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DEPARTMENT OF BIOCHEMISTRY

MSc Biochemistry

Program code 24

Choice Based Credit System (CBCS)
Outcome Based Education (OBE)

Syllabus effective from 2022-23 Batch onwards

Contents

Course Title: MAJOR PRACTICAL-IV MOLECULAR BIOLOGY & NUTRITION

M.SC., BIOCHEMISTRY THIRD SEMESTER

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Course Title: BIOSTATISTICS (CORE PAPER IX)

Course Title: RESEARCH METHODOLOGY (CORE PAPER X)

Course Title: HORMONAL BIOCHEMISTRY (Elective Paper IV)

Course Title: ADVANCED MEDICAL LABORATORY TECHNOLOGY (Elective Paper IV)

Course Title: BIOENTREPRENEURSHIP MANAGEMENT (Elective Paper IV)

Course Title : BIOINFORMATICS (ADVANCED)

Course Title: MAJOR PRACTICAL-V ADVANCED CLINICAL BIOCHEMISTRY

Course Title: MAJOR PRACTICAL-VI BIOINFORMATICS & IMMUNOLOGY

M.SC., BIOCHEMISTRY FOURTH SEMESTER

Course Title: IMMUNOLOGY (CORE PAPER X)

Course Title: NUTRIGENOMICS (ADVANCED)

Course Title: LIFE STYLE DISEASE AND PREVENTION (Elective Paper V)

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Course Title: FREE RADICAL BIOLOGY (Elective PaperV

Course Title: PROJECT

Institution

VISION

TO IMPART KNOWLEDGE BY ESCALATING TO ACTIVE LEARNING FROM ROTE LEARNING THAT-

- **Ignites Wisdom**
- **Challenges Status Quo**
- **Strengthens Social Equality**
- **Elevates Human Values and Universal Oneness**
- **Recognizes Indian Tradition and Culture**

MISSION

- **Curriculum that makes student competent to contribute economically and intellectually.**
- **Offer an environment of learning that encourages innovation and excellence.**
- **Promote research and development**
- **Best of facilities with the Best of technology**
- **Provide an environment for all round growth of the student**
- **Quality in every activity undertaken by the student and the faculty**
- **Instilling pride in serving the society and in being the citizen of this country.**

DEPARTMENT OF BIOCHEMISTRY

VISION

To be the center for excellence in Biochemistry by/and producing students highly skilled in the latest tools and technologies and making them to enhance the quality of life. To become a leader in near future in biochemistry by integrating teaching & learning, learning & skills, skills & employability, learning & research and research & service.

MISSION

M1	To provide Better understanding of the subject with sound knowledge in theory & practical
M2	To cultivate the ability to apply creativity and independent thinking resulting in bridging the gap between industry and academics to meet the industrial demands.
M3	To follow a multidisciplinary research strategy by harnessing all the available resources
M4	To apply the biochemical knowledge in solving human life and environment related problems.

PROGRAM EDUCATION OBJECTIVES (PEOs)
POST GRADUATE

Our programme will produce graduates who

Our programme will produce graduates who	
PEO1	Will demonstrate the knowledge, understanding and application, of the various concepts related to Biochemistry.
PEO 2	will have sound foundation in scientific knowledge required to solve practical challenges during their work as a professional.
PEO 3	Will possess professional, ethical & effective communication skills and critical thinking and have problem solving ability with multidisciplinary approach.
PEO 4	will be able to design, plan and execute small scientific projects.
PEO5	Will have a sense of belonging to the Institution and strengthen all departmental activities through their support.

PEO to Mission Statement Mapping

MISSION STATEMENTS	**PEO 1**	**PEO2**	**PEO 3**	**PEO 4**	**PEO5**
M1	3	3	3	3	3
M2	3	3	3	3	3
M3	3	3	3	3	3
M4	3	3	3	3	3

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES

M.Sc BIOCHEMISTRY

By the end of the programme, the graduates will be able to	
PO1	To attain suitable scientific knowledge and technical skills to realize, calibrate and develop innovative processes / skills for creation of inventive products which are beneficial to society.
PO2	To implement discipline, professionalism, team spirit, communication skills, social and ethical commitment in the post graduates in order to embellish leadership roles expediting perfection in different sector with a categorical professional distinctiveness, business savvy, international recognition and imperishable expansion.
PO3	To be habituated with the emerging expanses of erudition and their applications in several domains of biological sciences and to enlighten the students of its relevance in forthcoming studies
PO4	To enhance the insight of research-oriented knowledge in conjunction with literature survey, design of experimental methodology, analysis and interpretation of results and draw valid conclusions.
PO5	To provoke entrepreneurship among the students along with strong ethics and communication skills
PO6	To engage in Lifelong learning and enduring proficient progress

Mapping of POs TO PEOs

PEO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6
PEO 1	3	3	3	3	3	3
PEO 2	3	3	3	3	3	3
PEO 3	3	3	3	3	3	3
PEO 4	3	3	3	3	3	3
PEO 5	2	2	2	2	2	2

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

PROGRAM SPECIFIC OUTCOMES (PSO) IN RELATION TO GRADUATE ATTRIBUTES

M.Sc BIOCHEMISTRY

After successful completion of 2 years MSc programme the students will be able to	
PSO1	Understanding of biological principles and the ability to make connections across different levels of biological organization, from molecules to cells, to whole organisms, populations and ecosystems.
PSO2	Students should be able to demonstrate advanced knowledge and understanding in macromolecular structure, enzyme kinetic behavior, gene expression, metabolic control, molecular signaling, immunity etc
PSO3	Students should be able to use their practical skills of wide range of biochemical techniques in various laboratory investigations. Students should be able to develop generic skills that allow them to analyze, interpret and relate known and unknown biological phenomenon
PSO4	Students should be able to communicate what they know through precise language, diagrammatic representation , graphical mode and using computational tools
PSO5	Post-graduates will be able to identify problems related to environment, analyse and derive valid conclusions with fundamental knowledge in biology and computers. Apply reasoning to assess societal, health, safety and legal issues and understand his responsibilities by undergoing waste recycling process.

Mapping of POs TO PSOs (MSc Program

PSO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
PSO 1	3	3	3	3	3	3
PSO 2	3	3	3	3	3	3
PSO 3	3	3	3	3	3	3
PSO 4	3	3	3	3	3	3
PSO 5	2	2	2	2	2	2

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

DEPARTMENT OF BIOCHEMISTRY
SCHEME OF SEMESTER M.SC., PROGRAM
M.SC BIOCHEMISTRY SEMESTER I

Sl. NO	Course category	Course	Credit Distribution				Over all Credits	Total Contact Hours /Week	Marks		
			L	T	P	S			CIA	ESE	Total
Part - III	Core paper-I	Biomolecules 2224101	3	0	1	0	4	4	50	50	100
	Core paper-II	Intermediary Metabolism 2224102	3	1	0	0	4	4	50	50	100
	Core paper-III	Plant Biochemistry 2224103	4	0	0	0	4	4	50	50	100
	Core paper-IV	Enzymes 2224104	2	1	0	1	4	4	50	50	100
	Elective I	Membrane Biochemistry224105A/Phytomedicine 224105B/Stem cell biology2224105C	4	0	0	0	3	4	50	50	100
	Core Practical I	Major Practical –I Biomolecules and Intermediary metabolism 2224106	0	0	3	1	2	5	50	50	100
	Core Practical II	Major Practical –II Enzymes and Plant Biochemistry 222410	0	0	3	1	2	5	50	50	100
Part – IV		Soft Skill	2	0	0	0	2	-	50	50	100
Total							**25**	**30**	**400**	**400**	**800**

IM.SC BIOCHEMISTRY II SEMESTER

Sl. NO	Course categor y	Course	Credit Distribution				Over all Credits	Total Contact Hours /Week	Marks		
			L	T	P	S			CIA	ESE	Total
Part I	Core Paper- V	Analytical Biochemistry 2224208	3	1	0	0	4	4	50	50	100
	Core Paper- VI	Human Physiology and Nutrition2224209	3	1	0	0	4	4	50	50	100
	Core Paper- VII	Molecular Biology2224210	3	0	1	0	4	4	50	50	100
	Elective paper II	Biotechnology 2224211A/Ecology & Population Education2224211B/Microbiology2224211C	3	0	0	1	3	4	50	50	100
	Elective – III	Bioethics, IPR & HR 2224212A/ Organization behavior222412B/ Good lab practices222412C	3	0	0	1	3	4	50	50	100
	Core practi Cal	Major practical -III- - Analytical Biochemistry & Microbiology 2224213	0	0	3	1	2	5	50	50	100
	Core Practical	Major Practical –IV Molecular biology and Nutrition222413	0	0	4	0	2	5	50	50	100
Part – IV		Soft Skill	-	-	-	-	2	-	50	50	100
	Summer Internship will be carried out during the summer vacation of the first year for 4 weeks in any hospital, industry at the end of II semester. Credits will be included in the third Semester Marks Statement.						2				
TOTAL							26	30	400	400	800

II M.SC BIOCHEMISTRY III SEMESTER

Sl. NO	Course category	Course	Credit Distribution				Over all Credits	Total Contact Hours /Week	Marks		
			L	T	P	S			CIA	ESE	Total
Part I	Core paper VIII	Advanced Clinical biochemistry2224315	4	0	0	0	4	5	50	50	100
	Core Paper-IX	Biostatistics 2224316	3	0	1	0	4	4	50	50	100
	Core Paper-X	Research Methodology2224317	4	0	0	0	4	4	50	50	100
	Elective paper-IV	Hormonal biochemistry/2224318A Advanced MLT2224318B/ Bioentrepreneurship2224318C	3	0	0	1	3	4	50	50	100
	Core Practical	Major Practical –V ADVANCED CLINICAL BIOCHEMISTRY224320	0	0	4	0	2	4	50	50	100
	Core Practical	Major Practical –VI BIOINFORMATICS & IMMUNOLOGY 22243212					2	4	50	50	100
	Advanced	Bioinformatics22243192	4	0	0	0	3	5	50	50	100
Part – II		Soft Skill	2	0	0	0	2	-	50	50	100
Total							**24**	**30**	**400**	**400**	**800**

M.SC BIOCHEMISTRY IV SEMESTER

Sl. NO	Course category	Course	Credit Distribution				Over all	Total Cont act Hours/ Week	Marks		
			L	T	P	S	Credits		CIA	ESE	Total
Part - I	Core paper-XI	Immunology 2224422	4	0	0	0	4	5	50	50	100
	Core Project	Project – Dissertation2224425	0	0	3	1	4	20	50	50	100
	Advanc Ed	Nutrigenomics2224423	3	1	0	0	3	5	50	50	100
	Elective V	Lifestyle disease & prevention A/ Free radical biologyB / Healthcare Management224424AC	3	0	0	1	3	5	50	50	100
	Part – II	Soft Skill	0	0	2	0	2		50	50	100
TOTAL							**16**	**30**	**250**	**250**	**500**

DEPARTMENT OF BIOCHEMISTRY
SCHEME OF SEMESTER M.SC., BIOCHEMISTRY

TOTAL NO OF CREDITS

S.No	**Course**	**No of papers**	**Total Credit**
1.	Core Theory paper	11 x 4	44
2.	Core Practical	6 x 2	12
3.	Elective Paper	5 x 3	15
4	Advanced Paper	2 x 3	06
5.	Soft Skill	4 x 2	08
6	Summer Internship	1 x 2	02
7.	Core project	1 x4	04
TOTAL			**91**

TOTAL NO OF CREDITS

Value added course 30 hours/ 2 Credits

M.SC., BIOCHEMISTRY FIRST SEMESTER

Course Title: BIOMOLECULES (CORE PAPER I)

		Credits	**04**
L:T:P:S	**3:0:1:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**:50**

CourseOutcomes: At the end of the Course, the Student will be able to:

CO NUMBER	**CO Statement**
CO1	Classify and explain the structure, biological importance and physico chemical properties of carbohydrates, from monosaccharides to polysaccharides, relate the importance of sugar derivatives and bacterial cell wall polysacchharides
CO2	Identify the structure of amino acids, classify proteins, explain their properties and relate the structural levels of organization of proteins
CO3	Describe the tertiary, quaternary structure, forces stabilizing the structure of proteins and explain the chemical synthesis of peptide
CO4	Illustrate the structure of nucleotides, distinguish DNA and RNA and describe the structure of DNA, its properties, types of RNA and their biological functions
CO5	Define and classify lipids with examples, explain the properties of fats and describe the structure and biological functions of phospholipids, glycolipids, sterols and terpenes

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	1	3
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	2	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	CO s
MO1	Definition, nomenclature, classification, structure, chemistry and function of Carbohydrates:- occurrence, classification and chemical properties of Monosaccharides:- structure and biological importance of sugars, their derivatives, NTPs, lactones, glycosides – Disaccharides, Lactose, Maltose, Sucrose – Oligosaccharides – structure and biological importance-Homoglycans ; starch, glycogen, cellulose, dextrin, inulin, Heteroglycans -mucopolysaccharides – cell surface carbohydrates; bacterial cell wall polysaccharides.	**15**	**CO1**
MO2	Classification, structure and properties of aminoacids - Classification and biological functions of proteins - Primary structure of proteins and sequence determination. Peptide bond and its salient features - secondary structure – α helix, β-pleated sheet and turns- Ramachandran Plot. Super secondary structures, motifs- helix-loophelix, hair pin, β-motif, β-α-β motif. Conformational study of collagen.	**20**	**CO2**
MO3	Tertiary structure of proteins (myoglobin) –quaternary structure of proteins of hemoglobin. Forces that stabilize the protein structure Chemical synthesis of Peptide, Folding of proteins.	**10** -	**CO3**
MO4	Structure of Purine, Pyrimidine, nucleosides and nucleotides - Major classes of RNA, their structure and biological function. Watson and Crick Model, A,B, and Z forms of DNA. DNA super coiling - Properties of DNA – hypochromicity, hyperchromicity, denaturation and renaturation, Cot curve, C value paradox. Maxam Gilbert method, Sangers dideoxy method and enzymatic methods of sequence analysis. Chemical synthesis of oligonucleotides.	**15**	**CO4**
MO5	Definitions, general structure of fatty acids- biological functions of lipids-properties of lipids-classification of lipids-simple-fats, oil, waxes. compound lipids, phospholipids, sulpholipids , glycolipids. Derived lipids-structure and function of important steroids- cholesterol, bile acids. Terpenes-mono,di,poly andsesqueterpenes,Carotenes and xanthophylls.	**15**	**CO5**

RECOMMENDED BOOKS

1. J. L. Jain, N. J. (7th ed 2016). *Fundamentals of Biochemistry 7th edition.* S. Chand @ Co.Ltd - ISBN: 9788121924535
2. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
3. David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry* . Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116
4. Robert K.Murray, D. A. (2018). *Harper's Illustrated Biochemistry* (28th ed.). The McGraw- Hill Companies - ISBN-10 : 0071625917 / ISBN-13 : 978-0071625913

REFERENCE BOOKS

1. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .

2Jeremy M. Berg, L. e. (2019). *Biochemistry* . WH Freeman - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

3Donald Voet, C. W. (2012). *Principles of Biochemistry* (4th ed.). Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446

M.SC., BIOCHEMISTRY

FIRST SEMESTER

Course Title: INTERMEDIARY METABOLISM (CORE PAPER II)

Course Code			**: 04**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Define metabolism, acquire a wide knowledge on the metabolism of the glucose and identify the steps involved in biochemical pathways that produceATP such as glycolysis, TCA cycle, ETC.
CO2	Explain the oxidation and synthesis of fatty acids, identify the steps involved in metabolism of cholesterol, synthesis of prostaglandins, leukotrienes and thromboxanes.
CO3	Explain How biochemical energy is generated in cells using principles of thermodynamics (free energy enthalpy) using coupled reactions to show how an endergonic reaction can occur by coupling with exergonic reaction
CO4	Gain knowledge on synthesis of urea and other biologically important amines.
CO5	Write the chemical reactions for the individual steps in the purine and pyrimidine metabolism.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3
CO2	3	3	2	3	3
CO3	3	3	1	3	3
CO4	3	3	2	1	3
CO5	3	3	1	1	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	**CARBOHYDRATES**; Definition of Metabolism, Anabolism and Catabolism. Carbohydrate metabolism: Aerobic and anerobic glycolysis and energetics of glycolysis. Pyruvate Dehydrogenase Complex. TCA cycle and energetics. Gluconeogenesis, Metabolism ofglycogen, Pentose Phosphate Pathway	**17**	**CO1**
MO2	**LIPID METABOLISM**- Biosynthesis of FA, sphingolipids, phosphoglycerides - Beta oxidation, Alpha oxidation, Omega oxidation. Biosynthesis and degradation of cholesterol, Role of HMG CoA Reductase - arachidonic acid pathway – eicosanoids.	**13**	**CO2**
MO3	**BIOLOGICAL OXIDATION**: ETC – Redox potential – redox couple – action potential – free energy - Role of High energy phosphates, Components, sequence and Inhibitors of electron transport chain. Oxidative phosphorylation- the chemiosmotic hypothesis. F0 F1 ATP synthase. ATP biosynthesis. Uncouplers, ATP/ADP exchange, malate aspartate/glycerol phosphate shuttle	**17**	**CO3,CO5**
MO4	**AMINO ACID METABOLISM**: Transamination and its mechanism, oxidative and non-oxidative deamination, decarboxylation-urea cycle and its regulation. Conversion of aminoacids to specialized products. Serotonin, gamma aminobutyric acid, dopamine, epinephrine, nor-epinephrine, creatinine, creatine.	**15**	**CO4, CO5**
MO5	**Nucleic Acid metabolism** – Synthesis of Purine and pyrimidine – Denovo and Salvage pathway. Regulation - Degradation of purines and pyrimidines.	**13**	**CO5**

RECOMMENDEDBOOKS:

1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .
3. David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry .* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116

REFERENCE BOOKS

1. Jeremy M. Berg, L. e. (2019). *Biochemistry .* WH Freeman - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
2. J. L. Jain, N. J. (7th ed 2016). *Fundamentals of Biochemistry 7th edition.* S. Chand @ Co.Ltd - ISBN: 9788121924535
3. voet.J.G, D. V. (2010). *Biochemistry* (4th ed.). Johm Wiley & Sons Inc - ISBN: 978-0-470-57095-1

M.SC., BIOCHEMISTRY
FIRST SEMESTER

Course Title: PLANT BIOCHEMISTRY-I SEMESTER (CORE PAPER III)

		Credits	**: 04**
L:T:P:S	**:4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Summarize Photosynthesis
CO2	Classify Plant Hormones And Explain Their Functions
CO3	Discuss Secondary Metabolites In Plants. Illustrate Nitrogen Fixation By Symbiosis Biochemistry Of Nitrogen Fixation
CO4	Distinguish Between Types of Stress Tolerance in plants
CO5	Evaluate The Anti Oxidant Defense In Plants

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	3
CO2	3	3	1	2	1
CO3	3	3	2	1	3
CO4	3	3	2	1	1
CO5	3	3	3	1	1

CORRELATION : 3-STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	**Photosynthesis** – Pigments in photosynthesis, Light and Dark reactions, Proton gradient and ATP synthesis of CHLOROPLAST. DCMU, regulation of photosynthesis, CAM metabolism, RUBISCO, photorespiration.	**15**	**CO1**
MO2	**Plant hormones** types and functions. Structure, mode of action, transport, distribution and physiological effect of Auxin, Gibberillin, Cytokinins, ABA and Ethylene,	**15**	**CO2**
MO3	Biofertilizers, Nitrate assimilation, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Nitrogen fixation – nodule formation – regulatory factors involved in modulation – nif genes.	**15**	**CO3,CO5**
MO4	Toxins of plant origin –mycotoxins, phytohemagglutinins, lathyrogens, nitriles, protease inhibitors, protein toxins. Stress metabolism in plants – Environmental stresses, salinity, water stress, heat, chilling, Stress due to heavy metals, radiations and their impacton plant growth and metabolism, criteria of stress tolerance.	**15**	**CO4, CO5,**
MO5	Antioxidative defencesystem in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defence mechanism – peroxidase, glutathione, chlorophyll, pigments, carotenoids, oxidative stress.	**15**	**CO5**

RECOMMENDEDBOOKS:

1. Verma. (2015). *Plant Physiology.* Athena Academic - ISBN: 9781910390016, 1910390011
2. Lincoln Taiz, A. M. (2018). *Fundamentals of Plant Physiology.* Oxford University Press - ISBN 10: 1605357901 ISBN 13: 9781605357904
3. MohitVerma, S. K. (2018). *Plant Physiology, Biochemistry and biotech.* S Chand - ISBN 10: 812190627X ISBN 13: 9788121906272

REFERENCE BOOKS

1. Jain, D. V. (2016). *Fundamentals of Plant physiology.* S Chand - ISBN: 9789352533343
2. N. Shankar, H. S. (2005). *Plant Physiology and Biochemistry.* Rastogi Publications - ISBN 10: 8171337856 / ISBN 13: 9788171337859
3. Piechulla, H.-W. H. (2010). *Plant Biochemistry.* Academic Press - ISBN 10: 0120883910 / ISBN 13: 9780120883912

M.SC., BIOCHEMISTRY

FIRST SEMESTER

Course Title: ENZYMES (Core paper IV)

		Credits	**: 04**
L:T:P:S	**: 2:1:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	**CO Statement**
CO1	Gain knowledge in relevant principles of enzyme, mechanism of enzyme kinetics, enzyme catalysis emphasizes on capability of the students to work in a group and gather the information.
CO2	Analyse and interpret the graphs based on kinetics data. Identification of Enzyme specificity of unknown samples using MM- Equation or by LB plot. Differentitation of enzyme catalysis by acid base, covalent metal ion and proximity orientation and coenzymes in enzyme catalysis shows the platform on the nature of enzymes.
CO3	Students will be familiarized with the terms such as activation energy, Lock and key theory and induce fit theory. Graduates get the knowledge of regulation of enzyme activity and its types can be able to apply in higher education. Distinguish the mechanism of action of specific enzymes such as chymotrypsin, carboxypeptidase, ribonuclease, lysoenzyme, abzymes and ribozymes
CO4	Determine Km and Vmax for competitive, non-competitve and uncompetitve inhibitors. To analyze the involvement of coenzymes in enzyme catalysis.
CO5	Comprehend the various methods for production, purification, characterization and immobilization of enzymes. Degrading the waste using microbes, isolating and immobilization of an enzyme produced by it can be used in food, pharmaceutical and textile industries. Commercialization of enzymes, envision the working of enzymes.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	1	1
CO2	2	1	2	1	1
CO3	3	1	1	1	1
CO4	3	2	1	1	1
CO5	2	2	1	1	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	**Introduction** - chemical nature and general characterization - nomenclature, IUB system of enzyme classification - definitions with examples of holoenzyme, apoenzyme, isoenzymes, monomeric enzymes, oligomeric enzymes, multi-enzyme complexes, Coenzymes, cofactors, metalloenzymes, activators, inhibitors, active site, allosteric site, catalytic site, regulatory site on the enzyme molecule. Enzyme specificity, specific activity, enzyme units – IU, Katal and enzyme turnover number andspecific activity.	**17**	**CO1**
MO2	**Enzyme Kinetics** - Introduction to chemical kinetics, rate and order of reactions. Derivation of Michaelis - Menton Equation. Line - Weaver and Burk plot, Eadie- Hofstee plot, Hanes plot - bi-substrate reactions - brie introduction to sequential and ping-pong mechanisms with examples. Factors affecting enzyme activity – enzyme concentration, substrate concentration, pH and temperature. Enzyme catalysis -acid – basecatalysis, Metal ion and proximity orientation effects	**17** f	**CO2**
MO3	**Mode of action of enzyme** - Definition and significance of energy of activation - Lock and key theory and induced fit theory - Regulation of enzyme activity - definition types and examples. Mechanism of action of chymotrypsin, carboxypeptidase, ribonuclease, lysoenzyme.	**13**	**CO3,**
MO4	**Enzyme inhibition** – Definition, examples, determination of K_m and V_{max} in presence and absence of Competitive, non- competitive and uncompetitive inhibitiors (with kinetic derivations). Coenzymes in enzyme catalysis : Reactions involving NAD/NADP, FMN/FAD, Coenzyme A, biotin, lipoamide, TPP, pyridoxal phosphate, Tetra hydrofolate and cobamide.	**15**	**CO4,**
MO5	Immobilization of enzymes and their industrial applications – abzymes – ribozymes – Medical application of enzymes - use of glucose oxidase inenzyme electrodes. Application of enzymes in food industry.	**13**	**CO5,**

RECOMMENDED BOOKS:

1. David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry .* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116

2. Trevor Palmer, P. B. (2007). *Enzymes Wood head Publishing*(7th ed.). Wood head Publishing - ISBN : 9780857099921, 0857099922

3. Meenakshi Meena, D. C. (2009). *Fundamentals of Enzymology.* Aavinshankar Publisher - ISBN-10 : 8179102807 / ISBN-13 : 978-8179102800

REFERENCE BOOKS

1. Donald Voet, C. W. (2012). *Principles of Biochemistry(4th ed).* Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446

2. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017

3. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .

M.SC., BIOCHEMISTRY FIRST SEMESTER

Course Title: MEMBRANE BIOCHEMISTRY (Elective Paper - I)

		Credits	**: 03**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

Understand the various concepts and knowledge in Membrane Biochemistry. Students are expected to have the following learning outcomes

CO NUMBER	CO Statement
CO1	Describe the structure and function of membranes, and illustrate the structure of phospholipid and membrane bilayer. Apply knowledge of liposomes in drug delivery and justify how Cell to Cell Communication occurs.
CO2	Classify the presence of different in RBC membrane. Describe the consequence of damage occurs in RBC membrane and be able to understand the diseases caused due to its mutations.
CO3	Explain the importance of mitochondria, nucleus, Lysosome and endoplasmic reticulum membrane. Describe bacterial cell wall synthesis and inhibitors.
CO4	Distinguish between passive and active transport; explain how substances are directly transported across a membrane. Understand the mechanism of gastric HCl secretion.
CO5	Classify the types of receptors – neuro and hormonal transmitter, photoreceptor LDL and hormonal receptors and its clinical significance. Identify the main components of G protein signal transduction pathway.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2
CO2	3	3	3	1	3
CO3	3	3	1	1	2
CO4	3	3	`1	1	2
CO5	3	3	1	1	1

CORRELATION: 3-STRONG 2-MEDIUM 1-LOW

S.No.	Content of Module	Hrs	Cos
M01	Biological Membranes – Structure and functions of plasma membrane, Chemical composition and properties of biomembranes - Model lipid membranes - preparation and properties. Detergents, micelles, Liposomes, - Cytological, chemical and physical methods to study membrane structure, Lipid raft and Calveolae. Different models of cell membrane a historical - perspective. Cell-cell communication-Gap junctions, desmosomes and tight junctions.	**17**	**CO1**
M02	Red cell membrane – Isolation, major proteins in RBC membrane (Spectrin, Ankyrin, Band 4.1, Anion exchange proteins, Glycophorin) - Diseases caused due to mutations affect membrane proteins - Hereditary spherocytosis, Paroxysmal nocturnal hemoglobinuria. Plant cell wall structure, composition and biosynthesis.	**12**	**CO2**
M03	Membranes surrounding mitochondria, Endoplasmic reticulum. Membrane surrounding nucleus and lysosomes. Bacterial cell wall-structure, composition and biosynthesis. Inhibitors of cell wall synthesis.	**15**	**CO3**
M04	Transport across biomembranes - Simple diffusion and Fick's law, facilitated diffusion - Kinetics of facilitated transport - Symport, antiport and Uniport. Active transport. - protein Pumps - Na^{+}- K+ - ATPase and metabolic significance - Gastric HCL secretion.	**15**	**CO4**
M05	Receptors-Definition and Types. Neurotransmitter and its types- structure and functions of adrenergic and cholinergic receptors, glucose receptors, Action potential generation. Photoreceptors and vision - Receptor desensitization, Receptor mediated endocytosis, LDL receptors - biological and clinical significance. Familial hypercholesterolemia. Hormonal receptors- G Proteins and adenylate cyclase. Cystic fibrosis, Wilson disease,	**16**	**CO5**

RECOMMENDED BOOKS:

1. Jeremy M. Berg, L. e. (2019). *Biochemistry(9th ed) .* WH Freeman - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

2. Donald Voet, C. W. (2010). *Principles of Biochemistry* (4th ed.). Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446

3. David.L.Nelson, M. M. (9th ed 2012). *Lehninger principles of Biochemistry .* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116

REFERENCE BOOKS

1. Karp, G. (2013). *Cell and Molecular Biology.* John Wiley and Sons Inc - ISBN-10 : 111830179X, ISBN-13 : 978-1118301791

2. Geoffery M. Cooper, R. E. (2013). *The Cell A Molecular Approach.* Sinauer Associations - ISBN 10: 0878939644 / ISBN 13: 9780878939640

3. ShlomoMelmed, K. S. (2015). *William Textbook of Endocrinology* (13th ed.). Elsevier- ISBN 10: 0323297382 / ISBN 13: 9780323297387

M.SC., BIOCHEMISTRY

FIRST SEMESTER

Course title: PHYTOMEDICINE (Elective Paper I)

		Credits	**: 03**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain a wide knowledge on plants and the phytochemicals present in plants
CO2	Perform the qualitative, GC analysis and HPLC analysis of various phytoconstituents
CO3	Understand Indian systems of medicine
CO4	Acquire knowledge on the biomedical importance of medicinal plants.
CO5	Categorize the herbal medicines for treating human ailments.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**2**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**
CO5	**2**	**2**	**2**	**2**	**1**

Correlation : 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	**Plant- Anatomy.** Function of various parts of plants Phytochemicals-Definition. Types of phytochemicals – Flavonoids (Flavones, isoflavones and flavonone), alkaloids, tannins, terpenoids and anthocynanins, phytosterols-their biological functions. Role of phytochemicals in ameliorating various ailments. Phytochemicals from various sources and their biological properties- Morin, Myricetin, Quercitin, isoquercitin, Capsaicin, Bicalein, Tangeritin, Curcumin, Fisetin, and Thymoquinone	**15**	**CO1**
MO2	**Phytochemical analysis-** Test for flavonoids, alkaloids, saponins, phytosterols, anthroquinones. Estimation of total phenols and flavonoids in plants. GC MS and HPLC analysis of phytocompounds.	**15**	**CO2**
MO3	**PHARMACOGNOSY** Definition and history, Indian systems of medicine - Siddha, ayurvedha, and Unani systems. Medicinal plants, their chemical constituents. Secondary metabolites and their human benefits Drugs - Classification of Crude drugs -Future of pharmacognosy.	**15**	**CO3**
MO4	**BIOMEDICAL IMPORTANCE OF MEDICINAL PLANTS** Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds - Nux vomica Gooseberry - unorganized drugs - Gum - Acacia - Resin - Turpentine, fixed oil - castor oil.	**15**	**CO4**
MO5	**HERBAL MEDICINES FOR TREATING HUMAN AILMENTS** **Me**dicinal plants for diabetes. Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal diseases - Blood pressure Drugs acting on Nervous system – Depressants, Stimulants. Respiration and Drugs - Urogenital system and drugs - Psychoactive plants.	**15**	**CO5**

RECOMMENDED BOOKS

1. Verma. (2015). *Plant Physiology.* Athena Academic - ISBN: 9781910390016, 1910390011
2. Lincoln Taiz, A. M. (2018). *Fundamentals of Plant Physiology.* Oxford University Press - ISBN 10: 1605357901 ISBN 13: 9781605357904
3. W. C. (2009). *Trease and Evans Pharmacognosy* (16th ed.). Elsevier - ISBN 10: 0702029343 / ISBN 13: 9780702029349
4. Williamson, M. H.-G. (2018). *Fundamentals of Pharmacognosy and Phytotherapy.* Elsevier.

REFERENCE BOOKS

1. Ajay Kumar Meena, P. B. (2009). *Plants-herbal wealth as a potential source of ayurvedic drugs.* Asian Journal of Traditional Medicines.
2. Saroya, A. S. (2017). *Contemporary Phytomedicines.* CRC Press - - ISBN9781315367071
3. Thangaraj, P. (2020). *Phytomedicine Research and Development.* CRC Press - ISBN 10: 0367857596 / ISBN 13: 97803678575

M.SC., BIOCHEMISTRY FIRST SEMESTER

Course Title: STEM CELL BIOLOGY (Elective Paper I)

		Credits	**: 03**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	**CO Statement**
CO1	Discuss the types, properties, sources and characteristic features of stem cell.
CO2	Apply the hematopoietic and mesenchymal stemcells in medical field.
CO3	Identify the techniques used for isolation, expansion and characterization of stem cells.
CO4	Analyze the therapeutic applications of stem cell
CO5	Distinguish between stem cells and cancer stem cells. Identify the stem cells and cancer stem cells. Describe the importance of Stem cell banking and recent advancements in Stemcell Biology

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Correlation : 3 strong 2 medium 1 low

.No.	Content of Module	Hrs	Cos
MO1	Stem cells -Introduction, Definition and basics of stem cells. Classification of stem cells .Human embryonic stem cells, Adult stem cells. Sources of stem cells - Fetus and various adult tissues – Advantages of stem cell Blastocyst culture- Various stages of embryonic development. In vitro fertilization. Properties of stem cells - self renewal, clonality and plasticity. Pluripotent nature of stem cells - Extrinsic and Intrinsic factors. Characterization of human embryonic stem cells – Expression of cell surface marker, Karyotyping	15	CO1
MO2	Hematopoietic stem cells (HSC) - Basics, Development and Regulation of HSC. Clinical Application of HSC – Gene Therapy – using haematopoietic stem cells HSC for Leukemia. Mesenchymal stem cells (MSC) - Differentiation and Identification. Characteristics of mesenchymal stem cells. Clinical applications of stem cells.	15	CO2
MO3	Neuronal stem cell, mesenchymal stem cell, cardiac stem cells , planaria stem cells, prostate and breast stem cells, transforming growth factor (TGFβ), G PROTEIN – COUPLED RECEPTORS (GPCRs).hematopoietic stem cells, stem cells and diabetes, techniques used for stem cell isolation, enumeration and Ex-VIVO expansion, techniques used for stem cell characterization.	20	CO3
MO4	Therapeutic applications of stem cell: fundamentals of regenerative medicine, autologous and allogenic stem cell transplatation, HLA typing, Animal models of regeneration.	15	CO4
MO5	Skeletal Muscle Stem Cells – Development and functions. Liver stem cells – Organization and functions. Tumor stem cells – Basics differences and Similarities of cancer stem cells and stem cells. Cancer stem cell signaling – NOTCH pathway. Canonical wnt signaling pathways in hematopoietic stem cells. Stem cell therapies in animal models. Use and benefits of stem cell for human beings. Stem cell banking – cryopreservation techniques, national guideline by ICMR, recent advances in stem cell biology.	10	CO5

RECOMMENDED BOOKS

1. Robert lanza, J. G. (2009). *Essential of stem cell biology.* Academic press - ISBN: 9780080884974
2. Peter J, Q. (1998). *Stem cell biology and gene therapy* (1st ed.). Willyless.
3. A. D. Ho. R. Hoffiman. (2006). *Stem cell transplantation biology processes therapy.* wiley-VCH.ISBN 10: 3527310185 / ISBN 13: 9783527310180

REFERENCE BOOKS

1. Potten, C. (2006). *Stem cells.* Elsevier.
2. Neil Singh, L. V.-J. (2011). *A Practical guide to human stem cell biology.* Wiley - ISBN 10: 0470595450 / ISBN 13: 9780470595459
3. Knoepfler, P. (2013). *Stem Cells: An Insiders Guide* . World Scientific Publishing Company.

PRACTICAL-I - BIOMOLECULES AND INTERMEDIARY METABOLISM

Course Code :	**Credits : 02**
L:T:P:S : 0:0:3:0	**CIA Marks : 50**
Exam Hours : 05	**ESE Marks : 50**

COURSE OUTCOMES

At the end of the Course, the Student will be able to:

CO Number	CO Statement
CO1	Become proficient in colorimetric determination of pyruvate, lactate and tryptophan
CO2	Determine the concentration of carbohydrate and protein in unknown solution
CO3	Analyse the extraction method for lipid and starch
CO4	Learn the isolation and estimation of DNA and Glycogen from biological sources
CO5	Demonstate the iodine number and saponification number of edible oil

Mapping of Course Outcomes to Program Specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	3	3	2	1	1
CO2	1	1	3	3	1	1	1
CO3	1	2	3	3	1	1	1
CO4	1	1	3	3	1	1	1
CO5	1	1	3	3	1	1	1

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

1	Estimation of Pyruvate	CO1-CO5
2	Estimation of Lactate	
3	Estimation of Tryptophan	
4	Estimation of Carbohydrates by Anthrone method	
5	Estimation of Protein by Lowry's method	
6	Extraction of Lipids	
7	Extraction and estimation of starch	
8	Isolation and estimation of Glycogen	
9	Isolation of DNA	
Demonstration experiments		
10	Demonstrate of Iodine Number	
11	Determination of Saponification Number	

TEXT BOOKS/ REFERENCE BOOKS:

Sl.No	**Authors**	**Title**	**Publishers**	**Year of Publication**
1	J. Jayaraman	Laboratory Manual in Biochemistry	New Age International (P) Limited	Fifth edition 2015
2	S. Sadasivam A. Manickam	Biochemical Methods	New age International Pvt Ltd publishers	third edition 2018
3	S. K. Sawhney and Randhir Singh	Introductory Practical Biochemistry	Narosa publishing house	Reprint, 2014
4	Dr. G. Sattanathan, , Dr. S.S. Padmapriya, Dr.B.Balamuralikrishnan,	Practical Manual of Biochemistry	Skyfox Publishing Group Skyfox Press #987, Medical College Road Thanjavur-613004 Tamil Nadu, India.	First Edition : December 2020

I MSC BIOCHEMISTRY

I SEMESTER

PRACTICAL-II -ENZYMES AND PLANT BIOCHEMISTRY

Course Code	**:**	**Credits**	**: 02**
L:T:P:S	**: 0:0:3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 05**	**ESE Marks**	**: 50**

Course outcomes : At the end of the course, the student will be able to :

CO Number	CO Statement
CO 1	Correlate the activity of enzymes with change in pH, Temperature and substrate concentration
CO 2	Determine enzyme activity and specific activity and understand the difference between the them
CO 3	Identify the secondary metabolites in plants
CO 4	Separate plant pigments using column chromatography
CO 5	Assess the presence of enzymatic antioxidants in plant extracts

Mapping Course Outcomes with Program Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	2	2	3
CO3	3	2	2	3	2
CO4	3	2	2	3	2
CO5	3	2	3	2	2

1	Determination of optimum pH of Salivary amylase	CO1-CO5
2	Determination of optimum temperature of Acid phosphatase	
3	Effect of substrate concentration on the activity of alkaline phosphatase	
4	Determination of enzyme activity of total ATPase.	
5	Determination of specific activity of lactate dehydrogenase.	
6	Qualitative analysis of Secondary metabolites a)Terpene b) Flavonoid c) Phenol d) Tannin e) Saponin F) Steroids	
7	Estimation of Total Phenol from plants	
8	Estimation of Total Flavonoid from plants	
9	Determination of Non enzymatic of antioxidants (vitamin E/C)	
Demonstration experiments		
10	Separation of Plant pigments Chlorophyll and Carotene by column chromatography.	
11	Determination of Enzymatic antioxidants (GPx, SOD & catalase) Any one	

RECOMMENDED BOOKS

1. WORK, T. W. (2009). *Laboratory techniques in Biochemistry & Molecular Biology by Amsterdam.* North Holland Pub. Co -

2. Walker, K. W. (2010). *Principles and techniques of Practical Biochemistry* (7th ed.). Cambridge University Press - ISBN-10 : 1108716989 / ISBN-13 : 978-1108716987

3. Singh, S. a. (2014). *Introductory Practical Biochemistry* (reprint ed.). Narosa publishing house - ISBN 10: 9386217627 / ISBN 13: 9789386217622

REFERENCE BOOKS

1. Manickam, S. S. (2016). *Biochemical Methods*. New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408

2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
3. Ashwood, B. a. (2001). *Tietz Fundamentals of Clinical chemistry.* WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 9780721686349

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: ANALYTICAL BIOCHEMISTRY (CORE PAPER V)

		Credits	**: 04**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO STATEMENT
CO1	Analyze and apply the methodology involved in organ and tissue slice, homogenization techniques. Perform cell sorting and cell counting
CO2	The students will know the structure of atoms and molecules. The larger th number of wavelength emitted by these system makes it possible to investigate their structure in detail including electronic configuration of ground and various excited state and also biochemical assay of macromolecules Advanced knowledge on the interactions of electromagnetic radiation and matter and their applications in spectroscopy Analyze and interpret spectroscopic data collected by the methods Assay of biomolecules (Carbohydrates, Cholesterol, Protein, Enzymes) using UV spectroscopy Estimate the amount of vitamins using spectrofluorimetry Interpret the molecular weight of compounds using mass spectra
CO3	To learn various techniques of product purification and design purification strategy based on product characterized and cost effectiveness Obtaining analytical skills to separate samples (amino acids) using paper chromatography Detection of sugars using thin layer chromatography Separation and purification of proteins using affinity chromatography Apply skills in separating various components of plant extract using HPLC
CO4	Demonstrate the methodology involved in separation of proteins based on molecular weight by SDS PAGE Separation of DNA by agarose gel electrophoresis by various electrophoretic techniques.
CO5	A practical knowledge on the separation of biological sample by centrifugation Separation of subcellular organelles by differential centrifugation

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1
CO2	3	3	3	3	1
CO3	3	3	3	3	1
CO4	3	3	3	2	1
CO5	3	3	3	2	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	General approaches to biochemical investigation. Organ and tissue slice technique, and homogenization techniques, cell sorting and cell counting. Electrochemical techniques – principles of redox reactions, pH electrode. Clark's oxygen electrode and their applications. Method of investigating metabolism-principle- isotopic tracers.	**15**	**CO1**
MO2	Principle of Spectroscopy: spectra - definition, types-absorption & emission-wavelength, wave number, frequency. Principle, procedure and application of NMR and mass spectroscopy. Principle, procedure and application of UV-VIS and ESR spectrophotometry, spectrofluorimetry and X ray diffraction.	**15**	**CO2**
MO3	Chromatography: definitions, types-adsorption &partition. Principles, procedure and application-paper chromatography- TLC. column chromatography- ion – exchange chromatography, gel filtration and affinity chromatography. Hydroxy apatite chromatography and hydrophobic interaction chromatography (HIC)-GLC and HPLC.	**15**	**CO3**
MO4	Electrophoresis :General Properties of electrophoresis, support media, factors affecting electrophoresis, high voltage and low voltage electrophoresis, SDS – PAGE, iso electric focusing, isotachophoresis, 2D PAGE and capillary electrophoresis. Cellulose acetate and continuous flow electrophoresis, pulse field gel electrophoresis, Agarose gel electrophoresis	**15**	**CO4**
MO5	Centrifugation- basic principles and laws of sedimentation. Preparative and analytical ultracentrifuges. Sedimentation equilibrium methods. Differential and density gradient centrifugation. Radioisotopes-definition and examples, half life. Detection-GM counter, and scintillation counter -autoradiography. units of radioactivity. Hazards and safety aspects in handling radioisotopes	**15**	**CO5**

RECOMMENDED BOOKS

1. Anand, C. (2014). *Instrumental methods of Analysis.* Himalaya Publishing house - ISBN : 978-93-5142-088-0
2. Wilson/Walker. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.* Cambridge University Press - ISBN: 9781316677056
3. Dr. AvinashUpadhyay, D. K. (2016). *Biophysical Chemistry.* Himalaya Publishing house - ISBN-10 : 8184888074 / ISBN-13 : 978-8184888072

REFERENCE BOOKS

1. Dua, S. (2010). *Biochemical Methods of Analysis: Theory and Applications.*Narosa - ISBN-10 : 1842655906 / ISBN-13 : 978-1842655900
2. Bernard J.White, J. F. (2015). *Biochemical Techniques - Theory And Practice.* CBS Publishers & Distributors.
3. Basha, M. (2020). *Analytical Techniques in Biochemistry.* Humana Press - ISBN : 978-1-0716-0134-1

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: HUMAN PHYSIOLOGY AND NUTRITION (CORE PAPER VI)

		Credits	**: 04**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Gaining a complete knowledge in the physiology of life. Classify blood groups so as to identify the blood groups of patients and donors for the purpose of safe blood transfusion. Exposure to the nature and types of blood cells, blood groups, lymphatic system
CO2	Acquire knowledge on morphology of lungs, types of respiration, mechanism of gaseous exchange, role of heamoglobin, chloride shift and bohr effect.
CO3	gain knowledge on morphology and functions of kidney, structure of nephron , mechanism of mechanism of urine formation, Structure and functions of neuron, neuro transmitters, Mechanism of nerve impulse transmission
CO4	Realizing the fact that "Food as medicine" Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific Value
CO5	A wide exposure to the classification and biological significance vitamins and minerals present in food

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	2
CO2	3	3	1	2	1
CO3	3	3	3	1	2
CO4	3	3	3	1	1
CO5	3	3	3	2	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	**UNIT – I** **15 HRS** **Blood:** Composition and function, Red blood cells, Hemoglobin, white blood cells and platelets. Hematopoiesis- Blood coagulation, blood groups and blood transfusion. Formation and functions of lymph. **Circulatory System**- heart-position, structure, properties of cardiac muscle. overview of systemic and pulmonary circulation, conducting system of the heart, heart rate, cardiac cycle, cardiac output.	**17**	**CO1**
MO2	**UNIT – II** **15 HRS** a) **Respiratory system:** components of Respiratory system, Mechanism of respiration. Bohr effect – gas exchange and partial oxygen pressure, chloride shift. b) **Digestive system:** Secretion of digestive juices, digestion and absorption of carbohydrates, proteins and fats.	**13**	**CO2**
MO3	**UNIT – III** **15 HRS** **Excretory System:** Components of Excretory system, structure of kidney. Mechanism of formation of urine, composition of urine Nervous system: Structure of neuron, resting potential and action potential, neuro transmitters-definitions, types – cholinergic and adrenergic with examples. Role of GABA -Mechanism of nerve impulse transmission.	**15**	**CO3,CO5**
MO4	**UNIT IV** **15 HRS** Definition of **Nutrition;** Basic food groups. Nutritional Aspects of carbohydrates- Dietary sources, RDA, Physiological role; significance of fibre in the diet; Nutritional Aspects of proteins - Dietary sources, RDA, Physiological role; significance of essential amino acids, Protein energy malnutrition in children; Nutritional Aspects of lipids - Dietary sources, RDA, Physiological role; significance of essential fatty acids, MUFAs, and PUFAs.	**13**	**CO4,** **CO5**
MO5	**UNIT V** **15HRS** **Vitamins** - major classification, Dietary sources, RDA, deficiency symptoms and physiological functions of Vitamin A, D, Vitamin C, B1, B2 and folic acid. Dietary sources, RDA, deficiency symptoms and Physiological functions of dietary Calcium, phosphorus, magnesium, iron, iodine, zinc fortification – enrichment with examples.	**17**	**CO5,**

RECOMMENDED BOOKS:

1. Derrickson, G. J. (2017). *Principles of Anatomy and Physiology.* John Wiley and Sons - ISBN: 978-1-119-40006-6
2. Hall, G. A. (2019). Text book of MEdical physiology. Elsevier india - ISBN-10 : 8131257738
3. Sembulingam, K. S. (2019). *Essentials Of Medical Physiology.* Jaypee Brothers Medical Publishers - ISBN 10: 9352706927 ISBN 13: 9789352706921
4. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271
5. B.Srilakshmi, B. (2017). *Food Science* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093

REFERENCE BOOKS

1. D. Venkatesh, H. H. (2018). *Textbook of Medical Physiology.* Wolters Kluwer India Pvt. Ltd - ISBN-10 : 9387963535 / ISBN-13 : 978-9387963535
2. D. Venkatesh, H. H. (2018). *Basics of Medical Physiology* (4th ed.). Wolters Kluwer India Pvt. Ltd.; - ISBN-10 : 9387963535 / ISBN-13 : 978-9387963535
3. H. S. Ravi Kumar Patil, H. K. (2009). A Textbook of Human Physiology. I K International Publishing House Pvt. Ltd - ISBN : 9789380026503.
4. Srilakshmi, B. (2019). *Dietetics* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: MOLECULAR BIOLOGY (CORE PAPER VII)

		Credits	**: 04**
L:T:P:S	**: 3:0:1:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Infer the central dogma of molecular biology and show that DNA is the genetic material through experimental evidence Compare and contrast the replication process in prokaryotes and eukaryotes and explain the events, enzymology, fidelity, inhibitors and regulation
CO2	Categorize DNA repair mechanisms, define mutation and list its types
CO3	Summarize the process of prokaryotic and eukaryotic transcription
CO4	Define genetic code, list its characteristics,relate genetic code to translation process and explain protein biosynthesis
CO5	Interpret the regulation of gene expression in prokaryotes using *lac* and *trp* Operon

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	1	1	3
CO3	3	3	1	2	3
CO4	3	3	1	1	2
CO5	3	3	2	1	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	REPLICATION– DNA as genetic material (Meselson & Stahl experiments), enzymology of replication in prokaryotes, replication in E.coli, Øx174 model, mitochondrial replication. Replication in eukaryotes. Regulation of replication in prokaryote and eukaryote.	**20**	**CO1**
MO2	DNA REPAIR AND MUTATION- Direct repair , Mismatch repair, base excision,nucleotide excision repair ,recombinant repair -SOS repair, Mutation-mutants, mutagen, Types-Spontaneous, induced, frameshift, site directed mutagenesis.	**15**	**CO2**
MO3	**TRANSCRIPTION-**Role of RNA polymerase, promoter site, consensus sequence, transcriptional factors –mechanism of prokaryotic and eukaryotic transcription, post transcriptional modifications and processing of mRNA-5'capping, 3'polyadenylation, splicing mechanism ,t RNA, rRNA. Inhibitors of transcription.	**15**	**CO3**
MO4	**TRANSLATION-** characteristics of genetic code, wobble hypothesis, monocistronic mRNA and polycistronic mRNA.Mechanism of protein synthesis in prokaryotes and eukaryotes, Shine Dalgarno sequence, inhibitors of protein synthesis. Post translational modifications, protein folding-chaperons and heat shock proteins	**15**	**CO4**
MO5	**Regulation of gene expression**- gene expression regulation in prokaryotes-operon concept- positive and negative regulation of la operon – role of cAMP and glucose - trp operon - attenuation	**10**	**CO5**

RECOMMENDED BOOKS

1. Watson, J. D. (2017). *Molecular Biology of the Gene.* Pearson - ISBN-10 : 9332585474 / ISBN-13 : 978-9332585478
2. V.Malathi. (2012). *Essentials of Molecular Biology* (1st ed.). Pearson Education - ISBN-10 : 8131773213 / ISBN-13 : 978-8131773215
3. David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry .* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116

REFERENCE BOOKS

1. DonalVoet, j. G. (2016). *Fundamentals of Biochemistry: Life at molecular level* (5th ed.). john Wiley & sons- ISBN: 978-1-118-91840-1
2. Albert, B. (2014). *Molecular Biology of the cell.* W.W. Norton and company - ISBN 10: 0815344643 / ISBN 13: 9780815344643
3. Rastogi, V. B. (2016). *Principles of Molecular biology* (2nd ed.). Medtech - ISBN-10 : 9789384007478 / ISBN-13 : 978-9384007478

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: BIOTECHNOLOGY (Elective Paper - II)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate the basic and recent techniques applied in the field of Biotechnology
CO2	Describe gene therapy and gain knowledge related to production of pharmaceutically important products
CO3	Apply the basic rDNA technique to produce transgenic animal, discuss gene transfer methods, their application in pharmaceutical industry, cloning and its importance
CO4	Interpret the principles and technical advances behind the in vitro culture of plant cells and Design plant related rDNA techniques
CO5	Discuss the basic requirements and tools employed in genetic engineering process.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	2	1	1	2
CO2	2	2	1	1	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	3	3	3	2	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Biotechnology Definition –scope –importance. Basic techniques: agarose gel electrophoresis –isolation, purification and sequencing of DNA –hybridization methods –southern, northern and western blotting amplification of DNA – PCR quantitative and qualitative.	**9**	**CO1**
MO2	Medical Pharmaceutical Biotechnology**:** Gene therapy -Sickle cell anemia, cystic fibrosis. DNA in disease –pharmaceutical products of DNA technology, recombinant vaccines – Monoclonal antibodies (hybridoma technology)	**9**	**CO2**
MO3	Animal biotechnology: Animal cell culture, tissue culture – gene transfer methods in animals – transfection, microinjection, electroporation, gene gun, use of polycation, transgenic mice – knock out and knock in technology. Embryo transfer and *invitro* fertilization – applications.	**9**	**CO3**
MO4	Plant biotechnology: Plant tissue culture –role of Auxins, Cytokinins, Giberellic acid. Somaclonal variations – microprojectiles, transgenic plant technology –for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants t produce commercially important proteins –growth promoting bacteria in plants –antisense RNA technology. gene transfer.	**9**	**CO4**
MO5	Genetic Engineering**:** Basic principles –mechanism of natural gene transfer by Agrobacterium, integration of foreign DNA molecules, restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homopolymers, enzymes used in genetic engineering, cloning vectors and their properties, natural plasmids, invitro vectors, cosmids and T-DNA based hybrid vectors.	**9**	**CO5**

RECOMMENDED BOOKS

1. U.Sathyanarayana. (n.d.). *Biotechnology* - ISBN-10 : 8187134909 / ISBN-13 : 978-8187134909
2. T.A, B. (2016). *Gene cloning and DNA analysis.* Wiley Blackwell - ISBN 10: 1119072573 / ISBN 13: 9781119072577
3. primrose, T. a. *principles of gene manipulation - ISBN-10 : 1405135441 / ISBN-13 : 978-1405135443*

REFERENCE BOOKS

1. Dubey, R. (2014). *A Textbook of Biotechnology* . S. Chand - ISBN 10: 8121926084 / ISBN 13: 9788121926089
2. Loroch, R. R. (2016). *Biotechnology for Beginners.* Academic Press - ISBN: 9780128012246
3. H.K.Das. (2010). *Textbook of Biotechnology.* Willey- ISBN: 9788126564040

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: ECOLOGY AND POPULATION EDUCATION (Elective Paper II)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Discuss the concepts of ecology and the significant role of species in the environment
CO2	Discuss the negative impact of Humans behavior on environment. Identify and classify the Biogeographical zones of India
CO3	Present their views about biodiversity and justify their roles in conservation of biodiversity.
CO4	Explore the needs of Population Education and the impact of population growth in the society
CO5	Calculate the population rate and Identify and classify populated regions.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	1	3	3
CO2	3	3	1	3	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	2	2	1	2	2

Correlations : 3 Strong 2 Medium 1 Low

S.No.	Content of Module	Hrs	Cos
MO1	Introduction to Ecology & environmental sciences; Flow of energy and cycling of materials; water, carbon, nitrogen and phosphorus. Trophic pyramids and food webs	**9**	**CO1**
MO2	Alterations of ecosystem function: acid rain, nuclear winter, global warming and ozone hole.Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.	**9**	**CO2**
MO3	Principles of conservation-Values of biodiversity; threats to biodiversity major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).	**9**	**CO3**
MO4	Population Education Definition, attributes /features of population education, significance, objective and scope of population education. Impact of population growth on the Basis Requirements of Life: Food, Clothing, Shelter, education and standard of living.	**9**	**CO4**
MO5	Density of population - Arthmetic density , Physiological density or Nutritional density, factors affecting population density- physical and non physical factors. Distribution of population- Regions of High density of population , Regions of moderate density of population , Regions of low density of population	**9**	**CO5**

RECOMMENDED BOOKS

1. C, G. K. (2018). *Principles of Conservation Biology.* Sinauer Associates Inc., Massachusetts - ISBN 10: 0878935215 / ISBN 13: 9780878935215

2. (Ed.), G. B. (1992). *Biodiversity status of the Earth's Living Resources.* Chapman & Hall, London-ISBN 10: 0412472406 / ISBN 13: 9780412472404

3. PD, Sharma. (2000). *Ecology and Environment.* Rastogi Publications, Meerut, India - ISBN-10 : 8171339654, ISBN-13 : 978-8171339655

REFERENCE BOOKS

1. Singh MP, S. B. (2004). *Conservation of Biodiversity and Natural Resources.* Daya Publishing House, New Delhi - ISBN 10: 8170359880 / ISBN 13: 9788170359883

2. Krohne, D. T. (2017). *Ecology: Evolution, Application, Integration* (2nd ed.). Oxford Univ Pr - ISBN 10: 0190638885 ISBN 13: 9780190638887

3. Thomas Smith, R. S. (2015). *Elements of Ecology* (9th ed.). Pearson. - ISBN 10: 1292077409 / ISBN 13: 9781292077406

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: MICROBIOLOGY (Elective Paper II)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Describe basic structure of bacteria, fungi, algae and protozoa and their biologica importance to mankind.
CO2	Gain knowledge on DNA organization & transfer of genetic information.
CO3	Acquire knowledge on the normal microbial flora and types of infections.
CO4	Categorize the design of bioreactors, rationale in medium formulation and appreciate the different types of fermentation process.
CO5	Evaluate the present worth on waste management in water resources and to recycle the solid and liquid waste.
CO6	Acquire, invent and practice, the theories and principles of food microbiology in current worldwide issues. Apply their skills in formulating the fermented foods and in food processing technology

Mapping of Course Outcomes to Program Specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	3	2	1	1
CO2	2	1	1	1	1
CO3	3	2	1	1	1
CO4	1	3	2	1	1
CO5	2	3	1	1	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Ultrastructure of bacteria,fungi, algae and protozoa. Structure and functions of the cellular components Cultivation of bacteria, nutritional requirements and nutritional types of bacteria. Physical factors affecting growth, Bacterial growth curve –continuous growth, (chemostat and turbidostat), synchronous culture and enumeration of bacteria.	**9**	**CO1**
MO2	DNA organization, extra chromosomal genetic elements – transfer of genetic information, conjugation, Hfr strains, transformation and transduction.	**9**	**CO2**
MO3	**Medical Microbiology:** Distribution, occurrence of normal microbial flora on skin, respiratory tract, genitourinary tract and GI tract. Infection – types, methods of transmission, factors affecting infection - epidemiological terminologies - epidemic, pandemic, endemic - infectious disease transmissions. Pathogenic micro organisms - *Salmonella, E.coli, Klebsiella, streptococcus,* and mycobacterium, HIV.	**9**	**CO3**
MO4	**Industrial microbiology**: Outline of fermentation process, fermentor-Design and types (Continuous stirred tank fermentor, Airlift fermentor) Producer organism-Development of Industrial strains, Fermentation/Production medium, Downstream Processing. Products of industrial microbiology – penicillin, ethanol, vinegar, citric acid, and protease. Bio remediation. Fermented foods - cheese, yoghurt, pickles, bread. **Water Microbiology** – microbes in waste treatment – Domestic and industrial. Bacteriological analysis of water.	**9**	**CO4**
MO5	**Food microbiology-** food spoilage, food preservation – methods with example- Food infections –clostridium, staphylococcus and salmonella, fungal intoxication – aspergillus and food toxicity. Microbiological examination of food- direct microscopic count and dye reduction method (MBRT) Food safety, Risks and hazards: Microbiological consideration in food safety, Effects of processing and storage on microbiological safety. Food laws and regulations- HACCP, FSSAI, BIS.	**9**	**CO5**

RECOMMENDED BOOKS:

1. Pelzar, C. a. (2007). *Textbook of Microbiology(5th ed).* Tata Mcgraw Hill -
2. Parija. (2012). *Textbook of Microbiology and Immunology, 2/e .* ELSEVIER - ISBN 10: 813124461X / ISBN 13: 9788131244616
3. Prescott. (2017). *Microbiology*(8th ed.). Mc Graw Hill, Boston - ISBN-10 : 1259281590 / ISBN-13 : 978-1259281594

REFERENCE BOOKS

1. Panicker, A. R. (2017). *Textbook of Microbiology* (10th ed.). Orient Longmans - ISBN 10: 1847558569 / ISBN 13: 9781847558565
2. W.C, F. (2014). *Food Microbiology.* Mc Graw Hill -
3. Baveja, C. (2019). *Textbook of Microbiology.* Arya Publications - ISBN 10: 8182967058 / ISBN 13: 9788182967052

M.SC., BIOCHEMISTRY

SECOND SEMESTER

Course Title: BIOETHICS, IPR AND HUMAN RIGHTS (Elective Paper - III)

			Credit:03
L:T:P:S: 3:0:0:1			
	CIA Marks	**: 40**	
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Outline International Instruments On Human Rights
CO2	Compare The Powers And Functions Of SHRC AND NHRC and Philosophies of Adamsmith and Thiruvalluvar.
CO3	Interpret Women's Right in India.
CO4	Analyze The Bioethics Of Cloning And Recombinant Drugs Production
CO5	Apply IPR and IPP and Prioritize Biosafety Measures From Biohazards.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	1	1
CO2	1	1	3	1	1
CO3	1	1	3	3	1
CO4	1	1	3	3	1
CO5	1	1	3	3	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Introduction to HR, definition fundamental rights- International Instruments- UDHR- United Nation commission for HR- ICCPR (International Covenant on civil and political rights)- Historical Development of HR.	**9**	**CO1**
MO2	Development of HR in India – Article 21 of Indian Constitution- Protection of Human Rights Act 1993- NHRC- SHRC (functions)- Economics of HR and Human Relations – Theory of moral sentiments by Adam Smith. Economic philosophy of Thiruvalluvar .	**9**	**CO2**
MO3	Students activity – Assignment/seminar- case study- definition, women rights, newspaper articles- right to livelihood, right of women, right to food, water, education, medical care and shelter.	**9**	**CO3**
MO4	Bioethics- Definition; Ethical concerns regarding trangenesis. Bioethical issues of reproductive and therapeutic cloning - Applications of cloning- Therapeutic cloning and FDA approved cloned food. Bioethics in animal genetic engineering – IAEC guidelines of animal experiments; bioethics in plant genetic engineering, ethics of using recombinant drug.	**9**	**CO4**
MO5	Genetically modified foods- contradiction – health hazards. Labeling- Regulations of field experiments and release of GMOs into the field, Biohazards, Biosafety measures.Intellectual Property Rights- Introductions – Patent Procedure in India.	**9**	**CO5**

TEXT BOOKS AND REFERENCE BOOKS

1. Benchamp, T. (1979). *Contemporary issues in bioethics.* Oxford university press -

2. Benchamp, T. (2020). *Principles of Animal Research Ethics.* Oxford university press - ISBN 10: 0190939125 / ISBN 13: 9780190939120

3. DeGrazie, T. A. (2015). *Biomedical Ethics.* Amazon

REFERENCE BOOKS

1. Dubey, R. (2014). *A Textbook of Biotechnology* . S. Chand - ISBN 10: 8121926084 / ISBN 13: 9788121926089
2. T.G.Agitha, N. &. (2009). *Principles of intellectual Property.* Eastern Book Company Lucknow - ISBN 10: 8170121132 / ISBN 13: 9788170121138

3. Acharya, N. (2014). *Text book of Intellectual property rights.* Asia Law House

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: ORGANIZATIONAL BEHAVIOUR (Elective Paper III)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Understand the evolution of an organization and its important components. Understand and appreciate the organization variables such structure , culture, change and creativity
CO2	Analyse and effectively manage individual behavior in an organization
CO3	Analyse and effectively manage group behavior in an organization
CO4	Develop leadership styles to handle management stress in diverse organisations
CO5	Understand the nuances and critical contributions of trained personnel in the health care Organizations

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	1	3	3
CO2	3	3	1	3	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	1	3	3

Correlations : 3 Strong 2 Medium 1 Low

Sl NO	CONTENTS OF MODULE	Hrs	Cos
1	Introduction toOrganizationalBehavior Historical Perspectives	**6**	**CO1**
2	Individual Dynamics-Individual Behavior & Personality, Perception & Learning, Motivation in the Workplace, Emotions & Attitudes in the Workplace, Emotional Intelligence	**10**	**CO2**
3	Interpersonal & Group Dynamics - Interpersonal Communication, Interpersonal Conflicts & Negotiations Foundations of Team Dynamics, Team Effectiveness, Developing High Performance Teams, Team Structure, Processes & Culture, Team Building	**10**	**CO3**
4	Organizational Dynamics Organizational Structure, Organizational Culture, Organizational Change, Creativity, Leadership Challenges in the Emerging Era, Leadership , Power & Influence in Organizations, Gender & Diversity inOrganizations, Managing Stress	**9**	**CO4, CO5**
5	Organizational behavior in health care Ensuring patient safety, ethical behavior among the medical practitioners, patient-centered care and strategies to improve healthcare delivery and patients' satisfaction, qualified personnel for home health rehabilitation with essentials in interpersonal and communication skills.(Case Studies to be included)	**10**	**CO5**

RECOMMENDED BOOKS

1. McShane, V. (2014). *Organizational Behavior* (7th ed.). McGraw-Hill Education - ISBN 10: 0077862589 / ISBN 13: 9780077862589

2. Stephen P. Robbins Timothy A. Judge, N. V. (2016). *Organizational Behavior.* Pearson - ISBN 10: 0138000409 / ISBN 13: 9780138000400

3. Jack Maxwell Wood, R. M.-S. (2012). *Organisational Behaviour: Core Concepts and Applications.* Wiley - ISBN: 978-0-730-30144-8

REFERENCE BOOKS

1. David Buchanan, A. H. (2016). *Organizational Behaviour* (9th ed.). Pearson - ISBN 10: 1292092882 / ISBN 13: 9781292092881

2. UdaiPareek. (2004). *Organization Behaviour .* Oxford Publishing - ISBN-10 : 019807073X / ISBN-13 : 978-0198070733

3. Robbins, S. (2004). *Organisation Behaviour* (10th ed.). Prentice Hall - ISBN-13: 978-0131000698 / ISBN-10: 0131000691

M.SC., BIOCHEMISTRY SECOND SEMESTER

Course Title: GOOD LABORATORY PRACTICES (Elective Paper III)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Objective: To learn and follow good laboratory practices

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the fundamental points of good laboratory practices
CO2	Handle laboratory animals with care
CO3	Acquire knowledge on the protocols need to be followed and Analyze the biosafety of GM foods
CO4	Explain the principle of good lab practicals.
CO5	Gain the Awareness of HACCP and, follow the Safety measures in Industrial Hygiene.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	2

Correlation: 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	Introduction to Good laboratory practices. Fundamental points of GLP. Resources(organization, personnel, facilities and equipment),, Characterization(test items and test systems), Rules (study plans (or protocols) and written procedures), Results(raw data, final report and archives), Quality Assurance. OECD GLP PRINCIPLES.	9	CO1
MO2	Facilities: buildings and equipment: Dose Mixing Unit, Animal House Facility- Laboratory animal care, CPCSEA guidelines, Maintenance and calibration of equipments and their importance- Suitability and Calibration, Documentation, reporting of study results, standard operating procedures (sops), storage and retention of records and materials	9	CO2
MO3	BIOSAFETY and HAZARDS Biotechnology - potential hazards, biological weapons, biosafety of GM foods and GMOs. Human genome research - the objectives and approaches, the controversies. Safety and Hazard Analysis Hazards : Chemical Hazards classification- Radiation hazards and control of exposure to radiation- Fire triangle , fire prevention methods.	9	CO3
MO4	Principle of GLP to in vitro studies, Facilities, Test System Facilities, Facilities for Handling Test and Reference Items, Facilities for Handling Test and Reference Items, Test Systems, Conditions for Test Systems, Newly Received Test Systems, Test System Records, Test and Reference Items (including Negative and Positive Control Items) Performance of the Study and Reporting of Study Results	9	CO4
MO5	Industrial Hygiene: Introduction, evaluation and control toxicology: Routes of entry of toxic substances, toxic studies safe house keeping instrumentation for safe operation, personal protective equipments and their importance –usage Awareness of HACCP, Hazard Analysis Critical Control Points and OHSAS, Occupational Health Safety Assessment Series – standards in process safety	9	CO5

RECOMMENDED BOOKS:

1. organization, W. h. (2008). *Good Laboratory Practice (GLP) : Quality Practices for Regulated Non-Clinical Research and Development* (2nd ed.). World Health Organization - ISBN 10: 0619216204 / ISBN 13: 9780619216207
2. organization, W. h. (2005). *TRAINING MANUAL. Good Laboratory Practice (GLP)* (2nd ed.). Alpha Science International, Ltd - ISBN-13: 978-0750691192, ISBN-10: 0750691190
3. Anderson, Milton. A. (2002). *GLP Essentials: A Concise Guide to Good Laboratory Practice,* (2nd ed.). CRP press -

REFERENCE BOOKS:

1. J, A.-S. M. (2010). *Good Laboratory Practice* . Pharmalogika -
2. P, S. J. (2014). *Good Laboratory Practice: the Why and the How.* Springer-Verlag Berlin and Heidelberg GmbH & Co. KG - ISBN 10: 3642441033 / ISBN 13: 9783642441035
3. Slomiany, M. G. (2009). *The Indispensable Guide to Good Laboratory Practice.* Createspace Independent - ISBN 10: 1449553125 / ISBN 13: 9781449553128
4. Deshmukh, P. (2020). *Principles of Good Laboratory.* Adhyyan Books - ISBN 10: 9388644549 / ISBN 13: 9789388644549

I MSC BIOCHEMISTRY

II SEMESTER

Course title : PRACTICAL-III-ANALYTICAL BIOCHEMISTRY & MICROBIOLOGY

Course Code :	**Credits : 02**
L:T:P:S : 0:0:3:0	**CIA Marks : 50**
Exam Hours : 05	**ESE Marks : 50**

Course outcomes : At the end of the course, the student will be able to :

CO Number	**CO Statement**
CO 1	Separate and identify sugars, amino acids, proteins and lipids on planar and column chromatographic techniques
CO 2	Identify bacteria by staining techniques
CO 3	Examine the microbiological quality of milk,water and food
CO 4	Analyze the sensitivity of bacteria towards antibiotics
CO 5	Deermine the molecular weight of protein by standard electrophoretic technique,namely SDS PAGE

Mapping Course Outcomes with Program Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**2**	**3**
CO3	**3**	**2**	**2**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**

1	Separation of identification of amino acids by paper chromatography	CO1- CO5
2	Separation of identification of sugars by paper chromatography	
3	Separation of identification of lipids by thin layer chromatography	
4	Separation of proteins by gel filtration	
5	Identification of bacteria by staining techniques (Simple & differential)	
6	Biochemical characterization -Screening test a) amylase b) Protease	
7	Bacteriological analysis of water by standard plate	
8	Bacteriological analysis and identification of quality of milk	
9	Microbiological examination of food	
Demonstration experiments		
10	Determination of molecular weight of the proteins by SDS PAGE	
11	Antibiotic sensitivity Test	

RECOMMENDED BOOKS

1. Archana Ayyagari, A. N. (2007). *Lab Manual in Biochemistry, Immunology and Biotechnology.* Tata McGraw Hill Education - ISBN : 9780070617674 0070617678 9780070077454 0070077452

2. Walker, K. W. (2000). *Practical Biochemistry principles and techniques* (5th ed.). Cambridge University press -

3. Singh, S. a. (2014). *Introductory Practical Biochemistry* (reprint ed.). Narosa publishing house - ISBN 10: 9386217627 / ISBN 13: 9789386217622

REFERENCE BOOKS

1. Manickam, S. S. (2018). *Biochemical Methods* (3rd ed.). New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408

2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
3. Walker, K. W. (2010). *Principles and techniques of Practical Biochemistry* (7th ed.). Cambridge University Press - ISBN-10 : 1108716989 / ISBN-13 : 978-1108716987

4.

I MSC BIOCHEMISTRY

II SEMESTER

Course Title PRACTICALS -IV- MOLECULAR BIOLOGY AND NUTRITION

Course Code :	**Credits : 02**
L:T:P:S : 0:0:3:0	**CIA Marks : 50**
Exam Hours : 05	**ESE Marks : 50**

Course Outcomes: At the end of the Course, the Students will be able to:

CO NUMBER	CO Statement
CO1	Isolate DNA and RNA from source and Estimate.
CO2	Estimate Protein, Iron, Calcium, Riboflavin, Thiamine, and Ascorbic acid from different sources.
CO3	Comprehend the application of Plasmid DNA and Gene cloning

Mapping of COs TO PSOs (MSc Program)

PSO/CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	**3**
CO2	3	3	3	3	3	3	**3**
CO3	3	3	3	3	3	3	**3**

S.No.	Content of Module	Cos
1	Absorption studies of DNA and protein	CO1-CO5
2	Determination of melting temperature Tm and % GC content of DNA sample	
3	Isolation and estimation of DNA from animal tissue / Plant / Bacteria.	
4	Isolation and estimation of RNA from yeast	
5	Estimation of protein from food sample	
6	Estimation of Iron from food sample	
7	Estimation of calcium from food sample	
8	Estimation of Riboflavin/Thiamine by Spectro fluorimetry	
9	Estimation of Ascorbic acid from food sample.	
	Demonstration experiments	
10	Extraction of Plasmid DNA and Agarose Gel Electrophoresis	
11	Gene cloning	

Sl.No	Authors	Title	Publishers	Year of Publication
1	Prashant Kale Prashant Shingote Shriram Mirajkar	A practical manual for basic techniques in molecular biology	LAP Lambert Academic Publishing	2017
2	Diwakar Singh	Molecular diagnostic A practical manual	New India Publishing Agency (NIPA)	2020
3	Shalini Sehgal	A laboratory manual of food analysis-paper back	Dreamtech Press	2020

M.SC., BIOCHEMISTRY THIRD SEMESTER

Course Title: ADVANCED CLINICAL BIOCHEMISTRY (CORE PAPER VIII)

		Credits	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	**CO Statement**
CO1	Identify the metabolic errors that lead to different disorders of carbohydrate metabolism and help in the management of the same.
CO2	Predict the underlying disease condition based on the measurement of diagnostically significant enzymes.
CO3	Analyze the disorders in lipid metabolism based on the detailed lipid profile of the patient. Relate laboratory results in the diagnosis of liver diseases.
CO4	Relate laboratory results to clinical diagnosis and relationship to liver, kidney, pancreas and gastrointestinal function
CO5	Use biochemical and molecular tools for diagnostic and therapeutic interventionon hereditary and acquired disorders. Recognize the blood disorders and classify them based on the underlying defect.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	1	3
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	3	3
CO5	3	3	3	1	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Disorders of carbohydrate metabolism - Glucose homeostasis, diabetes mellitus and its management, GTT, assay of HbAIC,glycogen storage disease. Inborn errors of metabolism-galactosemia, fructosuria and lactose intolerance.	**15**	**CO1**
MO2	Clinical enzymology - enzymes in plasma and their origin, Clinic significance of enzymes -isoenzymes (LDH, CK) - phosphatase, 5' nucleotidase, amylase, lipase, transaminase and gamma glutamyl transferase. Measurement of serum enzymes in diagnosis, enzyme pattern in myocardial infarction, liver, muscle and bone diseases.	**15**	**CO2**
MO3	Diseases related to lipid metabolism – Hypercholesterolemia, atherosclerosis role of LDL – hyperlipoproteinemias and its types. Diseases relating to liver - cirrhosis, hepatitis. Jaundice with its types. Inherited diseases of bilirubin metabolism – Criggler- najjar syndrome, dubin Johnson syndrome gilbert syndrome - liver function tests	**14**	**CO3,CO5**
MO4	Acidity, ulcers – gastrointestinal disorders - gastric, duodenal, colon cancer, pancreatitis, gastric and pancreatic function tests. Diseases related to kidney - nephritis, nephrosis, uremia, renal failure, renal calculi, renal hypertension, renal tubular acidosis, and diabetes insipidus. Kidney function tests.	**16**	**CO4, CO5**
MO5	Disorders of Blood - Blood dyscrasias, Agranulocytosis, Thrombocytopenia, Aplastic, Hemolytic anemia, Hemoglobinopathies, Thrombosis, leucocytosis, leucopenia	**15**	**CO5, CO6**

TEXT BOOKS/REFERENCE BOOKS:

1. ChatterjeeRanashinde. (2012). *Medical Biochemistry(8th ed).* Jaypee - ISBN : 9789350254844

2. Kaplan. (2010). *Clinical Biochemistry* (6th ed.). Mosby - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846

3. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders -

REFERENCE BOOKS

1. Gupta, P. P. (2013). Textbook of Biochemistry with Biomedical significance (2nd ed.). CBS Publishers and distributors - ISBN 10: 8123922450 / ISBN 13: 9788123922454

2. T.M.Devlin. (2006). *Textbook of Biochemistry with Clinical Correlations.* CBS Publishers and Distributers - ISBN 10: 0471513482 / ISBN 13: 9780471513483

3. Ayling, M. &. (2014). *Clinical Biochemistry* (3rd ed.). Metabolic and Clinical Aspects - ISBN 10: 0702051403 / ISBN 13: 9780702051401

M.SC., BIOCHEMISTRY
THIRD SEMESTER

Course Title: BIOSTATISTICS (CORE PAPER IX)

		Credits	**: 04**
L:T:P:S	**: 3:0:1:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Recognize the definition of biostatistics and its scope and Ascertain the methods and importance of data collection and presentation
CO2	Examine the usage of statistical tools like measure of central tendency and measure of dispersion and Infer the results of skewness, kurtosis, correlation and regression
CO3	Appraise normal distribution and evaluate the concept of hypothesis testing
CO4	Apply and deduce hypothesis testing via t, z and chi square statistical distribution and ANOVA and make statistical decision
CO5	Conceive and comprehend the use of MS Excel and various statistical packages in handling and analyzing scientific data

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	3	1
CO2	1	1	3	3	1
CO3	1	1	3	3	1
CO4	1	1	3	3	1
CO5	1	1	3	3	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Statistics – Scope –collection, classification, tabulation of Statistical Data – Diagrammatic representation – graphs – graph drawing – graph paper – plotted curve –Sampling method and standard errors – means – confidence limits – variance.		CO1
MO2	Measures of central tendency – spearman test with an example (Problems included) measures of dispersion – skewness, kurtosis, moments – Correlation and regression – correlation table – coefficient of correlation – Z transformation – regression – relation between regression and correlation (Only theory).	**15**	**CO2**
MO3	Normal distribution – graphic representation – frequency curve and its characteristics –measures of central value, dispersion, coefficient of variation and methods of computation – Basis of Statistical Inference –Sampling Distribution – Testing of hypothesis – Null Hypothesis – Type I and Type II errors (Only theory)..	**15**	**CO3,**
MO4	Tests of significance for large and small samples based on Normal, t, z distributions (Problems included) with regard to mean, variance, proportions and correlation coefficient – chi-square test of goodness of fit – contingency tables – Tests of significance –t tests – F tests – Analysis of variance (Problems included) – one way classification – Two way classification.	**15**	**CO4**
MO5	Spreadsheets – Data entry –mathematical functions – statistical function – Graphics display – printing spreadsheets – statistical analysis packages	**15**	**CO5**

RECOMMENDED BOOKS:

1. Ramakrishnan.P. (2015). *Biostatistics.*Saras publication - ISBN-10 : 9384826049 / ISBN-13 : 978-9384826048

2. PranabkumarBanerjee. (2011). *Introduction to biostatistics.*S.Chand& Co Ltd **-**

3. Sundaram. (2014). *Medical Statistics.* Wolters Kluwer India Pvt. Ltd -

REFERENCE BOOKS

1. Gurumani, N. (2006). *Research Methodology for Biological Science.* MJP Publisher - ISBN 10: 8180940160 / ISBN 13: 9788180940163
2. R.M., K. a. (2016). *Comprehensive textbook of biostatistics and research methodology.*Bhalani publishing house - ISBN-10 : 9381496250 / ISBN-13 : 978-9381496251
3. Bland.J., M. (2015). *An Introduction to Medical Statistics* (4th ed.). OUP Oxford - ISBN 10: 0199589925 / ISBN 13: 9780199589920

M .SC., BIOCHEMISTRY THIRD SEMESTER

Course Title: RESEARCH METHODOLOGY (CORE PAPER X)

		Credits	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Objectives:

To learn the fundamentals of research, research design, principles of scientific research, data collection and analysis of data.

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Gain wide knowledge on the fundamentals of research
CO2	Identify the research problem and research design
CO3	Enlighten Importance of Hypothesis, Characteristics of a Good Hypothesis
CO4	Exposure to write thesis
CO5	Acquire a knowledge on finding scientific articles using Pubmed

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Correlation : 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	**FUNDAMENTALS OF RESEARCH:** Definition of research – Objectives of research, general characteristics of research, qualities of researcher, criteria for good research, Types of Research, approaches and significance of Research. Problems encountered in research, Motivation in Research.	15	CO1
MO2	**IDENTIFICATION OF RESEARCH PROBLEM AND RESEARCH DESIGN :**Scientific thinking, identification of research problem, defining the problem, evaluation of a Problem. Research design- contents and typesof research design, factors affecting research design.	15	CO2
MO3	**THE RESEARCH HYPOTHESES**: Meaning of Hypothesis, Definitions of Hypothesis, Importance of Hypothesis, Characteristics of a Good Hypothesis, Variables in a Hypothesis, formulating a Hypothesis, Testingthe Hypothesis	15	CO3
MO4	**THESIS WRITING** Thesis- Components of a thesis – format for writing thesis (Abstract, introduction, review of literature, materials and methods and discussion), reference styles. Useful search engines. E-resources (e-books/e-journals).	15	CO4
MO5	**JOURNALS:** Standard of research journals – International and national journals, Scopus indexed journals-explanation. Impact factor - citation index and H index-Definition. Preparation of manuscript - report writing - format of journals - proof reading - sources of information; journals, reviews, books, and monographs-bibliography. search engines - google, pubmed - national informatics center network services. Online data bas library.	15	CO5

RECOMMENDED BOOKS

1. Garg, C. &. (2019). *Research methodology, Methods and techniques* (4th ed.). New age Publishers - ISBN 10: 8122436234 / ISBN 13: 9788122436235

2. mahal, P. –K. (2018). *Research methodology.* (6th ed.). New Age International publishers -

3. Gupta, D. K. (2013). *Research Methodology.* Nirali Prakashan - ISBN 10: 9383525541 / ISBN 13: 9789383525546

REFERENCE BOOKS

1. Kothari, C. (2014). *Research Methodology: Methods and Techniques.* Oryx Press - ISBN-10 : 935139154X, ISBN-13 : 978-9351391548

2. Day, Robert. A. (1998). *How To Write & Publish a Scientific Paper* (5th ed.). Oryx Press - ISBN 10: 1573561657 / ISBN 13: 9781573561655

3. Paneerselvam, R. (2013). *Research Methodology* (2nd ed.). Prentice Hall India Learning Private Limited - ISBN 10: 8120349466 / ISBN 13: 9788120349469

M.SC., BIOCHEMISTRY THIRD SEMESTER

Course Title: Hormonal Biochemistry (Elective Paper IV)

		Credits	**03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Understand the structure of hormones and receptors. Classify hormones based on nature, mechanism of action. Illustrate cell signaling mechanism and Demonstrate Second messengers and their actions.
CO2	Explain the structure, biological action and regulation of hypothalamic and pituitary hormones. Analyze and predict the cause for disease due to pituitary dysfunction
CO3	Discuss about Pancreas and its hormonal secretion, biological actions. Analyze the clinical conditions with reference to pancreatic gland
CO4	Explain the structures biological functions and synthesis of thyroid hormones.
CO5	Compare the structure and metabolic effects of adrenal hormones

Mapping of Course Outcomes to Program Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	3	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Hormones - Definition. Classification – Based on chemical nature and mechanism of action, class I, classIIa, class IIb with examples- Receptors - structure and types. Agonist and Antagonist –Definition. Secondary messengers-Definition Role of adenylate cyclase, G proteins, protein kinases, tyrosine kinase, Inositol phosphates, Diacyl glycerol, calcium, calmodulin Steroid hormone receptors – Mechanism of steroid hormone action.	**9**	**CO1**
MO2	Hypothalamus and pituitary hormones- hypothalamic hormones, Anterior pituitary hormones – actions and feedback regulation of synthesis. Glycoprotein hormones and POMC family. Natural Analgesics- Endorphins and Enkephalins. MSH. Posterior pituitary hormones- Oxytocin and vasopressin-Structure and biological functions Disorders due to Hypo and hyperactivity of pituitary hormones-gigantism, acromegaly, dwarfism. Diabetes insipidus	**9**	**CO2**
MO3	Pancreatic hormones – cell types of the islets of langerhans. Insulin – Biosynthesis and regulation of secretion. Biological actions. Mechanism of action. Insulin like growth factors. Glucagon –structure and functions. Role of Glucagon in glycogenolysis. Diabetes mellitus and its metabolic complications. Role of Somatostatin and Pancreatic polypeptide	**9**	**CO3**
MO4	**UNIT IV** Thyroid hormones – Synthesis and secretion, Transport and biological actions. Antithyroid agents. Thyroid diseases –Grave's disease and Hashimoto's thyroiditis. Calcium regulating Hormones: Calcitriol and calcitonin. Biosynthesis, functions. Rickets and osteomalacia – Calcium homeostasis – role of PTH. Hyperparathyroidism	**9**	**CO4**
MO5	**UNIT V** Adrenal hormones – Glucocorticoids, mineralocorticoids synthesis, secretion, transport. Biological effects. Adrenal androgens and estrogen – metabolic effects and functions. Adrenal medulla – Catecholamines, biosynthesis, storage, regulation of synthesis. Abnormal secretion of Adrenal gland hormones – Addison's disease, Cushing's syndrome, Phaeochromocytoma.	**9**	**CO5**

TEXT BOOKS

1. L, B. (2010). *Hormonal Biochemistry.* Discovery Publishing Pvt. Ltd -
2. Cooper, G. a. (2013). *The Cell: A Molecular Approach.* Sinauer Associates, Inc. - ISBN 10: 0878931066 / ISBN 13: 9780878931064
3. ShlomoMelmed, K. S. (2015). *William Textbook of Endocrinology* (13th ed.). Elsevier - ISBN 10: 0323297382 / ISBN 13: 9780323297387

REFERENCE BOOKS

1. Sathyanarayana. (2017). *Biochemistry(4th ed).* Elsevier - ISBN: 9788131236017
2. Robert K.Murray, D. A. (2018). *Harper's Illustrated Biochemistry* (28th ed.). The McGraw- Hill Companies - ISBN-10 : 0071625917 / ISBN-13 : 978-0071625913
3. Karp, G. (2013). *Cell and Molecular Biology.* John Wiley and Sons Inc - ISBN-10 : 111830179X, ISBN-13 : 978-1118301791

M.SC., BIOCHEMISTRY THIRD SEMESTER

Course title: ADVANCED MEDICAL LABORATORY TECHNOLOGY
(Elective Paper IV)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain a Wide knowledge on ABO blood grouping, Withdrawal of blood
CO2	State and discuss the importance of cerebrospinal fluid and semen
CO3	To know the importance of Urine and stool analysis in diagnosis of diseases.
CO4	Know the causes and consequences of amoebiasis and SARS
CO5	Culture of microorganisms and perform antibiotic sensitivity test

Mapping of Course Outcomes to Program Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	2	2	3	2	2
CO4	3	3	3	3	3
CO5	2	3	3	3	2

Correlation : 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	**Blood**: Composition of blood-Functions of RBCs, WBCs and Platelets. Blood grouping- ABO System, ABO Grouping, Rh typing. Coomb's test. Blood transfusion - Blood donors, donor screening, drawing of blood, compatibility testing, cross matching, blood transfusion complications. Blood Banking.	**8**	**CO1**
MO2	**Cerebrospinal fluid and Other Body Fluids:** Cerebrospinal fluid-composition-Function and analysis of CSF. Semen-Composition and its function. Sputum and its examination. Pregnancy test - Interpretation	**7**	**CO2**
MO3	**Urine Analysis:** Collection and preservation of urine sample. Composition of urine, Normal and abnormal constituents of urine. Urinalysis-Procedure. Examination of glucose, ketone bodies, bile pigments in urine. Hematuria. **Stool**-Composition. Collection and examination of stools - inspection of faeces- odour, pH, Interfering substance. Test for occult blood, faecal fat, microscopic examination of stool specimen.	**10**	**CO3,CO5**
MO4	Medical Parasitology Amoebiasis, Giardiasis - Causes and consequences, Treatment. Plasmodium vivax – life cycle, pathogenesis of malaria , Dengue fever, SARS, Ebola virus and corona virus	**10**	**CO4, CO5**
MO5	Medical Microbiology Culturing of organisms from various specimens. Culture media and antibiotic sensitivity test (pus, urine stool, sputum, throat swab, gram staining, Ziehl –Neilson staining (TB, Lepra bacilli). Safety procedure in microbiological techniques.	**10** ,	**CO5**

RECOMMENDED BOOKS:

1. V.H., T. (2019). *Handbook Medical Laboratory Technology* (2nd ed.). CBS publishers and distribution - ISBN-10 : 8123906773 / ISBN-13 : 978-8123906775
2. ChatterjeeRanashinde. (2012). *Medical Biochemistry(8th ed).* Jaypee - ISBN : 9789350254844
3. V.H., T. (2014). *Practical Textbook of Laboratory Medicine.*CBS publishers and distribution - ISBN-10 : 8123918720 / ISBN-13 : 978-8123918723

REFERENCE BOOKS

1. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders.
2. Praful B. Godkar, D. P. (2014). *Textbook of Medical Laboratory Technology.* bhalani Publishing House - ISBN-10 : 9780074632239 / ISBN-13 : 978-0074632239
3. Sood, R. (2009). *Medical Laboratory Technology Methods and Interpretations.* Jaypee - ISBN 10: 9351523330 / ISBN 13: 9789351523338

M.SC., BIOCHEMISTRY THIRD SEMESTER

Course title: BIOENTREPRENEURSHIP MANAGEMENT (Elective Paper IV)

	:	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Recognize the importance of Bioethics,Entrepreneurship, communication and management skills so as to prepare the next generation of Indian Industrialist
CO2	Prepare business plan and prepare budget proposals, Gain knowledge on funding agencies.
CO3	Analyze the market by different analysis methods.
CO4	Familiarize with the Legal requirements for starting a company & registration of company. Understand the basics of accounting & finance.
CO5	Identify scope for entrepreneurship in biosciences and utilize the schemes promoted throughknowledge centers and various agencies

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	3	3	3	3	3	2
CO2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	1
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3

Correlation : 3 strong 2 medium 1 low

S.No	Content of Module	Hrs	Cos
MO1	**Introduction to Bioentrepreneurship** Bioentrepreneurship – Introduction, Scope and its advantages of being an entrepreneur; Skills to developas an entrepreneur - Creativity, leadership,managerial, Team (identification & building), growth steps (tracking & building); self-discipline; decision making; Types of industries – Biopharma, BioagricultureandCRO; patents, Trademarks,Copyrights – Procedure of patenting, the essentiality of patenting.	**9**	**CO1**
MO2	**Business Plan, Budgeting and Funding** Idea or opportunity (activities - Brainstorm etc); Business plan & business proposal preparation; GANNT chart; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and make in India Initiative;start-up finance models / funding options (Angle , seed , VC & Bootstrapping); Entry and exit strategy; pricing strategy; negotiations with financiers, bankers, government and law enforcement authorities; disput resolution skills; external environment/ changes;avoiding/managing crisis; broader vision–global thinking; mergers & acquisitions.	**9**	**CO2**
MO3	**Market Strategy** Market analysis: SWOT analysis, PESTEL Analysis and Porter's Analysis to understand the Market; Basics of market forecast for the industry; distribution channels – franchising, policies,promotion, advertising, branding and market	**9**	**CO 3**
MO4	**Legal Requirements, Finance and Accounting** Legal requirements for starting a company; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: concepts of balance sheet, profit and loss statement, double entry, bookkeeping; collaborations &partnerships;Financialanalysis:Ratio analysis, break even analysis,Budget and planning process, Profitability analysis; information technology for business administration and expansion; difficulties of entrepreneurship in India	**9**	**CO 4**
MO5	Role of knowledge centres such as universities, innovation centres, research institutions (public & private) and business incubators in Entrepreneurship development; Assessment of technology development and technology transfer; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP	**9**	**CO 5**

RECOMMENDED BOOKS:

1. Adams, D. J. (2008). *Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences.* Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361
2. Shimasaki, C. (2014). *Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies.* Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303
3. Jordan, J. F. (2014). *Innovation, Commercialization, and Start-Ups in Life Sciences.* London: CRC Press - ISBN-10 : 812243049X ,ISBN-13 : 978-8122430493
4. Desai, V. (2009). *The Dynamics of Entrepreneurial Development and Management New Himalaya.* New Himalaya House Delhi:pub - ISBN : 9789350440810 9350440814

REFERENCE BOOKS

1. Shimasaki, C. (2014). *Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies.* Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303
2. Kapeleris, D. H. (2006). *Innovation and entrepreneurship in biotechnology: Concepts, theories & cases - ISBN-13: 978-1482210125, ISBN-10: 1482210126*
3. Friedman, Y. (2008). *Best Practices in Biotechnology Education.* Logos Press - ISBN 10: 0973467673 / ISBN 13: 9780973467673

M.SC., BIOCHEMISTRY THIRD SEMESTER

Course Title : BIOINFORMATICS (ADVANCED)

		Credits	**: 03**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	To introduce the fundamental concepts of computer devices and to explain the various features of operating system
CO2	To correlate the terminologies used in Bioinformatics with molecular biology. To summarize the organization of genes in prokaryotes and Eukaryotes
CO3	To classify biological database and to correlate the different file formats used by nucleic acid and protein database. To explain the tools employed in analysis of query sequence with subject sequence and illustrate the genome , pathway ,specialized and structural database
CO4	To discuss the concepts of alignment and phylogenetic analysis. To develop algorithms for interpreting biological data and construction of phylogenetic tree.To analyze the 3D visualization tool used in macromolecular structure Analysis
CO5	Understand the properties of Drugs and design drugs using computer tools.

Mapping of Course Outcomes to Program Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	2	3	2
CO3	3	3	2	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No	Content of Module	Hrs	Cos
MO1	Basics of computers – Input, output, CPU, ALU and Memory units – definitions and examples. Introduction to operating systems (MS Windows, linux) – Features of WINDOWS operating system, use of internet, email, search engines (Google, yahoo)	**15**	**CO1**
MO2	Bioinformatics: definitions – genomics, proteomics, metabolomics, transcriptomics, homologs, orthologs and paralogs. Prokaryotic and eukaryotic genome structure, Gene density, SNPs – gene diversity – gene ontology , gene order (synteny) , plasticity zone, gene network, tandem repeats.	**10**	**CO2**
MO3	Introduction to Biological databases: nucleotide databases (NCBI,Genbank , EMBL, DDBJ) protein databases (Swissprot EBI, TrEMBL, PIR,) ; derived database (prosite, Pfam, PRINTS); Sequence submission methods and tools (sequin); sequence retrieval systems (entrez); sequence file formats and conversion tools ; genome (TIGR, SANGER); metabolic pathway database (KEGG, EcoCyC); specialized database(COG, LIGAND, BRENDA) Structural databases-PDB.	**15** ,	**CO3**
MO4	Alignments- - sequence alignment –global alignment, local alignment; Scoring matrices - definition and method of derivation of the PAM & BLOSUM matrices Dynamic Programming-Needleman Wunch Algorithm, Smith Waterman Algorithm. Phylogenetic trees- concept of dendogram and cladogram ; methods of construction - maximum parsimony method, maximum likelihood method and distance methods. Molecular Visualization tools- Rasmol, Swiss PDB viewer.	**10**	**CO4**
MO5	Drug Discovery-History, steps in drug discovery, Target identification, Target validation-QSAR-Lead identification- Computer aided drug designing-Ligand based approach-Target based approach	**10**	**CO5**

RECOMMENDED BOOKS

1. Mount, D. w. (2004). *Bioinformatics sequence and Genome Analysis.* Cold Spring -ISBN 10: 0879697121 / ISBN 13: 9780879697129
2. S. G. Rastogi, N. (2013). *BI Mtds and Applications.* PHI learnings.
3. Ignacimuthu, S. (2013). *Basic Bioinformatics.* Alpha Science Int. Ltd - ISBN-10 : 1842658042 / ISBN-13 : 978-1842658048

REFERENCE BOOKS

1. Lesik, A. (2014). *Introduction of Bioinformatics.* Oxford University Press - ISBN 10: 0198724675 / ISBN 13: 9780198724674
2. Ramsden, J. (2015). *Bioinformatics-An Introduction.* Springer - ISBN 978-1-4471-6702-0
3. Andreas D. Baxevanis, G. D. (2020). *Bioinformatics.* Wiley - ISBN 10: 0471478784 / ISBN 13: 9780471478782

II MSC BIOCHEMISTRY

III SEMESTER

Course Title PRACTICAL V- ADVANCED CLINICAL BIOCHEMISTRY

Code :		**Credits**	**: 02**
L:T:P:S	**: 0:0:3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 05**	**ESE Marks**	**: 50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO	Description
CO1	Estimate biochemical parameters glucose, glycosylated Hb and A/G ratio
CO2	interpret the profile of lipids by estimation of cholesterol, triglycerides and free fatty acids
CO3	Determine the serum bilirubin, and renal markers
CO4	Estimate antioxidant stains by catalase and superoxide dismutase activity in blood
CO5	To fractionate the isoenzymes of LDH

Mapping of COs TO PSOs (MSc Program)

PSO/CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

S.No	Contents	COs
MO1	Estimation of blood glucose by glucose oxidase method	CO1
MO2	Determination of A/G ratio by biuret method	
MO3	Determination of glycosylated Hb	
MO4	Estimation of sreum cholesterol by Zak's method,	CO2
MO5	Estimation of serum triglycerides,	
MO6	Estimation of plasma free fatty acids	
MO7	Estimation of serum Bilirubin/ALP	CO3
MO8	Estimation of Urea in urine	
MO9	Estimation of Creatinine in urine	
MO10	Estimation of superoxide dismutase	CO4
MO11	Estimation of Catalase.	
	Demonstration Experiments a) LDH Isoenzyme by native gel electrophoresis b)Identification of biochemicals(Glucose, ketones, Protein,) with Test strips	CO5

REFERENCE BOOKS/TEXT BOOKS

1. Pal, G. P. (2006). *Text Book of Practical physiology* (2nd ed.). Orient Blacks - ISBN 10: 8125030506 / ISBN 13: 9788125030508

2. Raghu. (2006). *Practical Biochemistry for Medical Students* . Jaypee - ISBN-10 : 818061106X / ISBN-13 : 978-8180611063

3. Gowenlock, A. H. (1988). *Varley's Practical Clinical Biochemistry* (6th ed.). CBS Publishers and distributors, India - ISBN : 0849301564 9780849301568 0433338067 9780433338062 8123904274 9788123904276

REFERENCE BOOKS

1. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry(3rd ed).* Tata Mc Graw Hill - ISBN: 9780070841659
2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
3. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd - ISBN 10: 8173193029 / ISBN 13: 9788173193026

II MSC BIOCHEMISTRY

III SEMESTER

Course Title PRACTICALS – VI-BIOINFORMATICS & IMMUNOLOGY

Course Code:	**Credits : 02**
L:T:P:S : 0:0:3:0	**CIA Marks : 50**
Exam Hours : 05	**ESE Marks : 50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO	Description
CO1	Identify blood groups, test for complement fixation,RA factors
CO2	Test for quantitative determination of antigens
CO3	Analyze and Interpret nucleotide,protein sequences and predict protein structure
CO4	Identify enzyme regulatory sites using molecular visualization tool RASMOL , Examine homology search using Bioinformatics tool
CO5	Explain purification of antibody and analyze secondary structure of protein using prosite

Mapping of COs TO PSOs (MSc Program)

PSO/CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

S.No.	Content of Module	Cos
MO1	ABO blood grouping and Rh factor typing by slide agglutination Test	CO1
MO2	Complement fixation test	
MO3	Detection of RA factors	
MO4	VDRL test-Slide Flocculation test	
MO5	Quantitative determination of antigen -Single Radioimmuno diffusion	
MO6	Quantitative determination of antigen by Double Immunodiffusion	CO2
MO7	To retrieve the nucleotide sequence of interest from biological database	
MO8	To retrieve Protein sequence of interest from biological database	CO3
MO9	To Retrieve the protein structure using PDB	CO5

MO10	Identification of active site, allosteric site, catalytic site regulatory site of enzyme using RASMOL	CO4
MO11	Homology search-BLAST n/BLASTp	
	Demonstration experiments	
MO1	Purification of Antibody IgG by Ion exchange chromatography	
MO2	Protein motif and domain analysis using Prosite	

RECOMMENDED BOOKS

1. Immunology: Overview and Laboratory Manual TobiliSam-Yellowe, Springer,1st editio,2020

2. Laboratory Manual on Immunology and Molecular biology- Deepak Diwedi and Vinod – Lambert Academic Publishing, 2013

3. Bioinformatics practical Manual:SequencingPractical- Mohammed Iftekhar,Mohammed Ghalib, Kindle edition,2015

M.SC., BIOCHEMISTRY FOURTH SEMESTER

Course Title: IMMUNOLOGY (CORE PAPER XI)

		Credits	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Gain a wide knowledge on the types of immunity, cells and organs of immune system as well as state the types of vaccines.
CO2	Demonstrate familiarity with antigen, antibodies and complements.
CO3	Relate the origin, development, maturation process and general functions of B and T lymphocytes as well as explain the antigen processing and presentation pathways.
CO4	Identify the molecular mechanism behind hypersensitivity, anti immunity and immune suppression.
CO5	Discuss knowledge the principles & methodology involved in immunological techniques

Mapping of Course Outcomes to Program Outcomes:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	1	3
CO 3	3	3	3	2	3
CO 4	3	3	3	1	3
CO 5	3	3	3	1	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	**IMMUNITY** : Classification, Innate immunity- Factors governing innate immunity- Mechanical, and cellular factors. Acquired immunity-Types **Cells of immune system**. Lymphoid organs, Central and peripheral. Bone marrow, thymus, bursa of fabricius, spleen, lymph node, MALT, cells of lymphoreticular system. Vaccination – types – live, killed, attenuated, toxoids, recombinant vaccines.	**17**	**CO1**
MO2	Antigens and immunogens, Haptens, and adjuvants. - definition. Factors affecting antigenicity. Epitopes and Paratopes. Antibodies - Structure and function of IgG. IgA, IgM, IgD, and IgE. Isotypes, Allotypes and Idiotypes. Compliments – classical and alternate pathways – disorders of complements activation.	**13**	**CO2**
MO3	B-cell markers. B cell development. Maturation, activation, differentiation of B cells. Theories of antibody formation - clonal selection theory. Molecular basis of antibody diversity T cell marker, TCR structure and diversity,. Maturation, activation, differentiation of T cells. Antigen processing &presentation - Cytosolic and endocytic pathway Complement components and its activation (classical & alternate pathway)	**17**	**CO3**
MO4	Hypersensitivity – immediate & delayed, Autoimmunity – Organ and Systemic specific diseases. Myasthenia gravis, Graves disease, Systemic lupus erythromatosis, Glomerulonephritis and Rheumatoid arthritis. Transplantation immunology – MHC complex, class I and II structures and functions – graft vs. host reactions, HLA typing – lymphocytotoxicity, cross matching, immune suppressive agents.	**13**	**CO4**
MO5	Antigen – antibody reactions – precipitation & agglutination reactions – applications – WIDAL test and Coombs test – immunodiffusion – SID, DID – immunoelectrophoresis. ELISA and its types, Immunofluorescence - Direct, indirect and FACS. Monoclonal antibodies production and applications – RIA.	**15**	**CO5**

RECOMMENDED BOOKS

1. Jud Owen, J. P. (2013). *Kuby Immunology.* International Edition W. H. Freeman - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846
2. AK, A. (2011). *Cellular and Molecular immunology.* Elsevier Health Sciences - ISBN 10: 0808921355 / ISBN 13: 9780808921356
3. SudhaGangal. (2013). *Textbook of Basic and Clinical Immunology.* Orient Blackswan Private Limited - New Delhi - ISBN 10: 8173718296 / ISBN 13: 9788173718298
4. Delves P, M. S. (2011). *Roitt's Essential Immunology.* (12th ed.). Wiley- Blackwell Scientific Publication, Oxford - ISBN 10: 1405196831 / ISBN 13: 9781405196833

REFERENCE BOOKS

1. Roitt, I. (2017). *Immunology(13th ed).* Wiley Black Well - ISBN-10 : 1118415779 / ISBN-13 : 978- 1118415771
2. Kuby, J. (2018). *Immunology(5th ed).* W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701
3. Rao, C. V. (2017). *Immunology* (3rd ed.). Alpha Science Int. Ltd - ISBN-10 : 1842652559 / ISBN-13 : 978-1842652558
4. Paniker. (2017). *Immunology* (10th ed.). University Press - ISBN 10: 1847558569 / ISBN 13: 9781847558565

FOURTH SEMESTER

Course Title: NUTRIGENOMICS (ADVANCED)

		Credits	**: 03**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	**CO Statement**
CO1	Understand and apply the knowledge of basics of genetics, epigenetics in the context of nutrigenomics
CO2	Understand and differentiate between genetics and genomics in the context of diseases with an idea on SNPs
CO3	Understand the concept of nutrigenomics and the genes associated with few biochemical disorders
CO4	Understand the relationship between various nutrients and their role in gene regulation- the core concept of nutrigenomics
CO5	Understand the relationship & interactions between food (diet) and genes in humans.
CO6	Know the types of foods, biomarkers in identifying diseases and ethical issues associated with nutrigenomics field of study.

Mapping of Course Outcomes to Program Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	1	1	1	3	2	1
CO2	3	2	1	2	3	1	2
CO3	3	3	1	2	3	3	2
CO4	3	3	1	3	3	2	1
CO5	3	3	1	2	3	2	2
CO6	3	3	2	3	3	2	1

Correlations : 3 Strong 2 Medium 1 Low

Module No.	Module content	Hrs	CO
MO1	Basics Of Genetics - Branches of genetics -Epigenetics (http://learn.genetics.utah.edu/content/epigenetics/intro/) Methylation on the nucleosome -Mammalian DNA methyltransferases -Chromatin remodeling and histone modifications -Nutrients and DNA methylation Nutrients, histone modifications, & chromatin remodeling in chronic inflammation - Nutrients, epigenetics, and embryonic development - Nutrition, epigenetics, and agingNutrition, epigenetics, and cancer -Genetics History Of Dietetics And Genetics	12	CO1
MO2	Nutrigenetics – Applications - Nutrigenetics And Type 2 Diabetes Mellitus - - Nutrigenetics And Cardiovascular Diseases - Nutrigenetics And Cancer What Are Snps And How Are They Found? Snps& Disease Diagnosis - Snps& Drug Development - - Snps&Ncbi -Snp AnalysisGenetics Vs. Genomics	10	CO2
MO3	Nutrigenomics – Introduction -Rationale And Aims Of Nutrigenomics - Genes Associated With Various Diseases- Genes Associated With Lipid Metabolism, AntioxidantFunction And Detoxification, Bone Structure, Inflammatory Response, Glucose Balance	10	CO3
MO4	Nutrition And Gene Regulation - Effect Of Carbohydrate On Gene Expression - Regulation Of Gene Expression By Dietary Fat - Effect Of Protein On Gene Expression - Influence of amino acidsEffect Of Minerals On Gene Expression - Effect of Zinc on gene expression - Effect Of Vitamins On Gene Expression	16	CO4
MO5	Gene- Diet Interactions - Nutrient Intake Values (Nivs): A Recommended Terminology - Complexity Of Diet - Diet- Disease Relationships – Nutraceuticals - Functional Foods- Genetically Modified Foods – Gmos - Taster Strips PTC (Phenylthiourea-Phenylthiocarbamide): Sodium Benzoate - Personal Nutrition - Ectopic Fat "Dysfunctional" Fat vs. "Healthy" Fat - ectopic fat storage and lipotoxicity – Biomarkers - Genetic Tests - EthicalIssues	12	CO5

RECOMMENDED BOOKS:

1. Tsankova, N. R. (2007). *Epigenetic regulation in psychiatric disorders.* Nature Reviews Neuroscience, 8:355-367.
2. German JB, Y. C. (2004). *Personalizing foods - for health and preference.* Food technol 58:26-31
3. Raffaele De Caterina (Editor), J. A. (2019). *Principles of Nutrigenetics and Nutrigenomics: Fundamentals of Individualized Nutrition* (1st ed.). Academic Press.

REFERENCE BOOKS

1. Caterina, R. D. (2019). *Principles of Nutrigenetics and Nutrigenomics.* Elsevier Science and Technology - ISBN 10: 0128045728 / ISBN 13: 9780128045725
2. Lévesque L, O. V. (2008). *Integrating anticipated nutrigenomics bioscience applications with ethical aspects.* OMICS.
3. http://www.ncbi.nlm.nih.gov/pr ojects/GeneTests/static/about/w hatis/mission.shtml

M.SC., BIOCHEMISTRY FOURTH SEMESTER

Course Title: LIFE STYLE DISEASE AND PREVENTION (Elective Paper V)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO NUMBER	CO Statement
CO1	Ascertain the risk factors that contribute to obesity and diabetes mellitus and examine their management
CO2	Associate hypertension with chronic renal failure and quote the causes, types, symptoms and treatment of kidney stones
CO3	Assess the causes, types, symptoms, diagnosis and treatment of cancer and evaluate the consequences of cigarette smoking
CO4	Identify factors influencing aging and describe age related diseases
CO5	Diagnose the etiology, symptoms and treatment aspects of gall stone formation. Determine the causes and prevention of ulcer

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	1	1
CO2	3	2	2	1	1
CO3	3	2	2	1	1
CO4	3	2	2	1	1
CO5	3	2	2	1	1

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Obesity- prevalence- causes, consequences, symptoms-Coronary heart.Disease and type 2 diabetes mellitus- lifestyle and dietary management of obesity.	**9**	**CO1**
MO2	Hypertension- blood pressure- normal level of blood pressure, dietary management of hypertension, stroke and chronic renal failure due to hypertension.kidney stone- causes, types, symptoms and treatment (only lithotropy), dietary management for prevention of kidney stones.	**9**	**CO2**
MO3	Cancer- types of cancer, etiology of breast cancer diagnosis (self examination, Mammography)and treatment (radiation, chemotherapy, surgery). Cervical cancer causes, types, symptoms, diagnosis and treatment (radiation, chemotherapy, surgery).Cigarette smoking and symptoms, diagnosis and treatment (chemotherapy).	**9**	**CO3**
MO4	Aging- Factors influencing aging. Age related diseases- dementia, osteoporosis, Osteo arthritis- causes sign and symptoms, preventive, measures of aging with special reference to antioxidants.	**9**	**CO4**
MO5	Gallstones- causes, factors, aetiology of gall stones, types of gall stones, symptoms, preventive aspects of gall stone. Drug therapy- ursodeoxycholic acid, surgical treatment and dietary management – Ulcer- causes and prevention.	**9**	**CO5**

REFERENCE BOOKS/TEXT BOOKS:

1. Devlin, T. M. (2010). *Textbook on Biochemistry with Clinical Correlation* (7th ed.). John Wiley and Sons - ISBN: 978-0-470-28173-4

2. (eds)Tietz, C. A. (2012). *Textbook of Clinical Chemistry and Molecular Diagnosis* (5th ed.)- ISBN 10: 1416061649 / ISBN 13: 9781416061649

3. Tietz. (2014). *Fundamentals of clinical chemistry and molecular diagnostics - ISBN 10: 1455741655 / ISBN 13: 9781455741656*

REFERENCE BOOKS

1. M.N.Chatterjea. (2006). *Textbook of Medical Biochemistry(6th ed)* . Jaypee Brothers.Medical Publishers (P)Ltd - ISBN-13: 978-9350254844, ISBN-10: 9789350254844
2. Ayling, M. &. (2014). *Clinical Biochemistry* (3rd ed.). Metabolic and Clinical Aspects - ISBN 10: 0702051403 / ISBN 13: 9780702051401

3. Swaminathan. (2005). *Advanced Textbooks of food and Nutrition.* BAPP CO PRESS -

M.SC., BIOCHEMISTRY FOURTH SEMESTER

Course Title: HEALTHCARE MANAGEMENT (Elective Paper V)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course outcomes: At the end of the course, the student will be able to:

CO1	Understand the importance of effective healthcare administration
CO2	Compare and analyse the merits and demerits of different types of health systems in india
CO3	Recognize the role of the health care sector in the prevention and management of diseases.
CO4	Get suitably equipped to meet the challenges of the health care sector
CO5	Assist in the working of diverse departments in the hospital

Mapping of course outcomes to program specific outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**1**	**3**	**3**
CO2	**3**	**3**	**1**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**3**
CO4	**3**	**3**	**2**	**2**	**3**
CO5	**3**	**3**	**1**	**3**	**3**

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Introduction to public health- Evolution of public health. Important public health acts, health problems of developed and developing countries, health problems in india, environment and health.	**6**	**CO1**
MO2	Health care systems in India ,Health planning in India including various committees and national health plicy and health goals set from time to time . publicati sector with reference to centre, state, district and block level structures and local bodies and panchayati raj organization and functions of community health centres and primary health centres (PHCS). Health manpower, primary health care and concept, alternative systems of medicine, like ayurveda, homeopathy, etc. holistic approach non-governmental publications (NGOs) and private voluntary publications (PVOS). Unorganized sector.	**12**	**CO2**
MO3	Basic epidemiology and prevention of diseases Definition and concepts of epidemiology, concepts of health and disease..prevention and control of specific diseases – cholera, plague, smallpox, malaria, tuberculosis, leprosy, filariasis	**7**	**CO3**
MO4	Hospital operation management- Management of Indian hospitals-challenges & strategies. Moderntechniques of hospital management. Operation concept- use of models. Health services research & formalized managerial methods. Management of quality assured services of professional service units of hospitals . Quality control mechanisms	**8**	**CO4**
MO5	Medical record science Definition and types of medical record , importance of medical record, flow chart of function, statutory requirements of maintenance, coding, indexing and filing, computerization of record, report and returns by the record department, statistical information and ICD. Exceptional management needs in healthcare units- management of blood bank, donated organs, morgues, and dispensaries.	12	**CO5**

RECOMMENDED BOOKS

1. Amelung, V. E. (2013). *Healthcare Management .* Springer -
2. Kieran, W. (n.d.). *Healthcare management.* Second edition Tata McGraw Hill publishers- ISBN 10: 0070706646 / ISBN 13: 9780070706644
3. Sharon b. Buchbinder and Nancy h. Shaks, J. (2012). *Introduction to healthcare management .* Barlett Learning - ISBN 10: 1284156567 / ISBN 13: 9781284156560

REFERENCE BOOKS

1. galloway, N. g. (2017). *Leadership and management in healthcare* (3rd ed.). Sage publishers UK - ISBN 10: 1473965020 / ISBN 13: 9781473965027
2. vikas, S. l. (n.d.). *Public health management* (2nd ed.). CBS publishers - ISBN: 978-9387742932
3. Sharon B. Buchbinder, N. H. (2011). *Introduction To Health Care Management* (2nd ed.). Jones and Bartlett Publishers, In - ISBN 10: 0763790869 / ISBN 13: 9780763790868

M.SC., BIOCHEMISTRY

Course title: FREE RADICAL BIOLOGY (Elective Paper V)

		Credits	**: 03**
L:T:P:S	**: 3:0:0:1**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain a wide knowledge on free radicals and its deleterious effects
CO2	Analyze the importance of antioxidant rich foods
CO3	Assess the Biological functions of vitamin as an antioxidant
CO4	Describe the oxidative stress in diseased condition. Role of phytocompounds as antioxidants
CO5	Illustrate the formation of Reactive oxygen and nitrogen species formation in phagocytosis

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO 2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	2	2	2	2	2

Correlation : 3 strong , 2 medium , 1 low

S.No.	Content of Module	Hrs	C os
MO1	Free radicals-Definition-ROS and RNS. Superoxide radicals (O2•−), hydrogen peroxide (H2O2), hydroxyl radicals (•OH), and singlet oxygen ($^1O_2$) Oxidants and Free Radical Production. Physiological Activities of Free Radicals. Detrimental Effects of Free Radicals on Human Health autoxidation initiated by oxygen radicals. Oxidative stress-Definition-Role of oxidants - Lipid peroxides, hydroperoxides and protein carbonyls in cellular damage	**12**	**CO1**
MO2	Enzymatic antioxidants - Chemistry, mechanism, antioxidant effects of superoxide dismutase, catalase, Glutathione peroxidase. Antioxidant rich foods.	**8**	**CO2**
MO3	Vitamins as Antioxidants. Sources , chemistry , and biological functions of antioxidant vitamins- Vitamin A, Vitamin C, Vitamin E.	**7**	**CO3, CO5**
MO4	Oxidative stress in diseased condition- cancer, Cardiovascular Disease, Neurological Disease , Diabetes mellitus. Role of Exogenous Antioxidants and Human Health. Flavonoids, Ascorbic Acid, Polyphenols as antioxidants. **.**	**8**	**CO4, CO5**
MO5	Reactive oxygen species formation in phagocytosis, Respiratory burst. Role of SOD and catalase. Formation of Hypochlorous acid. Formation of Nitric oxide in cell. Formation of ROS in chlorophyll and their effects on photosynthesis. Triplet chlorophyll. Role of enzymatic antioxidants in neutralizing free radicals in plants	**10**	**CO5**

RECOMMENDEDBOOKS:

1. L, B. (2010). *Hormonal Biochemistry.* Discovery Publishing Pvt. Ltd -
2. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .
3. ShlomoMelmed, K. S. (2015). *William Textbook of Endocrinology* (13th ed.). Elsevier - ISBN 10: 0323297382 / ISBN 13: 9780323297387

REFERENCE BOOKS

1. B.Srilakshmi, B. (2017). *Food Science* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093
2. Sathyanarayana. (2017). *Biochemistry.* Elsevier- ISBN: 9788131236017
3. Karp, G. (2013). *Cell and Molecular Biology.* John Wiley and Sons Inc - ISBN-10 : 111830179X, ISBN-13 : 978-1118301791