge about the concepts of various cellular signal transduction pathways. **CO4**: Acquire insight into the mechanisms of cellular responses under varying conditions. **CO5**: Learn the association of the defects in the signaling processes to various diseases. **CO6**: Have an overview of advanced methodologies used in cell biology research.		
7	Course Description	The course is designed to understand the fundamental elements of cell biology.		
8	**Outline syllabus**			**CO mapping**
	Unit 1	**Cellular Organization, Sub-cellular Organelles and Cytoskeleton**		
	A	Historical background, Membrane models, chemical composition of membrane, membrane proteins, movement of small and large molecules across the cell membrane, osmosis, diffusion, endocytosis, phagocytosis.		CO1, CO6
	B	Structure and functions of intracellular organelles such as nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, plastids, peroxisomes.		CO1, CO6
	C	Structure, organization and function of microtubules and microfilaments, role of myosin, kinesin and dynein, cell movements.		CO1, CO6
	Unit 2	**Protein Sorting and Targeting**		
	A	Historical background, Protein translocation across ER membrane, SRP. Modification and quality control of protein in ER: Golgi vesicular traffic.		CO2, CO6

	B	Protein import in mitochondria, peroxisomes, chloroplasts. Signal for Import and Export of Macromolecules from Nucleus.	CO2, CO6
	C	Glycosylation in mammalian cells, origin, nature and types of Glycosylation. Role of Glycosylation in protein stability and folding with reference to ER exit.	CO2, CO6
	Unit 3	**Cellular Signaling**	
	A	General principles of signaling by cell surface receptors, endocrine, paracrine, and autocrine signaling, types of cellular responses induced by signaling molecules, components of intracellular signal-transudation pathways.	CO3, CO6
	B	G-protein coupled receptor system, General mechanism of the activation of effectors molecules associated with GPCRs, GPCRs that activate or inhibit adenylate cyclase, activate phospholipase C, regulating ion channels.	CO3, CO6
	C	Signaling of growth factors (EGF and Insulin) via activation of receptor tyrosine kinases. Signaling of TGFβ by direct activating Smad proteins. Cytokine signaling via JAK/STAT pathway.	CO3, CO6
	Unit 4	**Cell Cycle and Cell Death**	
	A	Cell cycle, role of cyclins, cylcin dependent kinase in cell cycle progression. Apoptosis; pro-apoptotic and anti-apoptotic regulators, mechanism of necrosis and autophagy.	CO4, CO6
	B	Restriction point of cell cycle and Quiescent cells. Control of cell cycle in yeast and mammalian cells.	CO4, CO6
	C	Programmed cell death and role of Caspase protein in apoptosis. Various pro-apoptotic and anti-apoptotic regulators and pathways.	CO4, CO6
	Unit 5	**Cancer Biology**	
	A	Definition and classification; evolution of cancer cells; cellular oncogenes; oncogene, viral-oncogene, tumorigenicity, tumor suppressor genes; p53, Rb and PTEN	CO5, CO6
	B	Genetic rearrangements in progenitor cells, cancer and the cell cycle, virus-induced cancer, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth, embryonic signature in cancer cells.	CO5, CO6
	C	Growth factor, receptors and cancer, detection and monitoring of metastasis process in animal models; osteoblastic & osteolytic metastasis, Success and failure of chemotherapy, targeted specific therapy, monoclonal antibody for cancer treatment, micro-RNA mediated cancer treatment and targeted drug delivery, drug resistance, molecular diagnosis and stem cell therapy.	CO5, CO6
	Mode of Examination	Theory	

	Weightage Distribution	CA	MSE	ESE
		25%	25%	50%
	Text Book/s*	1. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P Walter. (2021). Molecular Biology of the Cell, Garland Publishing, Inc. New York. USA. 2. G.M. Cooper. (2021). The Cell: Molecular Approach, ASM Press, Washington, D.C. USA.		
	Other References	1. Wilson, J., Hunt, T. (2014). Molecular Biology of the Cell 6E - The Problems Book. United States: W.W. Norton.		

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5205.1	3	2	1	3	1	2	2	3
CHT5205.2	2	2	2	2	2	1	2	2
CHT5205.3	2	2	2	1	2	1	1	1
CHT5205.4	2	2	1	1	1	2	2	1
CHT5205.5	2	1	1	1	1	2	2	1
CHT5205.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHT5207 Pharmaceutical Biochemistry

School: SSES		**Batch:** 2025-27		
Programme: M.Sc.		**Current Academic Year:** 2025-26		
Branch: Biochemistry		**Semester:** II		
Course Code		CHT5207		
Course Title		Pharmaceutical Biochemistry		
1	**Credits**	4		
2	**Contact Hour**	4-0-0		
	Course Status	Compulsory	Core	Theory
5	Course Objective	The student will gain insight into the working of a pharma industry, various classes of biotech products and the regulations governing production and marketing of pharmaceutical products. They will be prepared for careers in applied research or product development in the pharmaceutical industry.		
6	Course Outcome	**CO1:** Understanding the process of drug discovery, drug delivery along withvalidation techniques **CO2:** Learn about the various routes of drugs administration, drug toxicity,vaccines and proteins as pharmaceutical drugs **CO3:** Know about the xenobiotics, drug receptors, mechanism of action andmetabolism of drugs **CO4:** Evaluate and screen the drugs using *in vitro*, *in vivo* (animal models/humans) & *ex-vivo* experiments **CO5:** Discuss some biotechnological products in clinical trials and role of various organizations in regulation of pharmaceutical products along withethical issues **CO6:** To understand the fundamentals of pharmacology and regulations governing production and marketing of pharmaceutical products.		
7	Course Description	This course describes the process of drug discovery, delivery, toxicity, and their mechanisms of action. It focuses on fundamentals of drug screening using animal models & humans, and guidelines of regulatory bodies in regulation of pharmaceutical products.		
8	**Outline syllabus**			**CO mapping**
	Unit 1	**Drug Discovery Methods**		
	A	Meaning of drugs, difference between drug and medicine, Drug Discovery Process, biological activity directed and other types of screening, natural products, combinatorial chemistry		CO1, CO6
	B	General overview of validation techniques, Methods of Drug Discovery and development, QSAR and SAR.		CO1, CO6
	C	Concepts of Bio availability, Process of drug absorption, Timing for optimal therapy, Drug delivery considerations for the new biotherapeutics,		CO1, CO6
	Unit 2	**Pharmacology of Drugs**		
	A	Basic terminologies in drug delivery and drug targeting, Doses forms, Various routes of drugs administration, effects of route of administration, drug delivery		CO2, CO6
	B	Introduction to vaccines, types of vaccine, importance of		CO2, CO6

		vaccine, DNA vaccines, vaccines & monoclonal antibody-based pharmaceuticals, antibiotics, characterization and bioanalytical aspects of recombinant proteins as pharmaceutical drugs	
	C	Pharmacokinetics and Pharmacodynamics of drugs, drug toxicity	CO2, CO6
	Unit 3	**Drug Metabolism and Interactions**	
	A	Drug-receptor interactions, receptor theories and drug action Xenobiotics, xenobiotics phases (Phase-I, Phase-II and Phase-III), role of cytochrome P450 oxidases and glutathione S-transferases in drug metabolism, factors affecting drug metabolism	CO3, CO6
	B	Drug targets, Enzymes as a drug target, Kinase inhibitors, ATPase inhibitors, drug protein interaction, Drug-DNA interaction, Basic ligand concepts-agonist, antagonist, partial agonist, inverse agonist, efficiency and potency	CO3, CO6
	C	Forces involved in drug-receptor complexes. Receptor classification – the four super families. Receptor binding assays- measurement of Kd, Bmax and IC50.	CO3, CO6
	Unit 4	**Drug Delivery and Trials**	
	A	General principles of screening, correlations between various animal models and human situations, Correlation between in-vitro and in-vivo screens; Special emphasis on cell-based assay, biochemical assay, radiological binding assay, Pharmacological assay	CO4, CO6
	B	In vitro, In vivo & Ex-vivo experiments, Preclinical and clinical trials (Phase-I, Phase-II, Phase-III and Phase-IV clinical trial)	CO4, CO6
	C	Main features of clinical trials, including methodological and organizational considerations and the principles of trial conduct and reporting. Key designs surrounding design, sample size, delivery and assessment of clinical trials.	CO4, CO6
	Unit 5	**Formulations and Regulations**	
	A	Formulation of Biotechnological Products, Examples of some Biotechnological products in clinical development.	CO5, CO6
	B	Food and drug administration (FDA), role of FDA, international council for harmonization (ICH), ICH guidelines, current good manufacturing practice (cGMP), importance of cGMP	CO5, CO6
	C	Regulation of pharmaceutical biotechnological products and ethical issues.	CO5, CO6
	Mode of Examination	Theory	
	Weightage Distribution	CA: 25% / MSE: 25% / ESE: 50%	
	Text Book/s*	1. Woodbury, C. P. (2011). Biochemistry for the Pharmaceutical Sciences. United States: Jones & Bartlett Learning. 2. Lal, H. (2019). Essentials of Pharmaceutical Biochemistry Including Practical Exercises. India: CBS Publishers &	

		Distributors.
	Other References	1. Komoda, T., Matsunaga, T. (2015). Biochemistry for Medical Professionals. Netherlands: Elsevier Science. 2. J.F.V.Mil, F. Costa and A. Alvarez-Risco. (2019) The Pharmacist Guide to Implementing Pharmaceutical Care. Germany: Springer International Publishing. ISBN: 978-3319925752

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHT5207.1	3	2	1	1	1	2	2	3
CHT5207.2	3	2	2	1	2	1	2	2
CHT5207.3	3	2	2	1	2	1	1	1
CHT5207.4	3	2	1	1	1	2	2	1
CHT5207.5	3	1	1	1	1	2	2	1
CHT5207.6	3	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHP5205 Pharmaceutical Biochemistry Lab

School: SSES		**Batch:** 2025-27		
Program: M.Sc.		**Current Academic Year:** 2026-2027		
Branch: Biochemistry		**Semester:** IV		
1	**Course Code**	CHP5205		
2	**Course Title**	Pharmaceutical Biochemistry Lab		
3	**Credits**	2		
4	**Contact hours**	0-0-4		
	Course Status	Compulsory	Core	Practical
5	**Course Objectives**	1. To understand the Principles of Pharmaceutical Biochemistry Lab 2. Learn the process to synthesize crystals of therapeutic monosaccharides and disaccharides 3. To master the techniques to explore protein and carbohydrate quantification of therapeutic nature 4. To perform the separation techniques to isolate bioactive compounds from plant sources 5. To undergo the process of cell disruption process using homogenization and ultrasound technology		
6	**Course Outcomes**	**CO1:** Students will learn techniques for isolating various bioactive compounds from plant sources **CO2:** Analyze and understand the process technology behind the formation of therapeutic crystals of monosaccharides and disaccharides **CO3:** Students will gain expertise in quantifying therapeutic proteins and carbohydrates **CO4:** Students will master the techniques involved in the process of cell disruption using homogenization, centrifugation and acoustic study **CO5:** Students can analyse and understand the skills to estimate different kinds of vitamins using titration method **CO6:** Equip students with the skills to pursue careers in the area of pharmaceutical industries, specializing in the quantification of therapeutic proteins, carbohydrates and mastering isolation and separation techniques involved in therapeutic molecules		
7	**Course Description**	Students will gain practical skills in pharmaceutical biochemistry, estimation and quantification of vitamins, proteins and carbohydrates, isolation of bioactive compounds from plant sources		
8	**Outline Syllabus**			**CO mapping**
	Unit 1	**Isolation and estimation of bioactive compounds and from plant sources**		
	A	Bioactive compound isolation from bark of medicinal plants		CO1, CO6
	B	Bioactive compounds isolation of roots of medicinal plants		CO1, CO6
	C	Estimation of secondary metabolites from bark and roots of medicinal plants		CO1, CO6
	Unit 2	**Isolation and estimation of therapeutic proteins from edible plants and animals**		
	A	Isolation of therapeutic proteins from soyabean, rajma and pulses		CO2, CO6

	B	Isolation of therapeutic proteins from egg and milk			CO2, CO6
	C	Quantification of therapeutic proteins using Bradford and Lowrys method			CO2, CO6
	Unit 3	**Estimation of Vitamins**			
	A	Estimation and quantification of vitamin A			CO3, CO6
	B	Estimation and quantification of vitamin C			CO3, CO6
	C	Estimation and quantification of vitamin B complex			CO3, CO6
	Unit 4	**Separation and characterization of bioactive compounds**			
	A	Separation of bioactive compounds using paper chromatography and TLC			CO4, CO6
	B	Characterization of proteins and bioactive compounds using UV-Visual spectroscopy and IR spectroscopy			CO4, CO6
	C	Characterization of compounds using HPLC and electrophoresis			CO4, CO6
	Unit 5	**Estimation of drug dissolution and half-life of drugs**			
	A	Estimation of drug solubility of aspirin and paracetamol			CO5, CO6
	B	Estimation of half-life of aspirin			CO5, CO6
	C	Estimation of half-life of paracetamol			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	CE Viva	ESE	
		30%	30%	40%	
	Text book/s*	1. Agarwal, S., Khan, S. (2018). Advanced Lab Practices in Biochemistry and Molecular Biology. India: I.K. International Publishing House Pvt. Limited. 2. Roy, J. (2011). An Introduction to Pharmaceutical Sciences: Production, Chemistry, Techniques and Technology. United Kingdom: Elsevier Science.			
	Other References	1. Kowalski, T. (2001). Calibration in the Pharmaceutical Laboratory. United States: Taylor & Francis.			

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHP5205.1	3	2	1	3	1	2	2	3
CHP5205.2	2	2	2	2	2	1	2	2
CHP5205.3	2	2	2	1	2	1	1	1
CHP5205.4	2	2	1	1	1	2	2	1
CHP5205.5	2	1	1	1	1	2	2	1
CHP5205.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHR5103 Dissertation I (RBL-1)

School: SSES		**Batch:2025-2027**
Programme: M.Sc.		**Current Academic Year: 2024-25**
Branch: Biochemistry		**Semester III**
1	Course Code	**CHR5103**
2	Course Title	Dissertation I (RBL-1)
3	Credits	16
4	Contact Hours	0-0-32
	Course Status	Compulsory
5	Course Objective	1. Develop knowledge of a specific area of specialization. 2. Develop research skills in project writing and oral presentation.
6	Course Outcomes	CO1: Understand the objectives of research. CO2: Acquire the methodology of scientific work. CO3: Understand the reason behind scientific research. CO4: Prepare the model of research work. CO5: Prepare the roadmap for research work. CO6: Prepare students to face challenges in solving unsolved problems.
7	Course Description	This course is designed for students to study topics not offered in regularly available courses. This course encourages reading a field of special interest and gain in-depth update knowledge about it.

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR5103.1	3	2	1	3	1	2	2	3
CHR5103.2	2	2	2	2	2	1	2	2
CHR5103.3	2	2	2	1	2	1	1	1
CHR5103.4	2	2	1	1	1	2	2	1
CHR5103.5	2	1	1	1	1	2	2	1
CHR5103.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHR5104 Dissertation II (RBL-2)

School: SSES		**Batch:2025-2027**
Programme: M. Sc.		**Current Academic Year: 2024-25**
Branch: Biochemistry		**Semester IV**
1	Course Code	**CHR5104**
2	Course Title	Dissertation II (RBL-2)
3	Credits	14
4	Contact Hours (L-T-P)	(0-0-28)
	Course Status	Compulsory
5	Course Objective	1. This course will help to ensure that students are able to demonstrate advanced knowledge of the role of science and of its contribution to the disciplines related to the field of technology. 2. Critically analyze and interpret the results of scientific and technological research, and evaluate its limits and possibilities with respect to knowledge and its implementation.
6	Course Outcomes	CO1: To be able to identify and describe methods within the philosophy of science in general. CO2: Extract line of approach to overcome the research gap. CO3: To acquire an overview of important characteristics within technological research and development. CO4: To identify the relation between pure science on the one hand and applied research on the other, the relation between research and practice, and the relation between technology and society. CO5: To demonstrate an understanding of the limits and possibilities for research in science and technology. CO6: To acquire skills of presenting arguments and results of scientific and technological research.
7	Course Description	This course will deepen the student's understanding of research in general, and with basic science and technological research in particular. The students are expected to apply knowledge of methodology, concepts, philosophical problems, and arguments presented in this course to their own fields of exploration.

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR5104.1	3	2	1	3	1	2	2	3
CHR5104.2	2	2	2	2	2	1	2	2
CHR5104.3	2	2	2	1	2	1	1	1
CHR5104.4	2	2	1	1	1	2	2	1
CHR5104.5	2	1	1	1	1	2	2	1
CHR5104.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHR5105 Minor project/Term paper (Dissertation II / RBL-2)

School: SSES		**Batch :2025-27**
Programme: M.Sc.		
Branch: Biochemistry		**Semester: IV**
1	Course Code	CHR5105
2	Course Title	Minor project/Term paper (Dissertation II or RBL-2)
3	Credits	3
4	Contact Hours	0-0-6
	Course Status	Compulsory
5	Course Objective	1.To enhance the practical knowledge and result analysis skills.
		2.To enable the students, experience a real-life problem solving under the supervision of faculty members. 3.To prepare the students perform functions that demand higher competence in national/international organizations. 4.To train the students in scientific research. 5.To help the students find meaning in life by broadening their field of vision. 6.Develop deep knowledge of a specific area of specialization by literature search.
6	Course Outcomes	CO1: Able to do literature search, develop deeper interest / inquisitiveness in chemistry and interdisciplinary subjects. CO2: Able to prepare stock solutions, buffers etc . CO3: Understand the basics of chemistry and become familiar with qualitative and qualitative estimations. CO4: Able to understand the chemistry of reactions. CO5: Able to analyses the results and understand the chemical reactions involved. CO6: Enhance the practical skills.
7	Course Description	This course provides the applied knowledge of chemistry and gives confidence and a solid foundation for future learning.

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR5105.1	3	2	1	3	1	2	2	3
CHR5105.2	2	2	2	2	2	1	2	2
CHR5105.3	2	2	2	1	2	1	1	1
CHR5105.4	2	2	1	1	1	2	2	1
CHR5105.5	2	1	1	1	1	2	2	1
CHR5105.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

CHR5106 Dissertation II (RBL-2)

School: SSES		**Batch :2025-27**
Programme: M.Sc.		
Branch: Biochemistry		**Semester: IV**
1	Course Code	CHR5106
2	Course Title	Dissertation II (RBL-2)
3	Credits	6
4	Contact Hours (L-T-P)	0-0-12
	Course Status	Compulsory
5	Course Objective	1. To enhance the practical knowledge and result analysis skills. 2. To enable the students, experience a real-life problem solving under the supervision of faculty members. 3. To prepare the students perform functions that demand higher compresence in national/international organizations. 4. To train the students in scientific research. 5. Develop research/ experimentation skills as well as enhancing project writing and oral presentation skills 6. Inculcate team spirit and time management.
6	Course Outcomes	CO1: Able to use lab instruments independently. CO2: Cultivate the understanding of problem, study design, methodology/ experimentation, significance of reproducibility of results. CO3: Understanding of ethics of science and research for supporting higher studies. CO4: Learn effective project organizational skills along with discussions, result interpretation and paper writing. CO5: Able to analyse the results and understand the chemical reactions involved. CO6: Enhance the practical skills.
7	Course Description	This course will help to develop knowledge and research skills applicable to a career in chemistry.

Mapping of CO vs. PO

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CHR5106.1	3	2	1	3	1	2	2	3
CHR5106.2	2	2	2	2	2	1	2	2
CHR5106.3	2	2	2	1	2	1	1	1
CHR5106.4	2	2	1	1	1	2	2	1
CHR5106.5	2	1	1	1	1	2	2	1
CHR5106.6	2	1	2	1	2	2	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)


ACCREDITED WITH GRADE
A+
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