Govt. Nagarjuna PG Autonomous College of Science

Raipur (C.G.), India 492010

CURRICULUM & SYLLABI

(Based on CBCS & LOCF)

M. Sc. Biochemistry

Semester System

Semester: I-IV

Session: 2025-27

The syllabus for M.Sc. Bio-Chemistry is hereby approved for the session 2025-26 & 2026-27. In case any change or modification is prescribed by Central Board of Studies or Higher Education Department, Govt. of Chhattisgarh or Pt. RSU Raipur for Postgraduate syllabi, it will be implemented accordingly.

Approved by:	**Board of Studies Biochemistry**	**Academic Council**
Date: 18/07/2025	Chairman (B.O.S.)	

M. Sc. Biochemistry

The Students of M.Sc. Biochemistry program will learn experimentally and theoretically about the chemistry of biological phenomenon of living organisms. The course aims to provide the skills of identifying scientific issues, developing hypothesis based on literature, designing experiments and displaying results for betterment of mankind. To prepare students for the future careers in the concerned/various relevant fields in which a core understanding of the chemistry of life is important. This program would add highly skilled scientific workforce in the area of biomedical research sectors, academic, industry as well as for research laboratories across the country and the globe by following best practices for improving the professionalization and employability of students. This program would provide the practical and technical skills with laboratory-based work and the final year research project would prepare the students for a research or technical position by defining specific and transferable skills. Aim of this program to sensitize and train the students towards research with typical employers include pharmaceutical, biotechnology, food, water and agricultural companies and specialist services, such as toxicological studies and train the students in generic and competency skills so as to be able to work in potential places including scientific and medical publishers and the Intellectual Property Office.

Program Outcome:

On successful completion of this program the graduates shall have:

PO1.	**Knowledge:** A knowledge of contemporary issues related to biochemistry. Ability to demonstrate the fundamental knowledge of molecules of life, molecular techniques, toxicology in the area of biochemistry.
PO2.	**Critical Thinking and Reasoning:** Ability to think critically and apply the same to update scientific knowledge.
PO3.	**Problem Solving:** Ability to identify, formulate and solve professional problems in the area of biochemistry, experimental skill and critical thinking, students will be capable of addressing intricate societal and industrial challenges.
PO4.	**Advanced Analytical and Computational Skills:** Ability to design experiment and interpret the results. An ability to design a system, or process to meet desired need within realistic constraints
PO5.	**Effective Communication:** An ability to communicate effectively in scientific reasoning and data analysis in both written and oral forms.
PO6.	**Social/ Interdisciplinary Interaction:** Ability to function in a multidisciplinary team.
PO7.	**Self-directed and Life-long Learning:** A recognition of the needed for and an ability to engage in lifelong learning in the area of biochemistry.
PO8.	**Effective Citizenship: Leadership and Innovation:** An ability to use the techniques, skills and modern professional tools necessary for professional practice and for research.
PO9.	**Ethics:** An understanding of professional and ethical responsibility in the area of biochemistry.
PO10.	**Further Education or Employment:**
PO11.	**Global Perspective:** The broad education necessary to understand the impact of solutions in a global, economic, environmental and societal context.

Program Specific Objectives:

PSO1.	Students shall be able to identify, formulate and solve the problems of biological metabolisms, protein biochemistry and molecular biology.
PSO2.	Students shall be able to conduct the experiments in the field of medicine, toxicology and immunology as well as to analyses and interpret the results.
PSO3.	Students shall be able to use the biochemical techniques, bioinformatics tools, biostatistics, skills and modern pathological tools necessary for professional practice and for research.

M. Sc. Biochemistry

Specification of Course	Semester	No. of Courses	Credits
Core	I-IV	22	90
Elective	IV	09	10
Total		31	100
Additional Courses (Qualifying in nature, for Student admitted in School of Studies only)			
Generic Elective	II-III	02	04
Indian Knowledge System/ Skill Enhancement / Value Added Courses	I, III	02	04

M.Sc. Biochemistry: Program Structure

Semester	Course Nature	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
							CIA	ESE	Total
Semester-I	Core	(BCH-110)	Cell and Molecular Biology	T	5	5	30	70	100
	Core	(BCH-120)	Chemistry of Biomolecules	T	5	5	30	70	100
	Core	(BCH -130)	Microbial Biochemistry	T	5	5	30	70	100
	Core	(BCH-140)	Biology of Immune System	T	5	5	30	70	100
	Core	(BCH-150)	Lab Course I (Based on paper I & II)	P	6	3	30	70	100
	Core	(BCH-160)	Lab Course II (Based on paper III & IV)	P	6	3	30	70	100
TOTAL						**26**	**180**	**420**	**600**
Semester-II	Core	(BCH-210)	Human Physiology	T	5	5	30	70	100
	Core	(BCH-220)	Bioenergetics & Metabolism	T	5	5	30	70	100
	Core	(BCH-230)	Biophysical chemistry and Biochemical Techniques	T	5	5	30	70	100
	Core	(BCH-240)	Biometry, Computer and Scientometry	T	5	5	30	70	100
	Core	(BCH-250)	Lab Course III (Based on paper I & II)	P	4	2	30	70	100
	Core	(BCH-260)	Lab Course IV (Based on paper III & IV)	P	4	2	30	70	100
TOTAL						**24**	**180**	**420**	**600**
Semester-III	Core	(BCH-310)	Genetic Engineering	T	5	5	30	70	100
	Core	(BCH-320)	Plant Physiology and Biochemistry	T	5	5	30	70	100
	Core	(BCH-330)	Nutritional and Environmental Biochemistry	T	5	5	30	70	100
	Core	(BCH-340)	Enzymology	T	5	5	30	70	100
	Core	(BCH-350)	Lab Course V (Based on paper I & II)	P	4	2	30	70	100
	Core	(BCH-360)	Lab Course VI (Based on paper III & IV)	P	4	2	30	70	100
TOTAL						**24**	**180**	**420**	**600**
Semester-IV	Core	(BCH-410)	Clinical Biochemistry and Endocrinology	T	5	5	30	70	100
	Core	(BCH-420)	Nutraceuticals and Functional Foods	T	5	5	30	70	100
	Elective-1 (Select any one)	(BCH-430- A)	Plant Biotechnology	T	5	5	30	70	100
		(BCH-430 B)	Infectious Diseases: Molecular basis, Control and Prevention	T			30	70	100
	Elective-2 (Select any one)	(BCH-440 A)	Life Style Disorders: Cancer and Cardiovascular Diseases	T	5	5	30	70	100
		(BCH-440B)	Bioinformatics	T			30	70	100
	Core	(BCH-450)	Lab Course I (Based on paper I & II)	P	6	3	30	70	100
	Core	(BCH-460)	Lab Course II (Based on paper III & IV)	P	6	3	30	70	100
						26	**180**	**420**	**600**
	OR Project work / Dissertation								
Semester-IV	Elective	BCH-470	Dissertation	P		14	90	210	300
			Seminar based on project	P		06	30	70	100
			Viva-voce	P		02	30	70	100
		BCH-480	Bio-safety, Bio-ethics and IPR Or Can opt paper(s) from MOOC courses (Swayam portal)**	T		4	30	70	100
			TOTAL			**26**			**600**

Internship*

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	-	-	T/P	*	2	30	70	100

*Total duration- 60 hours after examination of 2nd Semester, internship shall be done by students as guideline provided by University/ Autonomous Examination Cell of the college.

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a) The chosen paper will be other than the papers offered in the current course structure.
b) The paper will be for PG level with a minimum of 12 weeks duration.
c) The list of courses on SWAYAM keeps changing; the departmental committee will finalize the list of MOOC courses for each semester.
d. The paper(s) may be chosen from the Swayam Portal on the recommendation of the Head of the Department or its nominee / Professor in Charge.

1. The candidates who have joined the PG Programme, shall undergo Generic Elective Courses (only qualifying in nature) offered by other departments/SOS in Semester II and Semester III.
2. The candidates, who have joined the PG Programme shall undergo Skill Enhancement Course/Value Added Course (only qualifying in nature) in Semester I and Semester II.

Project Work

A student of IV semester will have the choice to opt for project work in lieu of four theory papers and two lab courses provided. The project has to be carried out in recognized national laboratories or UGC-recognized universities. Student will also be allowed to carry out project work a) Recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur, b) laboratories/ college/ institutions with academic and/or research MOU with this college, C) Private laboratories/ colleges /Institutions after approval of departmental committee. The valuation of all the projects will be carried out by an external examiner and HOD of Biochemistry or its nominee at the College.

Generic Elective (Any two): For Non- Biochemistry students (Offered to PG students of other Departments)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	BCH 270	BCH GE-1: Biomolecules	T	2	2	30	70	100
	BCH 280	BCHGE-2: Intermediary Metabolism	T	2	2	30	70	100
III	BCH 370	BCH GE-3: Biochemical Techniques	T	2	2	30	70	100
	BCH 380	BCH GE-4: Nutritional Biochemistry	T	2	2	30	70	100

Skill Enhancement Elective Course: (Offered to the PG students of Biochemistry)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
I/II/III	BCH 170	BCH SEC-1: Research Skill	P	2	2	30	70	100
Course on- INDIAN KNOWLEDGE SYSTEM (IKS)								
I/II/III	BCH 180	BCH IKS: Indian Health Sciences	T	2	2	30	70	100
Value Added Courses								
I/II/III	BCH 390	BCH VAC -1: Nanobiology	P	2	2	30	70	100

Evaluation & Assessment -

1. **Passing Criteria –** 40% of total marks (ESE+CIA)

Course	**ESE**	**CIA**	**M.M.**	**P.M.**	**Remarks**
Theory	70	30	100	40	For P.M. the ESE & CIA put together
Lab Course#	70	30	100	40	For P.M. the ESE & CIA put together

2. **Continuous Internal Assessment (CIA) Evaluation –** Out of 30 marks allocated for CIA for each paper:

Class Test	20 Marks
Assignment/ Seminar	10 Marks
Total	**30 Marks**

3. **Marks Distribution in ESE Lab Course** –

Activities	**Marks**
Laboratory Performance- On spot Assessment Performed the Task based on Lab work	40
Spotting based on Tools and Technology (written)	20
Viva-Voce	10
Total Marks	**70**

4. **End Semester Examination (ESE)–**

Three Section A, B & C. **M.M-70**
Section A: MCQs/ Objective Type- 1 mark x10 = 10 marks
Section B: Short Answer Type- 5 marks x 4 = 20 marks
Section C: Long Answer Type- 10 marks x 4 = 40 marks, (1 out of 2 from each unit).

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Programme Articulation Matrix:

Following matrix depicts the correlation between all the courses of the programme and Programme Outcomes.

Course Code	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
BCH110	√	√	√	×	√	√	√	×	×	√	√	√	√	√
BCH120	√	√	√	×	√	√	√	√	×	√	√	√	√	√
BCH130	√	√	√	×	√	√	√	√	×	√	√	√	×	√
BCH140	√	√	√	×	√	√	√	√	×	√	√	√	√	√
BCH150	√	√	√	√	√	√	√	×	√	√	√	√	√	√
BCH160	√	√	√	√	√	√	√	×	√	√	√	√	√	√
BCH210	√	√	√	×	√	√	√	√	×	√	√	√	√	√
BCH220	√	√	√	×	√	√	√	√	×	√	√	√	×	√
BCH230	√	√	√	×	√	√	√	√	×	√	√	√	√	√
BCH240	√	√	√	×	√	√	√	×	×	√	√	√	√	√
BCH250	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BCH260	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BCH310	×	√	×	√	×	√	√	×	×	×	×	×	×	×
BCH320	√	√	√	√	√	√	√	√	×	√	√	√	√	√
BCH330	√	√	√	√	×	√	√	√	×	√	√	√	√	√
BCH340	√	√	√	√	√	√	√	√	×	√	√	√	√	√
BCH350	√	√	√	×	√	√	√	√	√	√	√	√	√	√
BCH360	√	√	√	√	√	√	√	√	√	√	√	√	√	×
BCH410	√	√	√	×	√	√	√	√	×	√	√	√	√	√
BCH420	√	√	√	×	√	√	√	√	×	√	√	√	√	√
BCH430 (A)	√	√	√	√	√	√	√	√	×	√	√	√	√	√
BCH430 (B)	√	√	√	√	√	√	√	√	×	√	√	√	√	√
BCH440 (A)	√	√	√	√	√	√	√	√	×	√	√	√	√	√
BCH440 (B)	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BCH450	√	√	√	√	√	√	√	×	√	×	×	×	×	×
BCH460	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BCH470	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BCH480	√	√	√	√	√	√	√	√	√	√	√	√	√	√
No. of courses mapping The PO/PSO	28	28	28	18	27	26	28	26	11	27	26	25	25	25

M. Sc. Biochemistry Semester- I (July 2025 – December 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	I
Course Code	**Course Title**		**Course Type**
BCH 110	Paper I – Cell and Molecular Biology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO):

The module is designed to provide introduction the molecular mechanisms of life together with its advancements.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe the chemical and molecular foundations of cell and the role in biological systems.	Ap
2	Demonstrate basis of the cell – cell interactions, its regulation and development.	Ap
3	Analyze Cell Cycle and its regulations.	
4	Understand Regulation of gene expression in prokaryotes, Operon concept, posts transcriptional and post translational modifications, protein as signal.	U
5	Evaluate the gene regulatory mechanisms in prokaryotic and eukaryotic cell.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	2	3	1	2	2	2	3	2	3
CO2	3	3	3	1	1	1	3	-	-	2	2	3	2	3
CO3	3	3	3	1	1	1	3	-	-	2	1	3	2	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	2
CO5	3	3	3	1	1	2	3	1	-	2	1	3	2	2

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Molecular organization of membranes - asymmetrical organization of lipids, proteins and carbohydrates. Osmosis, ion channels, membrane pumps and electrical properties of membranes. Active transport by ATP-powered pumps: types, properties and mechanisms. Transport of proteins into mitochondria, chloroplast and endoplasmic reticulum. Transport of proteins into and out of nucleus. Transport by vesicle formation: exocytosis, endocytosis and its molecular mechanism.	19	1
II	Cell signaling: Signaling via G-protein linked and enzyme linked cell surface receptors, MAP kinase pathways. Eukaryotic cell division cycle: different phases and molecular events, regulation and control of cell cycle. Apoptosis. Oncogenes and tumor suppressor genes: viral and cellular Oncogenes, retinoblastoma, E2F and p53 proteins.	19	2
III	Mechanism of DNA Replication in Prokaryotes and Eukaryotes. DNA Repair. Mutation: Types, causes and detection. Transcription in prokaryotes and Eukaryotes. Post transcriptional modifications.	19	3
IV	Translation in prokaryotes and Eukaryotes and post translational modification. Regulation of gene expression in prokaryotes. Induction and repression, positive and negative control. Operon concept, lac operon, Trp operon, Ara operon. Protein as signal.	18	4, 5

Books Recommended:

1. Molecular Cell Biology H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, andJames Darnell.
2. Essential Cell Biology B. Alberts, D. Bray, K. Hopkin and A. Johnson
3. Molecular Biology of the Cell B. Alberts, A. Johnson, J. Lewis and M. Raff
4. Cell and Molecular Biology Gerald Karp : Concepts and experiments
5. Molecular Biology of the Gene JD Watson et al.
6. Molecular Biology of the Cell John Wilson, Tim Hunt
7. Martin Raff, Keith Roberts, Peter Walter
8. Genes VIII Benjamin Lewin

M. Sc. Biochemistry Semester- I (July 2025 – December 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	I
Course Code	**Course Title**		**Course Type**
BCH 120	Paper II - Chemistry of Biomolecules		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO):

The module is designed to provide introduction & detailed information on the molecules of life.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand and Describe H-bonding, acids and bases, reaction equilibrium, ionization behavior.	U
2	Understand and Describe the detailed structure and functions cellular components and importance of carbohydrate and lipids.	Ap
3	Understand and Describe the structure and biological importance of Amino acids and Proteins.	U
4	Understand and Describe the structure and synthesis of nucleic acids.	U

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	2	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Carbohydrates –** Structure of Monosaccharide, Isomerism of sugars, Ring structure and anomeric forms, mutarotation, structure, occurrence and biological importance of monosaccharide, oligosaccharides and polysaccharides e.g., Starch, Glycogen, cellulose, Inulin, chitin, Hyllurhonic acid, Heparin.	19	1
II	**Lipids -** Definition and classification. Fatty acid – classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acid, prostaglandins.Triacylglycerols-nomenclature, physical and chemical properties of fats- hydrolysis, saponification value, rancidity of fats, Reichert-Meissel number, reaction of glycerol. Glycerophospholipid, sphingomyelins, glycolipids. Properties and functions of phospholipids and sterols.	19	2
III	**Amino Acids and Proteins** – Amino Acids and Proteins – Amino Acids – common structural features, classification and structures of standard amino acids, physical and chemical properties of amino acids. Essential Amino acids. Level of organization of protein – primary, secondary, tertiary structure of protein.Forces stabilizing the tertiary and quaternary structure of protein. Denaturation and renaturation of proteins. Salting in and salting out of proteins.	19	3
IV	**Nucleic Acids** Structure of constituents of nucleic acids, purines, pyrimidines, nucleosides and nucleotides. General structural plan of nucleic acids, features of DNA double helix. Denaturation and annealing of DNA, structure and roles of different types of RNA. Central dogma and molecular biology. Biological roles of nucleotides.	18	4

Books Recommended:

1. Nelson, Cox and Lehninger Principles of Biochemistry
2. G. Zubay Biochemistry
3. Stryer Biochemistry
4. Garrett and Grosham Biochemistry
5. West, Tood, Mason &Bbruglen Text book of biochemistry
6. White, Handler & Smith Biochemistry-clinical application
7. D. Voet and J C Voet Biochemistry

M. Sc. Biochemistry Semester- I (July 2025 – December 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	I
Course Code	**Course Title**		**Course Type**
BCH 130	Paper III - Microbial Biochemistry		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction to the biochemistry of micro-organisms and give a general description of the basic recombinant DNA Techniques.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the structure of bacteria and their microscopic examinations.	U
2	Analyze the types, bacterial toxins and the toxicology.	An
3	Apply the use of microbes.	U
4	Analyze the types bacterial toxins and the toxicology.	An
5	Analyze and explain bacterial nutrition, culture and types of microbes using different energy	Ap

CL:CognitiveLevels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	2
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	2
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	1
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	General characteristics of fungi, classification of fungi, life cycle of selected fungal genus (Aspergillus, Pencillium, Fusarium and Mucor). Algae: Distribution, classification, reproduction, ecology and Economic importance.	19	1
II	Morphology and ultra-structure of bacteria, morphological types, cell wall of archaebacteria, gram negative, gram positive eubacteria, eukaryotes. Cell membranes – structure, composition and properties. Structure and function of flagella, cilia, pili, gas vesicles.Cyanobacteria, protozoa, mycoplasma and Rickettsia.Gene transfer mechanisms, transformation, transduction, conjugation and transfection. Plasmids F: factors colicins and col factors, plasmids as a vector for gene cloning.	19	2
III	Viruses: Structure and classification of viruses; morphology and ultra-structure; capsids and their arrangements, types of envelopes, viral genome, their types and structure, virus related agents (viroids, prions). General feature of virus reproductions, early events in virus multiplication, virus restriction and modification of host, virus mRNA. General overview of bacterial viruses, RNA and DNA bacteriophages (MS2, ϕX174, M13, T3, T4). Lysogeny and Lytic phase. General account of plant and animal viruses (TMV, HIV and other oncogenic virus, Hepatitis virus).	19	3
IV	Nutritional types (autotrophs, heterotrophs, phototrophs, chemotrophs), growth curves, measurement of growth, factors affecting growth, generation time, growth kinetics. Batch and continuous culture, asynchronous, synchronous culture. Basis of microbial classification, classification and salient feature of bacteria according to Bergey's manual of determinative bacteriology, cyanobacteria, prochlorons and cyanelles.	18	4, 5

Books Recommended:

1. Campbell RC Statistics for biologists
2. Zar JH Biostatistical Analysis
3. Wardlaw AC Practical Statistics for Experimental Biologists
4. Snedecor GW & Cochran WG Statistical Methods
5. Sokal RR &Rohlf FJ Introduction to Biostatistics
6. Microbiology L.M. Prescott, J.P. Harley and D.A. Klein
7. General Microbiology RY Stanier, J L Ingrahamana, ML Wheelis& P. R. Painter
8. Principles of Microbiology R.M. Atlas

M. Sc. Biochemistry Semester- I (July 2025 – DEC 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	I
Course Code	**Course Title**		**Course Type**
BCH 140	Paper IV - Biology of Immune System		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction & detailed information on the principles of body's defense mechanism.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe innate and adaptive immunity and also between humoral and cell mediated immunity.	Ap
2	Discriminate the nature of antigens and antibodies.	Ap
3	Explain the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.	U
4	Describe the primary and secondary responses and their relevance to immunizations.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Innate immune mechanism and characteristics of adaptive immune response. Cells of immune system: Hematopoisis and differentiation, mononuclear cells and granulocytes. Antigen presenting cells. Primary and Secondary lymphoid organs and tissues. Ontogeny and phylogeny of lymphocytes. Lymphocyte traffic.	19	1
II	**Antigens:** nature of antigens, factor affecting immunogenicity, Haptens and super antigens. Antigenic determinants. Recognition of antigens by T and B cell. Antigen processing. Role of MHC molecules in antigen presentation and co-stimulatory signals .Antigen and antibody interaction. **Antigen receptor molecules:** B-cell receptor complex, Immunoglobulin- structure types and functions. T-cell receptor complex. Clonal selection theory- concept of antigen specific receptor. Organization and expression of immunoglobulin genes. Generation of antibody diversity. Light and heavy chain gene recombination. Recombination Signal Sequences. Heavy chain constant region genes. Class switching. T-cell receptor diversity.	19	2
III	Cell mediated and Humoral immune response and its regulation. Cytokines and interleukins- structure and function. Hypersensitive reactions and their types. Immunodeficiency disorders. Autoimmunity. Major Histocompatibility Complex- types, structural organization, function and distribution. Transplantation and Rejection. Complements in immune function.	19	3
IV	**Immune response to infectious diseases:** viral, bacterial and protozoal. Cancer and immune system. Nutrition and Immune response. Principles of vaccination. Immunization practices. Passive immunization (immunotherapy). Role of vaccine in prevention of diseases: vaccines against important viral, bacterial, protozoan and parasitic diseases. DNA vaccines; Antiviral, antibacterial agents.	18	4

Books Recommended:

1. Kuby's Immunology R.A. Goldsby, T. J Kindt and B. A. Osborne
2. Immunology Roitt, Brostoff and Male
3. Fundamentals of Immunology William Paul
4. Immunology Tizard
5. Immunology Abbas et al

M. Sc. Biochemistry Semester- I (July 2025 – December 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	I
Course Code	**Course Title**		**Course Type**
BCH 150	Paper V- Lab Course- I		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
3	-	--	6

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction to basics of reagent preparation and quantification of biomolecules through different types of techniques. It includes the DNA isolation Technique, PCR, RFLP etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Analyze various cell organelles through micrograph techniques, various nucleic acids through staining techniques,.	An
2	Analyze polyploidy through onion root with various treatments.	An
3	Analyze various stages of mitosis and meiosis cell division	An
4	Evaluate normality and molarities of solutions, pKa value of amino acids, proteins content in different sample	E
5	Evaluate Sugar, lipids, proteins, nucleic acids and vitamins content in different sample.	E

CL:CognitiveLevels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List of Practical of paper BCH 110		
	1. Sub-cellular fractionation and marker enzymes 2. Identification of biomolecules in different tissues by histochemical techniques 3. Preparation of Karyotype of metaphase plate. 4. Preparation of Meiotic plate and determination of phases. 5. Isolation, purification and estimation of RNA 6. Isolation, purification and estimation of DNA 7. Determination of Tm of nucleic acid 8. Fraction of poly (A) RNA 9. Restriction Mapping 10. Restriction Digestion 11. Ligation 12. DNA molecular size determination	45	1,2,3
	List of Practical of paper BCH 120		
	1. Specific tests for sugars, amino acids and lipids 2. Formal titration of amino acids 3. Estimation of proteins using ninhydrin and biuret method 4. Estimation of sugar by anthrone and Folin-Wu method. 5. Saponification value and iodine number of fat. 6. Estimation of ascorbic acid. 7. Achromic point determination using salivary amylase 8. Effect of ions on salivary amylase activity. 9. Enzyme assay and kinetics (ex. Amylase, Protease)	45	4,5

Books Recommended:

1. Molecular Cell Biology H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, andJames Darnell.
2. Essential Cell Biology B. Alberts, D. Bray, K. Hopkin and A. Johnson
3. Molecular Biology of the Cell B. Alberts, A. Johnson, J. Lewis and M. Raff
4. Cell and Molecular Biology Gerald Karp : Concepts and experiments
5. Molecular Biology of the Gene JD Watson et al.
6. Molecular Biology of the Cell John Wilson, Tim Hunt
7. Martin Raff, Keith Roberts, Peter Walter
8. Genes VIII Benjamin Lewin
9. Nelson, Cox and Lehninger Principles of Biochemistry
10. G. Zubay Biochemistry
11. Stryer Biochemistry
12. Garrett and Grosham Biochemistry
13. West, Tood, Mason &Bbruglen Text book of biochemistry
14. White, Handler & Smith Biochemistry-clinical application
15. D. Voet and J C Voet Biochemistry

M. Sc. Biochemistry Semester- I (July 2025 – December 2025)

Program	Subject	Year	Semester
M.Sc.	Biochemistry	1	I
Course Code	**Course Title**		**Course Type**
BCH 160	Paper VI - Lab Course- II		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
3	-	-	6

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is designed to provide Experimental skills to the biochemistry of micro-organisms and skilled to students for techniques involved in evaluation of biomolecules like glucose, vitamins, hemoglobin, chlorophyll and lipids and nucleic acids.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Analyze bacteria and fungi, motility of the microbes, the impact of antibiotics on microbial survival, biochemical activities of microbes by various tests.	An
2	Demonstrate the techniques of pure culture of bacteria and fungi Interpret the motility of the microbes.	An
3	Apply the techniques to test various clinical conditions. Perform immunological techniques. Evaluate various enzymes related to organ disorders.	E
4	Analyze the different blood cell counting. Perform qualitative and quantitative test for proteins.	E

CL: Cognitive Levels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	1. Glassware preparation and sterilization techniques- wet heat- dry heat- 1. filter types- laminar flow chamber types- CDC- safety levels. 2. Preparation of liquid & solid media, plating, pouring, inoculation and incubation for growth of microorganism 3. Methods of obtaining pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods 4. Microscopic examination of the microorganisms, identification and staining methods 5. Micrometery and camera lucida drawings 6. Study of bacterial growth by turbiditimetry/ spectrophotometry 7. Biomass measurement for fungi 8. Isolation and enumeration of microorganisms from soil by serial dilution agar plating method. 9. Enumeration of viruses by plaque assay technique. 10. Motility of bacteria by hanging drop technique.	45	1,2
	11. Identification of cells of immune system 12. 2. Separation of mononuclear cells by Ficoll-Hypaque 13. 3. Identification of Lymphocytes and their subsets 14. 4. Lymphoid organs and their microscopic organization 15. 5. Isolation and purification of Antigens 16. 6. Purification of IgG from serum 17. 7. Estimation of Levels of gamma globulins and A/G ratio in blood 18. Antigen antibody interaction	45	3,4,5

Books Recommended:

1. Microbiology L.M. Prescott, J.P. Harley and D.A. Klein
2. General Microbiology RY Stanier, J L Ingrahamana, ML Wheelis& P. R. Painter
3. Principles of Microbiology R.M. Atlas
4. Microbiology Peleczar, Chan & Krieg.
5. General Virology Luria, Darnell, Baltimore and Campell.
6. Introduction to Mycology CJ Alexopoulos and CW Mims
7. Kuby's Immunology R.A. Goldsby, T. J Kindt and B. A. Osborne
8. Immunology Roitt, Brostoff and Male
9. Fundamentals of Immunology William Paul
10. Immunology Tizard
11. Immunology Abbas et al

M. Sc. Biochemistry Semester- II (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	II
Course Code	**Course Title**		**Course Type**
BCH 210	Paper I - Human Physiology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--
Maximum Marks	**CIA**		**ESE**
100	30		70

Learning Objective (LO): The module is designed to provide introduction & detailed information on the Human physiology

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain mechanism of signal transduction by steroid and polypeptidehormones and the role of second messengers in signal transduction.	Ap
2	Explain mechanism of Skeleton Muscles and locomotion and role of muscular dystrophies.	
3	Explain role of kidney in erythropoiesis.	Ap
4	Explain the process of Heart and gaseousexchange in tissues and lungs, respiratory adaption to high altitude and the difference between hemoglobin and myoglobin	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Neurotransmission:** Types of neurons, generalized structure of multipolar neuron. Resting membrane potential, Action potential, Transmission of nerve impulse along an axon and across a synapse. Neurotransmitters and inhibitors of neurotransmission. **Muscle:** Types of muscles and their structure. Ultra structure of skeletal muscle. Contractile andregulatory proteins of muscle.Sliding filament model of skeletal muscle contraction. Bone: Composition and structure of long bone, growth and remodelling of long bone. Factors affecting its growth.	19	1
II	**Excretory system:** Structure of the nephron, formation of urine – Glomerular filtration, tubular re-absorption and secretions. Body fluids: Blood volume, composition and functions, RBC, WBC and platelets, their structure and functions. Mechanism of blood coagulation. Biochemical events in transport ofCO2 and O2 in blood.Cerebrospinal fluid, lymph and its function. Blood brain barrier.	19	2
III	**Heart and lungs** –Structure and function of cardiac tissue and lungs Acid-base balance: Maintenance of normal pH of the body fluids. Blood buffers. Role of lungs and kidney in acid base balance. GIT and Liver: Structure and function of gastrointestinal tract, Structure of a lobule, functions– metabolic, storage and detoxification.	19	3
IV	**Endocrine system:** Endocrine organs, classification of hormones. Dynamic balance and regulation of hormone secretions. Functions of the hormones of hypothalamus, pituitary, adrenal, thyroid, pancreas and gonads. General mechanism of hormone action. Concept of messengers eg: cAMP, DAG, IP3.	18	4

Suggested Readings:

1. Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2. Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice HallInternational Inc.
5. Textbook of medical physiology: A. C. Gyton, and J. E HallSaunders Elsevier
6. Publications, A division of Reed Elsevier India Pvt .Ltd.New Delhi ISBN 81-8147-084-2
7. Human physiology: Chatterjee, Medical Allied Agency.

M. Sc. Biochemistry Semester- II (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M.Sc.	Biochemistry	1	II
Course Code	**Course Title**		**Course Type**
BCH 220	Paper II - Bioenergetics & Metabolism		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is designed to provide detailed knowledge of metabolism and its evaluation.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe the fundamentals of thermodynamics in biochemical processes and energy production in living systems by the degradation of carbohydrate.	Ap
2	Describe the energy generated from the metabolism.	Ap
3	Explain the various pathways of fatty acid metabolism in living systems.	U
4	Explain the various pathways of Amino acids and proteins in living systems.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	1	1	1	3	-	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	1	-	3	2	-
CO4	3	3	3	1	1	2	3	-	-	1	1	3	2	1

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction to Metabolism** General features of metabolism, experimental approaches to study metabolism: Use of intact organism, bacterial mutants, tissue slices, stable and radioactive Isotopes. **Carbohydrate Metabolism:** Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Entry of fructose, galactose, mannose etc. Reactions and energetic of TCA Cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reaction and Physiological significance of pentose phosphate pathway. Regulation of Glycolysis and TCA cycle Photosynthesis a brief review.	19	1
II	**Electron Transport Chain and Oxidative Phosphorylation-** Structure of mitochondria, sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Hypothesis of mitochondrial Oxidative phosphorylation. Transport of reducing potentials into mitochondria.	19	2
III	**Lipid Metabolism :**Introduction, hydrolysis of triacylglycerols, transport of fatty acids into Mitochondria, B oxidation saturated fatty acids, ATP yield from fatty acid Oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of Ketone bodies, oxidation of unsaturated and odd chain fatty acids. Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism. **Porphyrin Metabolism:** Biosynthesis and degradation of porphyrins. Production of bile pigments. Inborn Errors associated with metabolism.	19	3
IV	**Amino acid Metabolism:** General reactions of amino acid metabolism: transamination, oxidative Deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of Amino acids. Glycogenic and ketogenic amino acids. **Nucleotide Metabolism:** Sources of the atoms in the purine and pyrimidine molecules. Biosynthesis and Degradation of purines and pyrimidines biosynthesis.	18	4

Books Recommended:

1. Principles of Biochemistry Nelson, Cox and Lehninger
2. Biochemistry G. Zubay
3. Biochemistry Stryer
4. Biochemistry Garrett and Grosham
5. Text book of biochemistry West, Tood, Mason &Bbruglen
6. Biochemistry White,Handler& Smith
7. Biochemistry with clinical application D. Voet and J C Voet

M. Sc. Biochemistry Semester- II (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M.Sc.	Biochemistry	1	II
Course Code	**Course Title**		**Course Type**
BCH 230	Paper III - Biophysical Chemistry and Biochemical Techniques		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is a general introduction to different types of techniques. It includes the DNA isolation Technique, PCR, RFLP etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Apply the principle, methodology and applications of Spectroscopic techniques.	Ap
2	Apply the principle, methodology and applications of Centrifugation techniques.	Ap
3	Employ the principle, methodology and applications of Electrophoretic techniques.	An
4	Apply the principle, methodology and applications of Chromatography techniques.	An

CL: CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Centrifugation:** Principle, techniques. Preparative, analytical and ultracentrifuges, sedimentation coefficient and factors affecting sedimentation coefficient.Application of centrifugation. **Photometry:** Basic principles of colorimetry, UV- visible spectrophotometry & IR- spectrophotometry. Spectroflurometry Atomic absorption spectroscopy: Principle, Instrumentation and applications Electrophoresis: Paper electrophoresis, Starch gel, agarose, PAGE-type, 2D-E.	19	1 2
II	**Microscopic techniques:** light microscopy, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy. Microtomy: types, principle and applications *Lyophilization*: Principle, instrumentation and applications	19	2
III	**Chromatography**: Paper and Thin Layer Chromatography. Gel filtration, Ion exchange chromatography and Affinity chromatography. Gas-liquid chromatography and HPLC. **Histochemical and immunotechniques**: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, *In situ* localization; FISH and GISH. Radioactivity: GM counter, liquid Scintillation counter, solid Scintillation counter, gamma counters	19	3, 4
IV	**Molecular techniques:** Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, separation methods; RNA, DNA and proteins; 1-D and 2-D, isoelectric focusing gels; Molecular cloning of DNA and RNA fragments in bacterial systems; Expression of recombinant DNA; DNA sequencing. Gene expression; mRNA, cDNA using PCR and qRT-PCR. Micro array based techniques. Molecular Markers for diversity analysis: RFLP, RAPD, AFLP, VNTR, SSR, ISSR, SNP, DArT. .	18	5

Books Recommended:

1.K Wilson and John Walker Practical Biochemistry: Principles & Techniques
2.RF Boyer Biochemistry Laboratory: Modern Theory & Techniques
3.S Carson, H Miller and D Scott Molecular Biology Techniques: A Classroom Laboratory Manual
4.TC Ford and J. M. Graham An Introduction to Centrifugation
5.R Baserga and D Malamud Autoradiography: techniques and application
6.T Chard An Introduction to Radioimmunoassay and Related Techniques , Volume 6
7. MD Bruch NMR Spectroscopy Techniques

M. Sc. Biochemistry Semester- II (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M.Sc.	Biochemistry	1	II
Course Code	**Course Title**		**Course Type**
BCH 240	Paper IV - BIOMETRY, COMPUTER AND SCIENTOMETRY		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction to Graphs. It also gives insight about Data and result interpretation. The student will be taught how to design a research project and finally how to present his research work.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the concept of the sampling distribution in statistics and the behavior of the sample.	Ap
2	Demonstrate an appreciation of one- way analysis of variance (ANOVA).	Ap
3	Understand the method of regression analysis in statistics. Interpret the results of Bivariate Regression and Multivariate Regression.	An
4	Analyze the concept of research methodology and skills of scientific writing.	An

CL: CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Introduction to biostatistics. Types of biological data: data on different scales. Frequency distributions.Cumulative frequency distributions.Random sampling.Parameters and statistics. Measures of central tendency and dispersion: Mean, Median, Mode, Range, Variance and Standard deviation. Coefficient of variation. Distribution: normal & binomial. Probability: Basic laws of probability, addition law, multiplication law. Probability and frequency.	19	1
II	Statistical errors in hypothesis testing.Testing goodness of fit: Chi-square goodness of fit.Heterogeneity Chi-square.The 2 x 2 contingency table.One sample hypothesis.Two-sample hypothesis.Testing for difference between two means (t-test).Testing for difference between two variances (F-test).The paired sample t-test. Multiple-sample hypothesis (ANOVA): Single factor and two factors ANOVA. Multiple comparisons: Duncan's multiple-range tests. Simple linear regression.Regression vs. Correlation.Regression equation.Interpretations of regression functions.Simple linear correlation. The correlation coefficient.	19	2
III	Introduction to MS-Office software: Word processing; creating new document, editing documents, adding graphics to documents, Word tables. Management of Workbook & Worksheets; Applications, Features, Using formulas and functions, Features for Statistical data analysis, Generating charts/ graph. Presentation software; Working in PowerPoint, Creating new presentation, working with slides.	19	3
IV	Introduction to Internet and Applications. Basics of internet, e-mailing, Search engine – Google and Yahoo; Pub med, Scopus, Web of Science, Google Scholar, Indian Citation Index, Science Citation Index (SCI), h-index, i-10-index. Journal Impact Factor (JIF). Introduction to Plagiarism and Cyber laws. Scientific Writing: Interpretation and Report Writing. Meaning of Interpretation, Techniques of interpretation, Precaution of interpretation.Significance of Report Writing. Step in Report Writing. Types of Report Writing.Component of a Research Report.	18	4

Books Recommended:

1. Campbell RC Statistics for biologists
2. Zar JH Biostatistical Analysis
3. Wardlaw AC Practical Statistics for Experimental Biologists
4. Snedecor GW & Cochran WG Statistical Methods
5. Sokal RR &Rohlf FJ Introduction to Biostatistics
6. Sumner M Computers: Concepts & Uses
7. Shelly GB, Vermaat ME, Microsoft 2007: Introductory Concepts & Techniques
8. Cashman TJ, Habraken J Microsoft Office 2003 All in One Microsoft Office 2010 In Depth
9. Kumar Anupa P Cyber Law
10. Sood V Cyber Law Simplified

M. Sc. Biochemistry Semester- II (Jan 2026 – July 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	1	II
Course Code	**Course Title**		**Course Type**
BCH 250	Paper IV - Lab Course- I		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2			4

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide an experimental background on analysis of animal and plant metabolites and learn the basic plant tissue culture techniques.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Evaluate plasma sugar, lipids, cholesterol level from known sources,	E
2	Evaluate fermentation process by microorganism and salivary Amylase.	E
3	Apply the various techniques for isolation of lipids.	Ap
4	Evaluate biochemical parameters in biological system. eg: plasma sugar and cholesterol level.	E

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List Of Experiments of Course BCH210 1. Preparation of blood smear and differential leucocyte count. 2. RBC and WBC counting, Calculation of blood Indices. 3. Estimation of hemoglobin 4. Colorimetric estimation of Protein by Lowry's method. 5. Estimation of Uric acid. 6. Urea by DAMO method. 7. Creatinine by Jaffe's method. 8. Phosphorous by Fiske and Subbarow's method. 9. Iron by Wong's method. 10. Qualitative analysis of urine - detection of urea, uric acid and creatinine.	30	1, 2
	List Of Experiments of Course BCH220 1. Protein estimation by Lowry, Bradford and Spectrophotometric method 2. Estimation blood cholesterol 3. Estimation of sugar by Nelson- Somagy and Benedict's reagent 4. Isolation and estimation of lipid from seeds and egg. 5. Estimation of inorganic and total phosphorus by Fiske-SubbaRao method 6. Assay of phosphatases in blood and seeds 7. Urease estimation in plant tissues	30	1,2,3

Suggested Reading:

1. Fosket DF Plant Growth & Development
2. Foyer CH Photosynthesis
3. Bacon KE Photosynthesis: Photobiochem. &Photobiophysics
4. Leopold AC &Kriedemann PE Plant Growth & Development
5. Moore TC Biochemistry & Physiology of Hormones
6. L Taiz& E Zeiger Plant Physiology
7. BB Buchanan, W Gruissem& Biochemistry and Molecular Biology of Plants
8. Hans-Walter Heldt Plant Biochemistry & Molecular Biology
9. Principles of Biochemistry Nelson, Cox and Lehninger
10. Biochemistry G. Zubay
11. Biochemistry Stryer
12. Biochemistry Garrett and Grosham
13. Text book of biochemistry West, Tood, Mason &Bbruglen
14. Biochemistry White,Handler& Smith
15. Biochemistry with clinical application D. Voet and J C Voet
16. Practical biochemistry Plummer

M. Sc. Biochemistry Semester- II (Jan 2026 – July 2026)

Program	Subject	Year	Semester
M.Sc.	Biochemistry	1	II
Course Code	**Course Title**		**Course Type**
BCH 260	Paper IV - Lab Course- II		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2			4
Maximum Marks	**CIA**		**ESE**
100	30		70

Learning Objective (LO): The module is designed to provide introduction & detailed information on some basic immunodiagnostic techniques and quantification of blood proteins. Qualitative and quantitative analysis of biological molecules and their estimation using multiple methods

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Apply the estimation techniques for different blood components	An
2	Analyze plant pigments by calorimetric method.	E
3	Apply the knowledge of sampling techniques.	E
4	Illustrate various data presentation styles for a good presentation Test the significance of data	E

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List Of Experiments of Course BCH230	30	1, 2
	1 Verification of Beers Law 2. Determination of absorption maxima 3. Quantitative determination, Enzyme kinetics 4. Amino acid and carbohydrate separation by paper and TLC 5. Ion exchange and gel filtration chromatography 6. SDS Polyacralamide Gel Electrophoresis DNA electrophoresis 7. Isoenzymes 8. Separation of sub-cellular organelles by differential centrifugation. 9. Isolation of DNA and Agarose gel Electrophoresis 10. Isolation of RNA and Electrophoresis of RNA on denaturing gels. 11. Isolation of Protein and SDS-PAGE		
	List Of Experiments of Course BCH240		3,4,5
	11. Exercises for data distribution. 12. Exercises for computation of measures of central tendency. 13. Exercises for computation of measures of variability. 14. Computation of correlation coefficient, r, and regression constants. 15. Data analysis by ANOVA and multiple-range tests. 16. Hypothesis testing by t-test, F-test, and Chi-square test. 17. Graphical presentation of data using a suitable package. 18. Statistical analysis of a data using a suitable package. 19. Preparation of document using a suitable package. 20. Preparation of slides using a suitable package. 21. Review Writing.		

Books Recommended:

1. K Wilson and John Walker Practical Biochemistry: Principles & Techniques
2. RF Boyer Biochemistry Laboratory: Modern Theory & Techniques
3. S Carson, H Miller and D Scott Molecular Biology Techniques: A Classroom Laboratory Manual
4. TC Ford and J. M. Graham An Introduction to Centrifugation
5. R Baserga and D Malamud Autoradiography: techniques and application
6. T Chard An Introduction to Radioimmunoassay and Related Techniques , Volume 6
7. MD Bruch NMR Spectroscopy Techniques
8. Campbell RC Statistics for biologists
9. Zar JH Biostatistical Analysis
10. Wardlaw AC Practical Statistics for Experimental Biologists
11. Snedecor GW & Cochran WG Statistical Methods
12. Sokal RR &Rohlf FJ Introduction to Biostatistics
13. Sumner M Computers: Concepts & Uses
14. Shelly GB, Vermaat ME, Microsoft 2007: Introductory Concepts & Techniques
15. Cashman TJ, Habraken J Microsoft Office 2003 All in One Microsoft Office 2010 In Depth
16. Kumar Anupa P Cyber Law
17. Sood V Cyber Law Simplified

M. Sc. Biochemistry Semester- III (July 2027 – Dec 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 310	Paper I - Genetic Engineering		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Compute the basic steps of genetic engineering according to the species.	Ap
2	Modify the DNA recombinant molecules according to the target cell.	Ap
3	Apply the knowledge of DNA sequencing while genetic engineering.	Ap
4	Convert the genetic information into cDNA library and genomic library that would be beneficial for the preparation of transgenic organisms.	An

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Milestones of genetic engineering:** isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation of clones, cloning and patenting of life forms, genetic engineering guide lines. Molecular tools and their applications: restriction enzymes, modification enzymes. Molecular techniques: gel electrophoresis, polymerase chain reaction, DNA sequencing, DNA microarray.	19	1
II	**Gene cloning vectors:** plasmids and transformation, bacteriophages and in vitro packaging, cosmids, artificial chromosomes. Genomic library: strategies of genomic DNA library construction, transformation, construction of eukaryotic genomic library, screening methods. cDNA library: isolation and purification of mRNA, first strand synthesis, second strand synthesis, cDNA library construction. **Study of gene regulation:** reporter assays Expression strategies for heterologous genes: vector engineering and codon optimization, host engineering, in vitro transcription and translation.	19	2
III	**Processing of recombinant proteins:** recombinant proteins purification, refolding, characterization and stabilization Site directed mutagenesis, protein engineering Gene knockout technique	19	3
IV	**Plant transformation technology:** basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes. Vector-less or direct DNA transfer: particle bombardment, electroporation, microinjection. Application of plant transformation for productivity and performance, herbicide resistance, insect resistance, virus resistance, long shelf-life of fruits	18	4

Suggested Readings:

1. Genes VIII Benjamin Lewin
2. An Introduction to Genetic Engineering DST Nicholl
3. Principles of Gene Manipulation and Genomics SB Primrose and Richard
4. Gene Cloning and Manipulation CJ Howe
5. Genetic Engineering (Genetics and Evolution) R Hodge
6. Introduction to Biotechnology & AJ Nair
7. Genetic Engineering
8. Genetic Engineering A Kumar & N Garg
9. Biotechnology & Genetic Engineering L Yount
10. DNA Microarrays & Gene Expression: from P Baldi& G Wesley

M. Sc. Biochemistry Semester- III (JUL 2026 – DEC 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 320	Paper II - Plant Physiology and Biochemistry		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction & detailed information on the basics of plant biochemistry and latest development in plant biotechnology.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe transport of solute in plants.	Ap
2	Describe knowledge about nitrogen fixation.	Ap
3	Explain Photosynthesis in Plants.	U
4	Explain processes of plant hormones.	Ap
5	Understand the plant stress management.	U

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Solute transport and photo assimilate translocation** – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. **Nitrogen metabolism:** assimilation of nitrate,structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Biological nitrogen fixation by free living and in symbiotic association; structure and function of the enzyme nitrogenase.	19	1, 2
II	**Photosynthesis** – Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, their location; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, path of carbon in photosynthesis – C3 and C4 pathway of carbon reduction and its regulation, Photorespiration.	19	3
III	**Phytohormones**: Structure, biosynthesis, molecular mechanisms of Auxin, Gibberellins, Cytokinin, Abscisic acid and Ethylene, Brassinosteroids. Senescence and Programmed cell death: Senescence; Metabolism and regulation of pigment and nucleic acid, PGR regulation, SAG. PCD; Formation of TE and mobilization of cereal endosperm.	19	4
IV	**Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Antioxidative defense system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.	18	5

Books Recommended:

1. Fosket DF Plant Growth & Development
2. Foyer CH Photosynthesis
3. Bacon KE Photosynthesis: Photobiochem. &Photobiophysics
4. Leopold AC &Kriedemann PE Plant Growth & Development
5. Moore TC Biochemistry & Physiology of Hormones
6. L Taiz& E Zeiger Plant Physiology
7. BB Buchanan, W Gruissem& Biochemistry and Molecular Biology of Plants
8. RL Jones MB Wilkins Advanced Plant Physiology
9. JA Hopkins Introduction to Plant Physiology
10. FB Salisburry& CW Ross Plant Physiology
11. Hans-Walter Heldt Plant Biochemistry & Molecular Biology

M. Sc. Biochemistry Semester- III (July 2026 – Dec 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 330	Paper III - Nutritional and Environmental Biochemistry		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): 1. The module is designed to provide information on organic and inorganic content of food stuffs, food preservation techniques and some knowledge on various nutritional disorders.
2. This module will be helpful to develop understanding of Human-environment interactions and consequences of disturbance of the environment.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the basic components of food stuff and balance diet.	Ap
2	Summarize the dietary component and body electrolytes.	Ap
3	Recognize the food vitamins and minerals with nutritional disorder.	U
4	Distinguish the effect of toxic substances on environment.	An
5	Interpret the effect of toxic chemicals on body parts and their cure.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Composition of balanced vegetarian and non-vegetarian diets;** recommended dietary allowance (RDA) for different categories of the human beings. Food preservation standards, food adulterations and precautions, government regulations on preservation and quality of food. Food processing and loss of nutrients during processing and cooking. Basal metabolism and methods of measuring basal metabolic rate (BMR); energy requirements during growth, pregnancy, lactation and various physical activities. **Nutritional aspects of Minerals** - sources, requirement, physiological function, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, chromium. Cobalt, copper, manganese, molybdenum, selenium, iodine and zinc.	19	1, 2
II	**Nutritional aspects of the carbohydrates, lipids and protein:** nutritive value, requirements, and functions. **Nutritional aspects of vitamins -** definition and types of vitamins, sources, requirement, biological functions, deficiency symptoms of thiamine, riboflavin, niacin, pyridoxine, panthothenic acid, folic acid, biotin, cyanocobalamine, vitamins C, A, D, E and K. Hypervitaminosis. requirement and functions, Malnutrition, its implications, relationship with dietary habits and prevention. **Disorders related to the nutrition:** Protein energy malnutrition, Starvation, Obesity.	19	3
III	**Environmental Pollution:** Types, Outdoor and indoor Air pollution, sources, structure and control strategies. Water and Soil Pollution.Eco–toxicology and its environmental significance.Xenobiotic metabolism, Phase I reaction – oxidation – reduction, hydrolysis and hydration. Phase II reaction – conjugation and methylation.	19	4
IV	**Pesticide toxicity** – insecticides, fungicides, herbicides and biopesticides.Toxicology of food additives.Metal toxicity – arsenic, mercury, lead and cadmium. Toxicity testing – Test control, genetic toxicity testing. Occupational toxicology: Occupational hazards and their assessment. **Bioremediation:** Introduction and types of bioremediation, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, Phytoremediation.	18	5

Books Recommended:

1. LG Corkerhem and BSS Shane Basic Environmental Toxicology
2. T Shibamato& L F Bzeidanes Introduction to Food Technology
3. M. Stipanuk Biochemical, Phys. & Mol. Aspects of Human Nutrition
4. Tom Brody Nutritional Biochemistry
5. DA Bender Nutritional Biochemistry of the Vitamins
6. R.L. Pike and M.L. Brown Nutrition: An integrated approach -
7. G.P. Talwar Text book of Biochemistry and Human Biology
8. DWS Wong Mechanism and theory in food chemistry
9. M.S. Banji N P. Rao& V. Reddy Text book of Human Nutrition
10. Linten Nutritional Biochemistry and Metabolism

M. Sc. Biochemistry Semester- III (July 2026 – Dec 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 340	Paper IV - Enzymology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction & detailed information on structure, biosynthesis and engineering of proteins.

Course Outcome:

On successful completion of the course, the student shall be able to:

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the enzyme classification.	Ap
2	Interpret the mechanisms of enzyme actions.	Ap
3	Acquire knowledge of allosteric enzymes and their kinetics.	U
4	Analyze the thermodynamics of enzyme substrate reactions.	An
5	Outline the knowledge of enzyme action, isolation and purification techniques.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Isolation and purification of enzymes. General properties and effects of pH, substrate and temperature on enzyme catalyzed reactions. Kinetics of catalyzed reaction: Single substrate reactions, bisubstrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, Concept of convergent and divergent evolution of enzyme. Methods of examining enzyme – substrate complexes.	19	1
II	Enzyme Turnover and methods employed to measure turnover of enzymes, significance of enzyme turnover. Protein – ligand binding, including measurement, analysis of binding isotherms, cooperativity phenomenon, Hill and Scatchard plots. Multi enzyme system: occurrence , isolation & their properties , mechanism of action & regulation; Pyruvate dehydrogenase complex, fatty acid synthetase complexes. Mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase.	19	2
III	General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, symmetrical and sequential modes for action of allosteric enzymes and their significance.Water soluble enzymes and their coenzymes. Metalloenzymes. Immobilized enzymes and their industrial applications.	19	3
IV	Enzymes of Industrial Importance; their source, characteristic properties, functions and uses. Enzymes used in leather, paper, and textile industries. Enzymes in baking, brewing, Alcohol products; enzymes in detergents, starch and animal feeds. Amylases, cellulases, catalase, pectinase, lipase, protease, xylanase, laccase, beta glucanase.	18	4

Suggested Readings:

1. Enzymes Dixon and Webb
2. Fundamentals of Enzymology Price and Steven
3. Practical biochemistry Plummer
4. Enzyme biotechnology G. Tripathi
5. Enzyme Reaction Mechanism Walsh
6. Enzyme catalysis and regulation Hammes
7. Brandon and Tooze Introduction to Protein Structure
8. Campell Discovering Genomics, Proteomics and Bioinformatics,
9. Dan Gusfield Algorithms on Strings Trees and Sequences
10. Lesk, A.M Introduction to Protein Architecture
11. Mcpherson, A. Introduction of Molecular Crystallography
12. Pennington Proteomics from Protein Sequence to Function
13. Durbin, Eddy, Anders & Graeme Biological Seq. Analysis: Probabilistic Models of Proteins & Nucleic Acids
14. S.A. Bbernhard The structure and function of enzymes
15. J. Palmer Enzymes: biochemistry, Biotechnology, Clinical chemistry

M. Sc. Biochemistry Semester- III (Jan 2026 – July 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 350	Paper V - Lab Course- I		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction & detailed information on some basic diagnostic techniques.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Demonstrate isolation of nucleic acid from microorganisms.	Ap
2	Demonstrate digestion reaction in nucleic acids of various samples.	Ap
3	Illustrate PCR methods.	U
4	Evaluate Essential Oils, Phenols in plat cells.	An
5	Evaluate Alkaloids and Antimicrobial Activity of Plant Extract.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List Of Experiments of Course BCH310	30	1, 2,3
	1. Bacterial culture and antibiotic selection media. Preparation of competent cells 2. Isolation of plasmid DNA. 3. Isolation of Lambda phage DNA. 4. Quantitation of nucleic acids. 5. Agarose gel electrophoresis and restriction mapping of DNA. 6. Construction of restriction map of plasmid DNA. 7. Cloning in plasmid/phagemid vectors. 8. Isolation of RNA. 9. Synthesis of cDNA. 10. RAPD analysis by PCR.		
	List Of Experiments of Course BCH320	30	4, 5
	1. Isolation of essential oil and determination of the oil yield. 2. Qualitative test for determination of terpenoids, alkaloids, flavonoids and saponins. 3. Quantitative test for determination of terpenoids, alkaloids, saponins and phenolics. 4. Determination of antimicrobial activity of the plant extracts. 5. Demonstration of hairy root culture for production of secondary metabolites *6.* RNA extraction and gene expression of key enzymes of Biosynthesis of alkaloid; *Strictosidine Synthsae [STR1], Strictosidine glucosidase (SG), Acetylajmalan Esterase (AAE) etc.*		

Suggested Readings:

1. Genes VIII Benjamin Lewin
2. An Introduction to Genetic Engineering DST Nicholl
3. Principles of Gene Manipulation and Genomics SB Primrose and Richard
4. Gene Cloning and Manipulation CJ Howe
5. Genetic Engineering (Genetics and Evolution) R Hodge
6. Introduction to Biotechnology & AJ Nair
7. Genetic Engineering
8. Genetic Engineering A Kumar & N Garg
9. Biotechnology & Genetic Engineering L Yount
10. DNA Microarrays & Gene Expression: from P Baldi& G Wesley
11. Harper's Biochemistry: R.K.Murray, D.K.Granner, P.A. Mayes and V.W.Rodwell.
12. Clinical Laboratory Science Review: Robert R. Harr
13. Fundamentals of Clinical Chemistry: C.A. Burtis, E.R. AshwoodTietzvb
14. Notes on Clinical Chemistry- Principles of Internal Medicines: Whitby, Smith, Beckett, Walker, Harrison
15. Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
16. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
17. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice HallInternational Inc.

M. Sc. Biochemistry Semester- III (Jan 2026 – July 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 360	Paper VI - Lab Course- II		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide detailed techniques about estimation of vitamins and minerals in food products and also to analyze the microbial content of domestic and industrial effluents. This module is a general introduction to different analytical techniques involved in assessment of some specific enzymes of our body.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Evaluate the contents of mineral and vitamin, chemical and microbial contents in food samples.	E
2	Analyze the adulterants present in food samples.	An
3	Demonstrate TLC for different food components.	An
4	Illustrate the kinetics of a specific enzyme involved in a metabolic activity of human body	An
5	Evaluate optimum pH and temperature of an enzyme, enzyme inhibition by various factors and enzymatic activity	E

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List Of Experiments of Course BCH 330 1. Separation and purification of sub-cellular organelles and assay of marker enzymes. 2. Protein fractionation - salt, solvent and isoelectric precipitation. 3. Identification and assay of certain toxicants. 4. Effect of various toxicants on serum enzymes and proteins 5. Effect of various toxicants on liver and kidney metabolism 6. Estimation of carbohydrate, protein and fat in food materials. 7. Titrimetric method of ascorbic acid estimation in fruit. 8. Separation of casein protein from milk	30	1, 2
	List Of Experiments of Course BCH 340 1. Estimation of enzymes 2. Separation, purification of sub-cellular organelles & assay of marker enzymes. 3. Methods of purification of an enzyme - ion-exchange, gel filtration 4. Test of homogeneity by SDS-PAG E 5. Kinetics of an enzymatic reaction 6. Effect of various toxicants on serum enzymes and proteins 7. Enzyme modeling: Validation Criteria by WHATIF, Verify3d, PROSA and DOPE score 8. Verification of Ramachandran Plot: Estimation of interaction energy per residue by PROSA and Verify3D. 9. Enzyme packing quality: Assessed by WHATIF.	30	3,4,5

Books Recommended:

1. LG Corkerhem and BSS Shane Basic Environmental Toxicology
2. T Shibamato& L F Bzeidanes Introduction to Food Technology
3. M. Stipanuk Biochemical, Phys. & Mol. Aspects of Human Nutrition
4. Tom Brody Nutritional Biochemistry
5. DA Bender Nutritional Biochemistry of the Vitamins
6. R.L. Pike and M.L. Brown Nutrition: An integrated approach -
7. G.P. Talwar Text book of Biochemistry and Human Biology
8. DWS Wong Mechanism and theory in food chemistry
9. M.S. Banji N P. Rao& V. Reddy Text book of Human Nutrition
10. Linten Nutritional Biochemistry and Metabolism
11. Brandon and Tooze Introduction to Protein Structure
12. Campell Discovering Genomics, Proteomics and Bioinformatics,
13. Dan Gusfield Algorithms on Strings Trees and Sequences
14. Lesk, A.M Introduction to Protein Architecture
15. Mcpherson, A. Introduction of Molecular Crystallography
16. Pennington Proteomics from Protein Sequence to Function
17. Durbin, Eddy, Anders & Graeme Biological Seq. Analysis: Probabilistic Models of Proteins & Nucleic Acids
18. S.A. Bbernhard The structure and function of enzymes
19. J. Palmer Enzymes: biochemistry, Biotechnology, Clinical chemistry

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH 410	Paper I - Clinical Biochemistry and Endocrinology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction & detailed information on the basics of pathological conditions arising in body and the basic concepts of hormones and their functions.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Apply the normal constituents of urine, blood and their significance inmaintaining good health.	Ap
2	Apply the mechanisms of causation of diseases of liver, kidney and of Cancer will be explained.	Ap
3	Understand the variations in the levels of trigycerides and lipoproteins and their relationship with various diseases.	U
4	Analyze the role of enzymes in diagnosis of various diseases and Biochemistry of Cancer, Inborn errors of metabolism.	An

CL:CognitiveLevels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	2	3	1	-	2	2	3	1	1
CO2	3	3	3	1	1	1	3	-	-	2	2	3	2	1
CO3	3	3	3	1	1	1	3	-	-	2	2	3	2	1
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	1

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Plasma proteins – Properties, functions and their variations in diseases, Plasma lipids and lipoproteins, Interrelationship of lipids, lipoproteins and apolipoproteins.Erythropoiesis, abnormalities in blood formation. Anemias. Heamoglobinopathies. Cerebrospinal fluid – composition in health and diseases. Clinical enzymology - Plasma enzymes in diagnosis and prognosis, Isoenzymes in health and diseases (Liver, cardiac and skeletal muscle enzymes)	19	1
II	Liver function tests, their significance, Liver diseases – Jaundice, hepatitis, gall stones, cirrhosis and fatty liver. Free radical mechanism and role of reactive oxygen species in diseases. Role of liver in metabolic regulation and drug metabolism. Clinical chemistry of new born.Kidney – Renal hormones –Renin, erythropoietin and angiotensin.Investigations of renal functions, biochemical investigation of renal disorders. Nephritis, nephrotic syndrome and urolithiasis. Compensatory mechanism for acidosis and alkalosis.Gastrointestinal hormones - Gastrin, secretin and cholecystokinin. Disorders of gastric function, methods of evaluation.Pancreatic exocrine secretions, pancreatic diseases, steatorrhoea. Malabsorption syndrome – tests for their evaluation and significance.	19	2
III	Pancreatic hormones – Biosynthesis of insulin, regulation of secretion of insulin and glucagon, their role in carbohydrate ,lipid and protein metabolism. Endocrine disorders of pancreas – Diabetes mellitus, melliturias, hypoglycemia.Glucose tolerance test.Thyroidal hormones – Chemistry, function and metabolism. Hypo and hyper thyroidism, tests for thyroid function. Parathyroid hormones – Parathormone and calcitonin, their role in calcium and phosphate metabolism, abnormalities of parathyroid functions and methods of evaluation. Adrenals - Chemistry and biosynthesis of adrenal medullary and adrenal cortical hormones. Disorders of adrenal cortex and adrenal medulla, tests for the evaluation of adrenal functions. Biochemical effects of tumours.	19	3
IV	Synthesis, secretion, transport and biological actions of hypothalamic, adenohypophysial and neurohypophysial hormones. Hypothalamic disorders. Pituitary - Clinical syndromes and their evaluation. Penial hormones – Melatonin and serotonin.Chemistry, biosynthesis and role of androgens, estrogens and progesterone.Hormonal regulation of menstrual cycle, Hormonal contraception.Placental hormones.Biochemistry of reproductive disorders, pregnancy toxemia, pregnancy tests.	18	4

Suggested Readings:

1. Harper's Biochemistry: R.K.Murray, D.K.Granner, P.A. Mayes and V.W.Rodwell.
2. Clinical Laboratory Science Review: Robert R. Harr
3. Fundamentals of Clinical Chemistry: C.A. Burtis, E.R. AshwoodTietzvb
4. Notes on Clinical Chemistry- Principles of Internal Medicines: Whitby, Smith, Beckett, Walker, Harrison
5. Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
6. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
7. Harper’s Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice HallInternational Inc.
8. Textbook of medical physiology: A. C. Gyton, and J. E HallSaunders ElsevierPublications, A division of Reed Elsevier India Pvt .Ltd.New Delhi ISBN 81-8147-084-2
9. T.M. Delvin (editor), Text book of biochemistry with clinical correlation, (1982), JohnWiley & Sons Inc. USA.

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH 420	Paper II - Nutraceutical Biochemistry and Functional Foods		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): i) Provide basic knowledge on nutraceuticals/bioactive compounds (e.g. carotenoids, glucosinolates, and polyphenols);
ii) Familiarize students with the scientific evidence about the role of diet and dietary components in the modulation of risk factors associated with chronic diseases (e.g cardiovascular diseases) and human health;
iii) Enable students to understand the concept of functional foods and their role in the human health and well-being.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Basic knowledge on the nutraceuticals in the context of the human well-being.	U
2	Equipped with knowledge necessary to understand the diet-health relationships and the importance of human evidence-based nutrition.	Ap
3	Learn the regulatory aspects of functional foods and the requirements for safety and efficacy assessment of nutraceutical and functional food.	Ap
4	Perspectives about the application of biotechnology for improving the formulation of potential functional ingredients/foods will be mastered.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction to Nutraceuticals as Science:** Historical perspective, classification, scope and future prospects. Scrutinising the term 'nutraceutical' Regulation of various countries. Medicinal Plants: Ethnomedicine in India, Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition.	19	1
II	**Properties, structure and functions of various Nutraceuticals:** Glucosamine, Octacosanol, Lycopene, Falvanoids, Carnitine, Melatonin and Ornithine alpha, ketoglutarate.Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals. Nutraceutical Industry and Market Information, New technologies in development of Nutraceuticals and functional foods Functional Foods, Scope of Genetic engineering, Nutritional Genomics	19	2
III	**Food as remedies** Nutraceuticals bridging the gap between food and drug, Special Dietary Needs, Disease and Nutrition; Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc.	19	3
IV	**Anti-nutritional Factors present in Foods** Types of inhibitors present in various foods and how they can be inactivated. General idea about role of Probiotics and Prebiotics as nutraceuticals. Recent advances in techniques & feeding of substrates. Assessment of nutritional status and Recommended Daily allowances.	18	4,5

Books Recommended:

1. Stryer E.A., Biochemistry
2. Zubay, Geoffrey L. Biochemistry,
3. Greenberg David M. Metabolic Pathways, Vol 3 Todd and others, Clinical Diagnosis and Management, 17th Ed,
4. Gopalan C., et al Dietary Allowances for Indians, NIH, Hyderabad.
5. Anita F.P. Clinical Dietetics and Nutrition, 4th Ed, 1997,
6. Devlin, T.M. Text Book of Biochemistry with Clinical Correlation,
7. Mahan, L.K. &Ecott- Stump, S. [Ed.] Krause's Food, Nutrition and Diet Therapy
8. Lehninger Nutrition Concepts & Controversies,
9. W. Jeffrey, Hursts Methods of Analysis for Functional Foods and Nutraceuticals

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH 430 (A)	Paper III - Plant Biotechnology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module will help to understand production of plats in the lab, production of high quality seeds, plants and plant products, engineering with plant genome.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand Requirement and essentials of a plant tissue culture laboratory.	Ap
2	Skilled with plant tissue culture laboratory.	Ap
3	Socially aware with hybrid and indigenous verity and quality of plant based foods.	U
4	Understand research area and research possibility towards plant science.	Ap
5	Apply plant tissue culture and its importance in various fields for development of new crops.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids. Tissue culture media (composition and preparation). Initiation and maintenance of callus and suspension culture; single cell clones. Organogenesis; somatic embryogenesis; transfer & establishment of plants in soil. Shoot tip culture: Rapid clonal propagation and production of virus free plant.	19	1
II	Embryo culture and embryo rescue. Anther, pollen and ovary culture for production of haploid plants & homozygous lines. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Germplasm conservation: Cryopreservation & slow growth cultures. Chloroplast Transformation: Advantages, vectors, success; tobacco & potato.	19	2
III	Plant transformation technology: Basis of tumor formation, Mechanism of DNA transfer, Features of Ti and Ri plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, use of scaffold attachment regions, multiple gene transfers, particle bombardment, electroporation, microinjection. Applications of plant transformation for productivity and performance: herbicide resistance, insect resistance, Bt genes, Non–Bt like protease inhibitors & amylase inhibitors, virus resistance, nucleocapsid gene, disease resistance, PR (Pathogenesis Related) proteins, nematode resistance, abiotic stress, male sterile lines.	19	3
IV	Metabolic Engineering and Industrial Products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, biodegradable plastics, therapeutic proteins, antibodies, edible vaccines. Molecular Markers– RFLP maps, linkage analysis, RAPD markers	18	4,5

Books Recommended:

1. Razdan MK Introduction to Plant Tissue Culture
2. Vasil IK Plant Cell and Tissue Culture
3. Bhojwani SS and Razdan MK Plant Tissue Culture
4. Singh BD Biotechnology: Expanding Horizons
5. RH Smith Plant Tissue Culture Techniques and Experiments
6. L Kyte and J Kleyn Plants from Test Tubes: An Introduction to Micropropagation
7. M Smith Plant Propagator's Bible
8. MR AhujaMicropropagation of Woody Plants
9. YPS Bajaj Trees III

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH 430 (B)	Paper III - Infectious Diseases: Molecular Basis, Spread, Control and Prevention		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The objective is to offer detailed knowledge about the mechanisms of disease, cause, transmission, detection, treatment and prevention.

Course Learning Outcomes:

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Gain overall knowledge about the mechanisms of disease cause, transmission, detection, treatment and prevention.	U
2	Develop the ability to relate to any existing or emerging infection as well as will learn about drug resistance and its mechanisms.	Ap
3	Analyze Infectious Diseases risk measurement.	E
4	know-how to research and develop new tools for their management.	E

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	2
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	1
CO3	3	3	3	1	1	1	3	-	-	2	2	3	2	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	2

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Overview of infectious diseases, infectious agents - Bacteria, Viruses, protozoa and fungi, pathogenicity and virulence; Facultative / obligate intracellular pathogens. Emerging and re-emerging infectious diseases and pathogens including X-MDR M. tuberculosis, MRSA, SARS virus, Bird flu, prions, AIDS, Dengue Hemorrhagic Fever, and Chlamydiae, opportunistic fungal pathogens.	19	1
II	Bacterial disease, epidemiology, signs and symptoms, causative agent, history, infection and pathogenicity, Diagnostics, Therapeutics and vaccines. Drug resistance, mechanisms, Multidrug efflux pumps, extended spectrum β-lactamases (ESBL) and implications on public health, molecular mechanisms for Tuberculosis, Typhoid, Cholera	19	2
III	Viral diseases, epidemiology, signs and symptoms, causative agent, history, infection and pathogenesis, Detection, Drugs and inhibitors, Vaccines, molecular mechanisms for AIDS, hepatitis, influenza, dengue, polio, herpes.	19	3
IV	Parasitic diseases epidemiology, signs and symptoms, causative agents, history, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development, molecular mechanisms for Malaria. Coronavirus Disease (COVID-19), Fungal Infections, Analysis of Infectious Diseases Infection, Antimicrobials/Antibiotics/Antibacterial, Neuro Infectious Diseases.	18	4,5

Suggested readings

1. Klein's Microbiology (2008) 7th Ed., Prescott, Harley, Willey, J.M., Sherwood, L.M.,Woolverton, C.J. McGraw Hill International Edition (New York) ISBN: 978-007-126727.
2. Principles and practices of Infectious diseases, 7th edition, Mandell, Douglas andBennett. S, Volume, 2. Churchill Livingstone Elsevier. ISBN: 978-0-443-06839-3
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases. (2010).Kenneth J. Ryan, C. George Ray, Publisher: McGraw-Hill. ISBN-13: 978-0071604024 ISBN-10: 0071604022
4. Medical Microbiology. (2012). Patrick R. Murray, Ken S. Rosenthal, Michael A.Pfaller, Elsevier Health Sciences. ISBN: 978-0-323-08692-9.
5. Bacterial Pathogenesis: A molecular approach by Salyers AA and Whitt DD eds.American Society for Microbiology Press, Washington, DC USA. 2002

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH 440 (A)	Paper IV - Life style Disorders: Cancer and Cardiovascular Diseases		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The objective is to provide knowledge about common life style disorders with detailed insight in to two major killers: Cancer and Cardiovascular diseases.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Learn about the various life styles associated disorders.	Ap
2	Gain detailed insight into Cancer and Cardiovascular diseases with regards to the molecular mechanisms, causes, symptoms, stages, diagnosis and treatments.	Ap
3	Learn about alternative medicines; current research status, various ethical, social and regulatory issues.	U
4	Gain detailed insight into Behavioral and Mental disorders with regards to the mechanisms, causes, symptoms, stages, diagnosis and treatments.	

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	2	3	1	2
CO2	3	3	3	1	1	1	3	-	-	-	1	3	2	2
CO3	3	3	3	1	1	1	3	-	-	2	1	3	2	1
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	2

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction:** Life style associated disorders like obesity, diabetes, chronic obstructive pulmonary diseases (COPD), cancer and cardiovascular diseases (CVDs); Causes, symptoms, complications, diagnosis, intervention and management of disease; Two major killers: Cancer and Cardiovascular diseases.	19	1
II	**Cancer:** History of cancer; Characteristics of normal and transformed cells; Hallmarks of cancer; Causes and symptoms; Pathophysiology; Stages of cancer; Molecular basis of neoplastic growth and metastasis, Key oncogenic pathways; Proto-oncogenesis and Tumor suppressor genes; Cancer causing mutations; Tumor viruses, Overview of important techniques related to cancer research.	19	2
III	**Cardiovascular diseases:** Definition; The origin of cardiovascular diseases (electrical, structural and circulatory) and types of CVDs; Defining the broad spectrum of ailments; Understanding the underlying factors; Stages of CVDs; Molecular basis of CVDs like hypertension, coronary heart (artery) disease, cerebrovascular disease, cardiomyopathy, cardiac hypertrophy, atherosclerosis, myocardial infarction	19	3
IV	**Diagnosis and Treatment strategies :** Biochemical analysis of cancer and screening methods; Current treatment modalities and their disadvantages, major side effects; Molecular approaches to cancer treatment; Factors affecting prognosis of cancer; Challenges of treatment and disease control strategies. Diagnosis and biomarkers for CVDs; Treatment strategies and management of the condition; Drugs and their discovery; Model systems and animals for CVDs.	18	4

Suggested Readings:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Introduction to Human Physiology (2012) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning. ISBN-13: 978-1133104544 ISBN-10: 1133104541
3. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0- 87893-300-6.
4. The World of the cell, 7th edition (2009). Lewis J. Kleinsmith, Jeff Hardin, Gr Wayne M.Becker. ISBN-13: 978-0805393934 ISBN-10: 0805393935.
5. Life style disorders, National health portal of India (https://www.nhp.gov.in/lifestyledisorder_ mtl)

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH 440 (B)	Paper IV - Bioinformatics		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
5	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The module is designed to provide introduction & detailed information on storing, retrieving, analyzing biological data in silico.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Discuss the various databases and GenBank used in storing biological data.	Ap
2	Identify the basic concepts of sequence similarity by BLAST and FASTA algorithms.	Ap
3	Explain the phylogenetic analysis and various genome projects.	Ap
4	Apply the techniques for the protein structure prediction.	Ap
5	Summarize the cheminformatics and medicinal chemistry.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction to bioinformatics** Bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pub med, PDB) and software (RASMOL, Ligand Explorer). **Data generation** Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.	19	1, 2
II	**Biological Database and its Types** Introduction to data types and Source.Population and sample. Classification and Presentation of Data.Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB sum)	19	3
III	**Data storage and retrieval and Interoperability** Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.Data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.	19	4
IV	**Gene Expression and Representation of patterns and relationship** General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS. Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.	18	5

Books Recommended:

BAXEVANIS, AD & OUELLETTE, BFF : Bioinformatics: a practical guide to the analysis of genes and proteins. 2nd Ed.. 2002.
BAXEVANIS, AD, DAVISON, DB, PAGE: Current protocols in bioinformatics. 2004.
RDM & PETSKO, GA ORENGO, C, JONES, D & : Bioinformatics: genes, proteins and computers. 2003
THORNTON, J Ingvar Eidhammer, IngeJonassen, : Protein Bioinformatics. 2003
William R Taylor HIGGINS, D & TAYLOR, W : Bioinformatics: sequence, structure, and databank. 2000.
David Mount: Bioinformatics: sequence and genome analysis. 2004

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 450	Paper V - Lab Course- I		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	CIA	ESE
100	30	70

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Demonstrate isolation of nucleic acid from microorganisms, digestion reaction in nucleic acids of various samples, PCR methods and hyper expression of poly histidine-tagged recombinant protein and purification.	E
2	Student will be skilled with basic Research on bioactive compounds.	E
3	Skilled with plant tissue culture laboratory, Socially aware with hybrid and indigenous verity and quality of plant based foods, research area and research possibility towards plant science.	E
4	Apply plant tissue culture and its importance in various fields for development of new crops.	An
5	Evaluate risk of infectious disease and create way to minimize exposure, diagnose the disease and suggest way for treatment.	C

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List Of Experiments of Course BCH 410 1. Assay of Alkaline and Acid Phosphates 2. Estimation of blood glucose by GOD and POD method 3. Various types of glucose tolerance tests. 4. Estimation of SGOT, SGPT, LDH and CPK, Serum Amylase enzymes 5. Estimation of HDL- cholesterol, LDL- cholesterol. 6. Estimation of uric acid and creatinine in plasma. 7. Estimation of urine and blood billurubin. 8.. Histological / Histochemical / Cytological study of Endocrine gland	30	1, 2
	List Of Experiments of Course BCH 420 **I**dentification using characteristic features of nutracuetically important plants like; *Phyllanthusemblica, Curcuma longa, Zinziberofficinalis*, Solanaceae (*Withaniasomnifera)*, *Aloe vera*, Lilliaceae (*Aliumsativum*), Lamiaceae (*Ocimum sanctum*), Apiaceae (*Coriandrumsps*) and Liliaceae (*Asparagus sps.*), *Centellaasiatica.* Study of following Parasites/ Vectors/ pests: Identification, Habits and control measures (museum Specimens / slides): *Entamoebahistolytica, Taeniasps, Ascarislumbricoides, Ancylostomadueodenaei, Trichinellaspiralis, Trichuratrichuris,* Mosquito (*Culex and Anopheles*), House fly, Green bottle fly, Head Louse, Cockroach (*Periplanata&Blatta*), bed bug, *Mus*sps. (Mouse) and *Rattus*sps. (House rat) Reactions of mono, di and polysaccharides and their identification in unknown mixtures Determination of Acid value, Saponification and Iodine number of natural fats & oils. Estimation of proteins with Bradford's and other methods. Extraction and estimation of total sugars from food products (dairy product, fruit juices, bread). TLC separation of Plant pigments – Curcumin and carotene. To isolate DNA and RNA from given plant/ animal material and estimate DNA by Diphenylamine (DPA) method and RNA by Orcinol reagent Extraction, purification and evaluation of activity of any one digestive enzyme (e.g. Beta amylase from sweet potato) Estimation of ascorbic acid from lemon &amla juice by titration method Estimation of total Nitrogen of foods by Kjeldahl and Micro Kjeldahl methods. Chromatography: Paper, TLC, adsorption, ion exchange, gel filtration, affinity, GC & HPLC. Separation of Milk proteins on Native and SDS gels.	30	3, 4

Books Recommended:

1. Stryer E.A., Biochemistry
2. Zubay, Geoffrey L. Biochemistry,
3. Greenberg David M. Metabolic Pathways, Vol 3 Todd and others, Clinical Diagnosis and Management, 17th Ed,
4. Gopalan C., et al Dietary Allowances for Indians, NIH, Hyderabad.
5. Anita F.P. Clinical Dietetics and Nutrition, 4th Ed, 1997,
6. Devlin, T.M. Text Book of Biochemistry with Clinical Correlation,
7. Mahan, L.K. &Ecott- Stump, S. [Ed.] Krause's Food, Nutrition and Diet Therapy

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH 460	Paper VI - Lab Course- II		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	-	-	4

Maximum Marks	CIA	ESE
100	30	70

1. **Learning Objective (LO): 1.** This module will help to understand production of plats in the lab, production of high quality seeds, plants and plant products, engineering with plant genome.
2. Students will acquire the knowledge to isolate bacteria from water/sewage samples, to stain bacteria, fungi, acid fast bacilli and to perform important diagnostic tests for infectious diseases such as WIDAL test. Students will be exposed to permanent slides of pathogens in order to get hands-on training to know nature of various pathogens causing diseases and Life Style disorder.
3. The module is designed to provide a detailed knowledge of online databases available and functioning of all the software to study the bio molecules of life.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Skilled with plant tissue culture laboratory, Socially aware with hybrid and indigenous verity and quality of plant based foods, research area and research possibility towards plant science. Apply plant tissue culture and its importance in various fields for development of new crops.	Ap
2	Evaluate risk of infectious disease and create way to minimize exposure, diagnose the disease and suggest way for treatment.	
3	Demonstrate the use of databases.	
4	Demonstrate the gene and protein sequence retrieval techniques.	
5	Produce novel DNA and protein structures to be used in therapeutics.	

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO2	3	3	3	3	-	2	3	3	-	3	2	3	3	3
CO3	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO4	3	3	3	3	-	3	3	3	-	3	3	3	3	3
CO5	3	3	3	3	-	3	2	3	-	3	2	3	3	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
	List Of Experiments of Course BCH430 (A)	30	1, 2
	1. Preparation of culture media. 2. To perform meristem/ bud culture, shoot multiplication & rooting phenomenon. 3. To study organogenesis. 4. To perform somatic embryogenesis. 5. To study the process of plantlet acclimatization. 6. To perform embryo culture. 7. To study the process of another culture development. 8. Study of molecular markers. 9. Extraction of DNA from plant cultures. 10. Estimation & separation of DNA: Agarose gel electrophoresis & spectrophotometer.		
	OR		
	List Of Experiments of Course BCH430(B)		
	1. Case Studies 2. Power point presentations; discussion of research articles and reviews on it. 3. Identification of modifiable behavioral risk factor in case study. 4. Identification of Nonmodifiable behavioral risk factors in different life style disorder. 5. Students may be given short term project work (05 to 15 Days) to analyze risk factors for a life style disorder through case studies.		
	List Of Experiments of Course BCH 440 (A)	30	3, 4, 5
	1. Grams staining for bacteria 2. Isolation and culture of bacteria from water/sewage samples. 3. Demonstration of various media for bacterial culture 4. Isolation and enumeration of bacteriophages (PFU) from water/sewage samples 5. WIDAL test 6. Acid fast staining 7. Permanent slides of pathogens: Mycobacterium tuberculosis, Leishmania, Plasmodiumfalciparum 8. Fungal staining 9. Case Study		
	OR		
	List Of Experiments of Course BCH440 (B)		
	01. Retrieval of sequences from NCBI, EBI and EMBL databases. 02. Retrieval of sequences from NBRF-PIR, SWISSPROT and P databases. 03. Transition and Translation of sequences. 04. Retrieval of genome from genome databases. 05. Exploring DIP and PPI. 06. Exploring BIND and PIM. 07. Exploring MINT and GRID. 08. Analysis of phylogenetic tree 09. Exploring PDB file. 10. Analysis of active site by pymol		

Books Recommended:

Razdan MK Introduction to Plant Tissue Culture
1. Vasil IK Plant Cell and Tissue Culture
2. Bhojwani SS and Razdan MK Plant Tissue Culture
3. Singh BD Biotechnology: Expanding Horizons

4. RH Smith Plant Tissue Culture Techniques and Experiments
5. L Kyte and J Kleyn Plants from Test Tubes: An Introduction to Micropropagation
6. M Smith Plant Propagator's Bible
7. MR AhujaMicropropagation of Woody Plants
8. YPS Bajaj Trees III
1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Introduction to Human Physiology (2012) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning. ISBN-13: 978-1133104544 ISBN-10: 1133104541
3. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0- 87893-300-6.
4. The World of the cell, 7th edition (2009). Lewis J. Kleinsmith, Jeff Hardin, Gr Wayne M.Becker. ISBN-13: 978-0805393934 ISBN-10: 0805393935.
5. Life style disorders, National health portal of India (https://www.nhp.gov.in/lifestyledisorder_ mtl)
6. BAXEVANIS, AD & OUELLETTE, BFF : Bioinformatics: a practical guide to the analysis of genes and proteins. 2nd Ed.. 2002.
7. BAXEVANIS, AD, DAVISON, DB, PAGE: Current protocols in bioinformatics. 2004.
8. RDM & PETSKO, GA ORENGO, C, JONES, D & : Bioinformatics: genes, proteins and computers. 2003
9. THORNTON, J Ingvar Eidhammer, IngeJonassen, : Protein Bioinformatics. 2003
10. William R Taylor HIGGINS, D & TAYLOR, W : Bioinformatics: sequence, structure, and databank. 2000.
11. David Mount: Bioinformatics: sequence and genome analysis. 2004

M. Sc. Biochemistry Semester- IV (Jan 2027 – June 2027)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	IV
Course Code	**Course Title**		**Course Type**
BCH480	BIOSAFETY, BIOETHICS AND IPR (along with Project work)		ELECTIVE
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO):

1. To introduce basic concepts of ethics and safety that are essential for Life Science Labs.
2. To understand the procedures involved in the protection of intellectual property.
3. To give an insight into different treaties signed. To gain knowledge about patent filing.**Course Outcomes (COs**)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Gain Knowledge of working principles in a laboratory taking a, safety measures, Handling of live cultures, disposal of infectious waste, and care of the equipment requiring	Ap
2	Get an insight into Biosafety guidelines. . Analyze and Manage the Risks involved with GMOs.	Ap
3	Understand the international Agreements and Regulations with respect to Biosafety, Gain Knowledge about intellectual property Rights.	U
4	Understand guidelines to protect biological inventions. Understand different treaties, rights, and duties of patent owners.	An
5	Understand the process of filing a patent.	An

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	2	2	1	2	2	2	2	3	2	1
CO2	3	3	2	2	2	2	1	2	2	2	2	3	2	1
CO3	3	3	2	2	2	2	1	2	2	2	2	3	2	1
CO4	3	3	2	2	2	2	1	2	2	2	2	3	2	1
CO5	3	3	2	2	2	2	1	2	2	2	2	3	2	1

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**BIOSAFETY INTRODUCTION** Introduction: Biosafety issues; Biological safety, cabinets & their Types; primary containment for Biohazards; Biosafety Levels of specific Microorganisms. **GUIDELINES:** Biosafety guidelines and regulations (National and International); Role of institutional biosafety committees (IBSC).	19	1, 2
II	**RISK ANALYSIS AND GUIDELINES** Genetically modified organisms (GMos), GMo applications in food and agriculture, Risk Analysis; Risk Assessment and Risk Management; Experimental models: Use of Animals in Research and its Alternatives, Animal cloning, and their Ethical Aspects. Testing of drugs on Human volunteers.	19	3
III	**INTRODUCTION TO INTEILECTUAL PROPERTY** introduction to intellectual property and History Patents, Trademarks, Copyright, Trade secrets, industrial Design and Rights, Traditional Knowledge, importance of IPR- patentable and non-patentable; World intellectual Rights Organization (WtpO), pros and Cons of lp protection.	19	4
IV	**PATENT FILING AND GRANT** Types of patent applications: ordinary, Patent PCT, conventional, An introduction to patent Filing procedures; licensing and agreement; Agreements and Treaties: GATT, TRIPS Agreement; wipo Treaties; Budapest Treaty; lndian Patent Act 1970 & recent amendments. patenting of Living organisms.	18	5

Text Books Recommended –

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

M. Sc. Biochemistry Semester- I (July 2025 – Dec 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	II
Course Code	**Course Title**		**Course Type**
BCH GE-1	Introductory Biochemistry and Biomolecules		Generic Elective – I
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	2	1	--
Maximum Marks	**CIA**		**ESE**
100	30		70

Learning Objective (LO): This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Students will be exposed to the history of Biochemistry and key contributions of scientists such as Achary Nagarjun, Hans Kreb, G. N. Ramachandran, Melvin Calvin, Louis Pasteur, Har Gobind Khorana, Watson and Crick and Venky Ramakrishnan.	Ap
2	Understand the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA and their importance in biological systems.	Ap
3	Understand the methods of determination of amino acid and nucleotide sequence of proteins and DNA respectively.	U
4	They will understand the methods of estimation of DNA & RNA.	An

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	2	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**General understanding of Biochemical** Molecular Logic of Life. Definition of Biochemicals. Experiments and discoveries of Acharya Nagarjuna. Famous Indian Biochemists and their inventions/ Discoveries. Importance of Yog, Pranayam, food and healthy lifestyle for balance of biochemical (kaf, vat, pitta) of our body and role in maintaining good mental and physical health. Biochemical basis of Lifestyle disorders.	5	1
II	**Biological Importance of Carbohydrates:** Definition, classification, biological importance. Monosaccharides: Disaccharides: Polysaccharides: Partial structure, occurrence and importance of starch, glycogen, inulin, cellulose, chitine. heparin, hyaluronic acid.	7	2
III	**Biological Role of Lipids:** Properties and functions of saturated and unsaturated fatty acids. Phosphoglycerides: function of lecithin, cephalins, phosphotidylinosital, plasmalogens, and cardiolipin, importance of sphingomyelin, gangliosides and cerebrosides.	8	3
IV	**Biological Importance of Amino acids and Proteins.** General Structure, classification of amino acids based on R Group. Amino acids D & L notation. Proteins: Peptides, Structure of proteins **Structure and functions of Nucleic acids:** Composition of DNA and RNA. Nucleosides and nucleotides. Chargaff's rule. Primary and secondary structure of DNA, Watson and Crick model of DNA. Melting of DNA (Tm).	10	4

Books Recommended:

Nelson, Cox and Lehninger	Principles of Biochemistry
G. Zubay	Biochemistry
Stryer	Biochemistry
Garrett and Grosham	Biochemistry
West, Tood, Mason &Bbruglen	Text book of biochemistry
White, Handler & Smith	Biochemistry-clinical application
D. Voet and J C Voet	Biochemistry

M. Sc. Biochemistry Semester- II (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	II
Course Code	**Course Title**		**Course Type**
BCH GE-2	Intermediary Metabolism		Generic Elective – II
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	2	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe the fundamentals of thermodynamics in biochemical processes and energy production in living systems by the degradation of carbohydrate.	Ap
2	Describe the energy generated from the metabolism.	Ap
3	Explain the various pathways of fatty acid metabolism in living systems.	U
4	Explain the various pathways of Amino acids and proteins in living systems.	Ap
5	Explain the metabolism of nucleic acids and porphyrins.	U

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	1	1	1	3	-	-	-	-	3	1	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-
CO3	3	3	3	1	1	1	3	-	-	1	-	3	2	-
CO4	3	3	3	1	1	2	3	-	-	1	1	3	2	1
CO5	3	3	3	1	1	-	2	-	-	1	2	3	2	1

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Function and Importance of Carbohydrate Metabolism:** glycolysis. Alcoholic and lactic acid fermentations. TCA Cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Physiological significance of pentose phosphate pathway. Regulation of Glycolysis and TCA cycle.	5	1
II	**Function and Importance of ATP Production:** Structure of mitochondria, Mechanism of ATP Production, Effect of cyanide. Hypothesis of mitochondrial Oxidative phosphorylation. Function and importance of ETC.	5	2
III	**Function and Importance of Lipid Metabolism** Introduction, hydrolysis of triacylglycerols, transport of fatty acids into Mitochondria, β oxidation saturated fatty acids, ATP yield from fatty acid Oxidation. Function and Importance of Biosynthesis of saturated and unsaturated fatty acids. Function and Importance of Metabolism of Ketone bodies.	5	3
IV	**Function and Importance of Amino acid Metabolism** Function and Importance of of amino acid metabolism. Transport of amino group in blood. Urea cycle. Glycogenic and ketogenic amino acids. Inborn errors associated amino acid metabolism. **Function and Importance of Nucleotide Metabolism** Sources of the atoms in the purine and pyrimidine molecules. Function and Importance of Biosynthesis and Degradation of purines and pyrimidines. Inborn errors associated nucleotide metabolism.	15	4

Suggested Readings:

Principles of Biochemistry Nelson, Cox and Lehninger
Biochemistry G. Zubay
Biochemistry Stryer

M. Sc. Biochemistry Semester- III (July 2026 – Dec 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	II
Course Code	**Course Title**		**Course Type**
BCH GE-3	Bioanalytical Techniques		Generic Elective – III
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	5	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand the principle, methodology and applications of Spectroscopic techniques.	U
2	Understand the principle, methodology and applications of Centrifugation techniques.	U
3	Understand the principle, methodology and applications of Electrophoretic techniques.	U
4	Explain the principle, methodology and applications of Chromatography techniques.	U
5	Describe principle, methodology and applications of PCR techniques.	U

CL: CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	2	1	-
CO2	2	2	3	1	1	1	2	-	-	-	-	2	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	2	1	-	2	1	3	2	-
CO5	2	2	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Spectroscopy -** Concepts of spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry. Visible and UV spectroscopy.	5	1
II	**Electrophoretic techniques** – Principles of electrophoretic separation. Types of electrophoresis including paper and gel. SDS PAGE. **Chromatography** – Principles and applications of paper, thin layer, ion exchange, affinity, gel permeation, adsorption and partition chromatography. HPLC and FPLC.	15	2, 3
III	**Centrifugation** – Principle of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical, ultra-centrifugation, determination of molecular weights and other applications.	5	4
IV	**Microscopy** – Bright field, Dark field, Phase contrast and Fluorescence microscopy Transmission and scanning microscopy, freeze fracture techniques, **Immunological Techniques:** Immuno diffusion, immune electrophoresis, radioimmunoassay, ELISA, Immuno fluorescence.	5	5

Books Recommended:

8.K Wilson and John Walker Practical Biochemistry: Principles & Techniques
9.RF Boyer Biochemistry Laboratory: Modern Theory & Techniques
10. S Carson, H Miller and D Scott Molecular Biology Techniques: A Classroom Laboratory Manual
11. TC Ford and J. M. Graham An Introduction to Centrifugation

M. Sc. Biochemistry Semester- III (July 2026 – Dec 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	III
Course Code	**Course Title**		**Course Type**
BCH GE-4	Nutritional and Environmental Biochemistry		Generic Elective – IV
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	2	1	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand the basic components of food stuff and balance diet.	U
2	Understand the food vitamins and minerals with nutritional disorder.	U
3	Understand the Role of different food in the body.	U
4	Understand the effect of toxic substances on environment.	U
5	Understand the effect of toxic chemicals on body parts and their cure.	U

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	2	1	-
CO2	2	2	3	1	1	1	2	-	-	-	-	2	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	2	1	-	2	1	3	2	-
CO5	2	2	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Composition of balanced vegetarian and non-vegetarian diets**; recommended dietary allowance (RDA) for different categories of the human beings. Food preservation standards, food adulterations and precautions, Food processing and loss of nutrients during processing and cooking.	5	1
II	**BMR :** Basal metabolism and methods of measuring basal metabolic rate (BMR); energy requirements during growth, pregnancy, lactation and various physical activities. Disorders related to the nutrition: Protein energy malnutrition, Starvation, Obesity.	5	2
III	**Nutritional aspects of Food**: carbohydrates, lipids and protein: nutritive value, requirements, and functions. Nutritional aspects of the vitamins and minerals: requirement and functions Malnutrition, its implications, relationship with dietary habits and prevention.	5	3
IV	**Environmental Pollution:** Types, Outdoor and indoor Air pollution, sources, structure and control strategies. Water and Soil Pollution.Eco–toxicology and its environmental significance. Xenobiotic metabolism and role of liver. **Pesticide toxicity –** insecticides, fungicides, herbicides and biopesticides. Toxicology of food additives. Metal toxicity –lead and cadmium. Occupational toxicology: Occupational hazards and their assessment.	15	4, 5

Suggested Readings:

1. LG Corkerhem and BSS Shane Basic Environmental Toxicology
2. T Shibamato& L F Bzeidanes Introduction to Food Technology
3. M. Stipanuk Biochemical, Phys. & Mol. Aspects of Human Nutrition
4. Tom Brody Nutritional Biochemistry
5. DA Bender Nutritional Biochemistry of the Vitamins

M. Sc. Biochemistry Semester- I (July 2025 – Dec 2025)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	I/II/III
Course Code	**Course Title**		**Course**
BCH IKS-1	Indian Health Sciences		Course on Indian Knowledge System (Theory Based)
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	2	-	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand Base of Indian therapeutic system.	U
2	Understand basics of Ayurveda.	U
3	Understand holistic approach to maintain mental and physical health.	U
4	Understand the large pharmacopeia of Ayurveda	U
5	Understand Current revival of Ayurveda and Yoga	U

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	-	1	-	3	1	-	-	-	2	1	-
CO2	2	2	3	1	1	1	2	-	-	-	-	2	2	-
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-
CO4	3	3	3	1	1	2	2	1	-	2	1	3	2	-
CO5	2	2	3	1	1	-	2	-	-	2	2	3	2	3

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Vedic foundations of Ayurveda. Ayurveda is concerned both with maintenance of good health and treatment of diseases. Basic concepts of Ayurveda. The three Gunas and Three Doshas, Pancha-mahabhuta and Sapta- dhatu.	5	1
II	The importance of Agni (digestion). Six Rasas and their relation to Doshas. Ayurvedic view of the cause of diseases. Dinacharya or daily regimen for the maintenance of good health. Ritucharya or seasonal regimen. Important Texts of Ayurveda.	5	2
III	Selected extracts from Astāngahrdaya (selections from Sūtrasthāna) and Suśruta-Samhitā (sections on plastic surgery, cataract surgery and anal fistula).	5	3
IV	The large pharmacopeia of Ayurveda. Charaka and Sushruta on the qualities of a Vaidya. The whole world is a teacher of the good Vaidya. Charaka's description of a hospital. Hospitals in ancient and medieval India. How Ayurveda continued to flourish till 18/19th centuries. Surgical practices, inoculation. Current revival of Ayurveda and Yoga.	15	4, 5

Suggested reading:

1. Ayurveda: The Science of Self Healing by Dr.Vasant Lad
2. Astāngahrdaya, Vol. I, Sūtrasthāna and Śarīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.

Online resources:

1. https://vikaspedia.in/health/ayush/ayurveda-1/ayurveda-basics
2. https://www.gersonayurveda.com/ayurvedic-principles
3. https://www.banyanbotanicals.com/info/ayurvedic-living/living-ayurveda/health-guides/digestion/the-importance-of-agni/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2816487/

M. Sc. Biochemistry Semester- III (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	I/II/III
Course Code	**Course Title**		**Course**
BCH VAC-1	Nanobiology		Value Added Course (Theory Based) -1
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	2	-	--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): The learning objectives of nanobiology are to equipped students with the knowledge and skills to

1. Understand Core Concepts: Explain the fundamental principles of nanobiology, including the interaction between nanoscale materials and biological systems.
2. Identify and describe the properties and functions of various nanomaterials (e.g., nanoparticles, nanofibers, nanotubes) used in biological applications.
3. Demonstrate knowledge of synthesizing and characterizing bio-nanomaterials using methods such as sol-gel, self-assembly, and electrospinning.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand the basic principles of nanoscience, including the unique physical, chemical, and biological properties at the nanoscale. Develop nanomaterials with tailored properties for specific applications.	U
2	Explain the unique physical, chemical, and mechanical properties of nanomaterials compared to their bulk counterparts.	Ap
3	Utilize advanced analytical techniques like scanning electron microscopy (SEM), atomic force microscopy (AFM), and X-ray diffraction (XRD) to analyze nanomaterials.	Ap
4	Propose innovative applications and improvements in existing nanomaterial technologies.	Ap
4	Address challenges related to stability, toxicity, and scalability in the production and application of nanomaterials.	Ap

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	2	2	3	2	2	2	2	3	3	2	1
CO2	3	3	3	2	2	3	2	2	2	2	3	3	2	1
CO3	3	3	3	2	2	3	2	2	2	2	3	3	2	1
CO4	3	3	3	2	2	3	2	2	2	2	3	3	2	1
CO5	3	3	2	2	2	3	2	2	2	2	3	3	2	1

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Unit No.	Topics	No. of Lectures	CO No.
I	Introduction of nanotechnology, nanobiology, bio-nanotechnology, Emergence of nanotechnology, challenges in Nanotechnology, Nano biomaterials, Application of Nanobiology in daily life.	6	1
II	Nanomaterials: Metal and carbon nanomaterials, Nanoparticles and nanocomposites, Toxicity and environmental risks of nanomaterials. Synthesis of nanomaterials and biomaterials, Quantum Dots for Biological Applications, Applications of Nanomaterials.	5	2
III	Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), Atomic Force Microscopy (AFM), Field Emission Scanning Electron microscope (FESEM), scanning tunneling microscopy (STM), High-Resolution Transmission electron microscopy (HR-TEM). Energy-dispersive X-ray spectroscopy (EDAX) and X-ray photoelectron spectroscopy (XPS)	5	3
IV	Biosensors: Types of biosensors, characteristics of biosensors, Nanobiosensors: genosensors, biosensor-fabrication, nanomaterial-based biosensors, applications of biosensors in healthcare. Microfluidics and Lab-on-a-chips devices, Biosensor Techniques: cyclic voltammetry (CV), Difference Pulse voltammetry (DPV), and Electrochemical Impedance Spectroscopy (EIS).	15	4, 5

Recommended books:

1. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition,2005.
2. Manoj K. Patel and Pratima R. Solanki. Nanobiotechnology for Sensing Applications: From Lab to Field. Nanomaterials Based Immunosensors for Clinical Diagnostics Applications. Apple Academic Press, Waretown, New Jersey 08758 USA (2015).
3. Challa S.S.R. Kumar, Nanomaterials for medical diagnosis and therapy, Wiley-VCH, 2007.

M. Sc. Biochemistry Semester- I/II/III (Jan 2026 – June 2026)

Program	Subject	Year	Semester
M. Sc.	Biochemistry	2	I/II/III
Course Code	**Course Title**		**Course**
BCH SEC-1	RESEARCH SKILL		Skill Enhancement Elective Course (Practical Based) -1
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
2	2		--

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO): Explain the scientific method, research ethics, and the process of inquiry. To develop clear, concise, and researchable questions or hypotheses.

Course Outcomes (COs)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Develop clear, concise, and researchable questions or hypotheses.	Ap
2	Conduct a comprehensive literature review to identify gaps, trends, and relevant studies in the chosen field.	Ap
3	Choose appropriate qualitative, quantitative, or mixed-method approaches based on the research objectives.	U
4	Use reliable and valid methods for gathering data, such as surveys, experiments, observations, or archival research. Analyze quantitative data using statistical tools and qualitative data using thematic analysis or coding.	An
5	Present research findings in a clear, structured, and well-documented format, adhering to academic standards.	

CL:CognitiveLevels(**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate; **C**-Create).

CO-PO/PSO mapping for the course:

PO / CO	POs											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	3	3	2	2	2	2	3	3	3	2
CO2	3	3	2	2	3	3	2	2	2	2	3	3	3	2
CO3	3	3	2	2	3	3	2	2	2	2	3	3	3	2
CO4	3	3	2	2	3	3	2	2	2	2	3	3	3	2
CO5	3	3	2	2	3	3	2	2	2	2	3	3	3	2

"3"–Strong;"2"–Moderate;"1"- Low; "-"No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**SKILL OF IDENTIFYING A RESEARCHPROBLEM** Specifying a Problem - Justifying it - Suggesting the need to study it for audiences.	6	1
II	**RESOURCE SEARCHING:** Skill of reviewing the literature Locating Resources - Selecting Resources - Summarizing Resources.	5	2
III	**SKILL OF SPECIFYING A PURPOSE FOR RESEARCH** Identifying the purpose statement - Narrowing the purpose statement to research - Questions or hypotheses.	5	3
IV	**SKILL OF COLLECTING DATA** Selecting individuals to study - Obtaining permissions - Gathering information. Skill of analyzing and interpreting DATA Breaking down the data - Representing the data - Explaining the data. **SKILL OF REPORTING AND EVALUATING RESEARCH** Deciding on audience - Structuring the report - Writing the report sensitivity.	16	4, 5

Suggested Readings:

1. Theses and Dissertations by R. Murray Thomas; Dale L. Brubaker ISBN: 9781412951159: 2007
2. Dissertations and Project Reports by Stella Cottrell ISBN: 9781137364265: 2014