DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(Autonomous)
Reaccredited with "A++" by NAAC
College with Potential for Excellence, Linguistic Minority Institution
Affiliated to University of Madras
Gokul Bagh, 833, Periyar E.V.R. High Road, Arumbakkam, Chennai – 600 106.

DEPARTMENT OF BIOCHEMISTRY

MSc Biochemistry

Program code 24

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

Syllabus effective from 2024-25 Batch onwards

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.
PEO2	will have sound foundation in scientific knowledge required to solve practical challenges during their work as a professional.
PEO3	Will possess professional, ethical & effective communication skills and critical thinking and have problem solving ability with multidisciplinary approach.
PEO4	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	**PEO1**	**PEO2**	**PEO3**	**PEO4**	**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

MSc 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

MSc 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, analyze 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	PO1	PO2	PO3	PO4	PO5	PO6
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 M.SC., BIOCHEMISTRY
IM.SC BIOCHEMISTRY

SEMESTER I

Sl. NO	Course category	Course	Credit Distribution				Over all Credits	Total Contact Hours/ Week	Marks		
			L	T	P	S			CI E	ESE	Total
1	Core paper-I	Biomolecules	3	1	0	0	4	4	50	50	100
2	Core paper-II	Intermediary Metabolism	3	1	0	0	4	4	50	50	100
3	Core paper-III	Human Physiology and Nutrition	4	0	0	0	4	4	50	50	100
4	Core paper-IV	Enzymes	3	1	0	0	4	4	50	50	100
5	Elective I	A)Membrane Biochemistry B)Plant Biochemistry C) Stem cell biology	3	0	0	0	3	4	50	50	100
6	Core Practical I	Core Practical I - Biomolecules and Intermediary metabolism	0	0	3	0	3	5	50	50	100
7	Core Practical II	Core practical II -Enzymes and Nutritional Biochemistry	0	0	3	0	3	5	50	50	100
8	Soft Skill	Soft Skill I	2	0	0	0	2	-	50	50	100
Total							**27**	**30**	**400**	**400**	**800**

IM.SC BIOCHEMISTRY

SEMESTER II

Sl. No	Course category	Course	Credit Distribution				Over all Credits	Total Contact Hours /Week	Marks		
			L	T	P	S			CIE	SEE	Total
1	Core Paper- V	Analytical Biochemistry	3	1	0	0	4	5	50	50	100
2	Core Paper- VI	Molecular Biology	3	1	0	0	4	5	50	50	100
3	Extra Disciplinary paper I	Bioinformatics	2	0	1	0	3	5	50	50	100
4	Elective paper II	A) Nanotechnology B)Fundamentals of Forensic science C) Molecular Endocrinology	3	0	0	0	3	5	50	50	100
5	Elective Paper –III	A)Bioethics, IPR & HR B) Developmental biology C) Biochemical pharmacology & toxicology	3	0	0	0	3	5	50	50	100
6	Core Practical III	Core Practical III - Analytical Biochemistry , Molecular biology and Bioinformatics	0	0	3	0	3	5	50	50	100
7	Internship	Summer Internship will be carried out during the summer vacation of the first year (II Semester) for 4 weeks in any hospital/industry/Research institute. Credits will be included in the third Semester Marks Statement					-	-	-	-	-
8		Soft Skill	-	-	-	-	2	-	50	50	100
TOTAL							**22**		**350**	**350**	**700**

II M.SC BIOCHEMISTRY

III SEMESTER

Sl. NO	Course category	Course	Credit Distribution				Overall Credits	Total Contact Hours /Week	Marks		
			L	T	P	S			CIA	ESE	Total
1	Core paper VII	Advanced Clinical biochemistry	4	0	0	0	4	4	50	50	100
2	Core paper VIII	Biotechnology	4	0	0	0	4	4	50	50	100
3	Core paper IX	Microbiology	4	0	0	0	4	4	50	50	100
4	Core paper X	Immunology	4	0	0	0	4	4	50	50	100
5	Open Elective	Healthcare Management	3	0	0	0	3	4	50	50	100
6	Core Practical IV	Core practical IV - Advanced Clinical Biochemistry	0	0	3	0	3	5	50	50	100
7	Core Practical V	Core Practical V Microbiology, Immunology and Biotechnology	0	0	3	0	3	5	50	50	100
8	Internship		-	-	-	-	2	-	50	50	100
9	Soft Skill	Soft Skill III	2	0	0	0	2	-	50	50	100
Total							**29**		**450**	**450**	**900**

II M.SC BIOCHEMISTRY
IV SEMESTER

Sl. NO	Course category	Course	Credit Distribution				Over all Credits	Total Contact Hours /Week	Marks		
			L	T	P	S			CIE	ESE	Total
1	Extra disciplinary paper II	Biostatistics and Research Methodology	3	0	0	0	3	4	50	50	100
2	Elective Paper IV	A)Gene editing and gene therapy B)Molecular basis of diseases and therapeutic strategies C) Nutrigenomics	3	0	0	0	3	4	50	50	100
3	Core Project	Project-Dissertation	1	0	4	0	5	22	50	50	100
4	Part - IV	Soft Skill IV	2	0	0	0	2	-	50	50	100
TOTAL							**13**	**30**	**200**	**200**	**400**

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	10 x 4	40
2.	Core Practical	5 x 3	15
3.	Elective Paper(4) Extra disciplinary(2) Open Elective(1)	7x 3	21
4.	Soft Skill	4 x 2	08
5	Summer Internship	1 x 2	02
6	Core project	1 x5	05
TOTAL			**91**

TOTAL NO OF CREDITS :91

Value added course 30 hours/ 2 Credits

IM.SC., BIOCHEMISTRY

FIRST SEMESTER

Course Title: BIOMOLECULES (CORE PAPER I)

Course code	**2424101**	**Credits**	**04**
L:T:P:S	**3:0:1:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

Course Outcomes: 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 physicochemical properties of carbohydrates, from monosaccharides to polysaccharides, relate the importance of sugar derivatives and bacterial cell wall polysaccharides
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	COs
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 amino acid - 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-loop helix, 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 – hypo chromicity, 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 and sesqueterpenes, c arotenes 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 .

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

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

I M.SC.,BIOCHEMISTRY

FIRST SEMESTER

Course Title: INTERMEDIARY METABOLISM(CORE PAPER II)

Course Code	**2424102**	**Credits**	**04**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 produce ATP 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 thromboxane.
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 of glycogen, Pentose Phosphate Pathway	**17**	**CO1**
MO2	**LIPID METABOLISM**- Biosynthesis of FA, sphingolipids, phosphor glycerides - 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 amino acid 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

I M.SC.,BIOCHEMISTRY
FIRST SEMESTER

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

Course code	**2424103**	**Credits**	**04**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 hemoglobin, 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	**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.	**15**	**CO1**
MO2	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.	**15**	**CO2**
MO3	**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	Definition of **Nutrition;** Basic food groups. Nutritional Aspects of carbohydrates- Dietary sources, RDA, Physiological role; significance of fiber 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.	**15**	**CO4, CO5**
MO5	**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.	**15**	**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

I M.SC.,BIOCHEMISTRY

FIRST SEMESTER

Course Title: ENZYMES (Core paper IV)

Course code	**2424104**	**Credits**	**04**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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	Analyze and interpret the graphs based on kinetics data. Identification of Enzyme specificity of unknown samples using MM- Equation or by LB plot. Differentiation 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-competitive and uncompetitive 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 and specific 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 –base catalysis, Metal ion and proximity orientation effects	**17**	**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 inhibitors (with kinetic derivations). Coenzymes in enzyme catalysis : Reactions involving NAD/NADP, FMN/FAD, Coenzyme A, biotin, lipoamide, TPP, pyridoxal phosphate, Tetra hydro folate and cobamide.	**15**	**CO4**
MO5	Immobilization of enzymes and their industrial applications – abzymes – ribozymes – Medical application of enzymes - use of glucose oxidase in enzyme 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 .

I M.SC., BIOCHEMISTRY

FIRST SEMESTER

Course Title: MEMBRANE BIOCHEMISTRY (Elective Paper - IA)

Course Code	**2424105 (A)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 bio membranes - 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 bio membrane - 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

IM.SC., BIOCHEMISTRY

FIRST SEMESTER

Course Title: PLANT BIOCHEMISTRY- (ELECTIVE PAPER IB)

Course code	**2424105(B)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 Antioxidant 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 impact on plant growth and metabolism, criteria of stress tolerance.	**15**	**CO4, CO5,**
MO5	Antioxidative defence system 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: 978012088391

I M.SC., BIOCHEMISTRY

FIRST SEMESTER

Course Title: STEM CELL BIOLOGY (ELECTIVE PAPER I C)

Course code	**2424105C**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 stem cells 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 Stem cell 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

S.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 hematopoietic 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 transplantation, 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.

M.SC., BIOCHEMISTRY

FIRST SEMESTER

CORE PRACTICAL-I - BIOMOLECULES AND INTERMEDIARY METABOLISM

Course code	**2424106**	**Credits**	**03**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**06**	**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	Analyze the extraction method for lipid and starch
CO4	Learn the isolation and estimation of DNA and Glycogen from biological sources
CO5	Demonstrate the iodine number and saponification number of edible oil

Mapping of Course Outcomes to Program Specific Outcomes:

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

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

S.No	Experiments	CO Number
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	

RECOMMENDED BOOKS

1. S. K. Sawhney and Randhir Singh Introductory Practical Biochemistry Narosa publishing houseReprint, 2014
2. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publishers Third edition 2018
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
4. Shalini Sehgal, A Laboratory manual of food analysis -Paper Back Dream tech press,2020
5. Dr. G. Sattanathan, , Dr. S.S. Padmapriya, Dr.B. Balamurali krishnan,Practical Manual of Biochemistry, Sky fox Publishing Group Sky fox Press #987, Medical College Road Thanjavur-613004 Tamil Nadu, India. First Edition : December 2020

I MSC BIOCHEMISTRY

SEMESTER I

CORE PRACTICAL-II – ENZYMES AND NUTRITIONAL BIOCHEMISTRY

Course Code	**2424107**	**Credits**	**03**
L: T:P:S:	**0:0:3:0**	**CIA marks**	**50**
Hours	**06**	**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 them
CO 3	Estimate Protein, Iron, Calcium, Riboflavin, Thiamine, and Ascorbic acid from different sources.

Mapping Course Outcomes with Program specific Outcomes

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

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

S.No	CONTENTS	CO's
1	Determination of optimum pH of Salivary amylase	CO1-CO3
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	Estimation of protein from food sample	
7	Estimation of Iron from food sample	
8	Estimation of calcium from food sample	
9	Estimation of Ascorbic acid from food sample	
Demonstration experiments		
10	Estimation of Riboflavin by Spectro fluorimetry	
11	Separation of LDH isoenzymes by native gel electrophoresis	

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

4.Shalini Sehgal,A Laboratory manual of food analysis -Paper Back Dreamtech press,2020

IM.SC., BIOCHEMISTRY

SECOND SEMESTER

Course Title: ANALYTICAL BIOCHEMISTRY (CORE PAPER V)

Course code	**2424208**	**Credits**	**04**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 the 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 spectro fluorimetry Interpret the molecular weight of compounds using mass spectrometry
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 : 978-1-07

I M.SC., BIOCHEMISTRY

SECOND SEMESTER

Course Title: MOLECULAR BIOLOGY (CORE PAPER VI)

Course code	**2424209**	**Credits**	**04**
L:T:P:S	**3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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, mono cistronic 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.Donald Voet, 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

I M.SC., BIOCHEMISTRY
SECOND SEMESTER

Course Title : EXTRA DISCIPLINARY I- BIOINFORMATICS

Course code	**2424210**	**Credits**	**03**
L:T:P:S	**2:0:1:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 classify biological database and to correlate the different file formats used by nucleic acid and protein database, pathway database and structural database.
CO3	To discuss the concepts of alignment and to develop algorithms for interpreting biological data
CO4	To analyze phylogenetic tree and methods of construction of phylogenetic tree.
CO5	Understand the properties of Drugs and design drugs using computer tools.

Mapping of Course Outcomes to Program Specific 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,) – Features of MS WINDOWS, use of internet, email, search engines (Google, yahoo)	**15**	**CO1**
MO2	Bioinformatics: genomics, proteomics, metabolomics, transcriptomics, homologs, orthologs and paralogs (Definitions only). Introduction to Biological databases: nucleotide databases (NCBI, Gen bank , EMBL, DDBJ) protein databases (Swiss prot, TrEMBL,), metabolic pathway database (KEGG), Structural databases-PDB, Specialized data base(COG, BRENDA)	**10**	**CO2**
MO3	Alignments- - sequence alignment –global alignment, local alignment; BLAST- Features-types- BLAST P,BLAST N, BLAST X ,Scoring matrices – Dot plot, PAM & BLOSUM matrices. Alignment algorithms-Needleman Wunch Algorithm, Smith Waterman Algorithm	**15**	**CO3**
MO4	Phylogenetic trees- concept of dendrogram 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.Lesk, A. (2014). *Introduction of Bioinformatics.* Oxford University Press - ISBN 10: 0198724675 / ISBN 13: 9780198724674

2.Ramsden, J. (2015). *Bioinformatics-An Introduction.* Springer - ISBN 978-1-4471-67020

3.Andreas D. Baxevanis, G. D. (2020). *Bioinformatics.* Wiley - ISBN 10: 0471478784 / ISBN 13: 9780471478782

I M.SC., BIOCHEMISTRY
SECOND SEMESTER

Course title: NANOTECHNOLOGY -ELECTIVE PAPER II A

Course code	**2424211 (A)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

On the successful completion of the course, student will be able to

Course outcome	Course outcome statement
CO1	Understand the history of nanotechnology, Properties of nanoparticles, types and its types
CO2	Explain the bottom up and top down approaches and synthesis of nanoparticles
CO3	Gain knowledge on the characterization of nanoparticles using Microscopy techniques such as SEM, TEM, AFM, STM
CO4	Illustrate the surface modification of biomolecules and conjugation to nanomaterials and to know about Nano-biomimetics
CO5	Describe the treatment of diseases using nanoparticles in nanomedicine and to know about nanotechnology in big data analysis

Mapping of Course Outcomes to Program Specific 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	**Introduction to Nanotechnology;** Nanotechnology and nanoparticles –Definition, Scope and its importance-Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales. Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes). Applications of nanotechnology	**15**	**CO1**
MO2	**Nanomaterials Synthesis**: Top down and bottom up synthesis -Gas, liquid, and solid phase synthesis of nanomaterials; Polymers in nano material synthesis- natural and synthetic polymers. Metals used in nanomaterial synthesis, Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials -Green synthesis.	**15**	**CO2**
MO3	**Characterization techniques :**Characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. XRD, FTIR	**15**	**CO3**
MO4	**Biomolecules and biomimetics :**Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nano fluidics to solve biological problems. Nano-biomimetics.	**15**	**CO4**
MO5	**Nanocarriers**: Properties of nanocarriers; drug delivery systems used in nanomedicine; Role of nano particles in drug delivery. Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.	**15**	**CO5**

RECOMMENDED BOOK(S)

1. Bio-nanotechnology Concepts and applications. Madhuri Sharon, MaheshwarSharon, Sunil Pandey and Goldie Oza Ane Books Pvt Ltd, 1 edition 2012.

2. Nanobiotechnology: Bioinspired Devices and Materials of the Future by Oded Shoseyovand Ilan Levy, Humana Press; 1 edition 2007.

3 .Microscopy Techniques for Material Science. A. R. Clarke and C. N. Eberhardt (Editors) CRC Press. 1st Edition, 2002.

REFERENCE BOOKS

1 .Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer(Editor), Chad A. Mirkin (Editor), Wiley-VCH; 1 edition, 2004.

2. Nanobiotechnology Protocols (Methods in Molecular Biology) by Sandra J Rosenthal and David W. Wright, Humana Press; 1 edition, 2005.

II M.SC., BIOCHEMISTRY
SECOND SEMESTER

Course title: FUNDAMENTALS OF FORENSIC SCIENCE-ELECTIVE PAPER II B

Course code	**2424211 (B)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

CO NUMBER	CO STATEMENT
CO1	Provide methodology of PCR & RFLP
CO2	Apply DNA profiling in Forensic Science
CO3	Differentiate Forensic toxicology and forensic pharmacology
CO4	Critically explain radiation hazards & methods of detection of radiations in specimen
CO5	Describe digital forensics and steps involved in solving cyber crime

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	2	2	2	2	2
CO5	2	2	2	2	2

SNo.	Content of Module	Hrs	Cos
MO1	Forensic Biochemistry - Definition and scope of forensic science.- DNA profiling Introduction, Principle, methodology and role of RFLP and PCR in DNA profiling. Analysis of SNP, Y-STR, Mitochondrial DNA	**12**	**CO1**
MO2	Applications of DNA profiling in disputed paternity cases, Child swapping, Civil immigration, and fossil studies with case studies as examples. Combined DNA Index System (CODIS) Legal and ethical standards for DNA profiling	**12**	**CO2**
MO3	Forensic Toxicology and pharmacology. Scope of Forensic toxicology, Types of poisons, Fate of drug in body samples in fatal and non-fatal cases. Definition of drugs, toxins, and pharmaceuticals. Absorption distribution, Pharmacokinetics, Metabolic pathway of common drugs and poisons, drug toxicity, excretion of drugs and poisons.	**12**	**CO3**
MO4	Radiation Hazards, sources of exposure and contact, acute and chronic effects on the organs of the body, Methods of detection and measurement, Handling and disposal of specimens and tissues containing radioisotopes.	**12**	**CO4**
MO5	Digital Forensics- case scenario-, the evolution of cybercrime, Definition of computer forensics, types of digital forensics, and stages of computer forensics process –identification, collection, examination and reporting cybercrime.	**12**	**CO5**

RECOMMENDED BOOKS

1.Forensic toxicology by Vipul Ambade second edition CBS Publishers & Distributers , India.

2.A text book of Forensic Pharmacy by B.M.Mithal , 2011, ISBN- 978-8185731131, publishers Vallabh Prakasan

3.Understanding the role of DNA Microsatellite in Cancer Diagnosis and Forensic analysis by Dr.Hakim Saboowala, 2019

REFERENCE BOOKS:

1.Principles and techniques of Biochemistry & Molecular Biology by Wilson and Walker,2018, ISBN- 978-1316614761

2.Digital Forensics by Nilakshi Jain & Dhananjay R. Kalbande 2016, Wiley Publishers, ISBN- 978-8126565740

3.Forensic DNA typing: principles, Applications and Advancements-SPRINGER Nature Singapore, 2020,ISBN-9789811566554 Pankaj Srivastava, Hirak Ranjan Dash, Jose A Lorente

MSC BIOCHEMISTRY

SEMESTER II

Course Title: MOLECULAR ENDOCRINOLOGY- ELECTIVE PAPER IIC

Course code	**2424211 (C)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

Course outcome	Course outcome statement
CO1	Classify hormones based on nature, mechanism of action and understand the functions of receptors
CO2	Understand the structure ,biological action and regulation of hypothalamic and pituitary hormone.
CO3	Obtain knowledge on the chemistry and functions of thyroid and pancreatic hormones.
CO4	Student will be able to understand the actions of adrenal hormones.
CO5	Compare the structure and metabolic effects of adrenal hormones.

Mapping of Course Outcomes to Program Specific 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 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	**Hormones**: Definition, Chemical nature and classification. Mechanism of action of Group I and Group II hormones, secondary messengers- G protein, adenyl cyclase, cAMP, Inositol triphosphate and protein kinases. Hormonal receptors- Definition- Adrenergic and cholinergic receptors	**15**	**CO1**
MO2	**Pituitary hormones**- Chemistry, Secretion, Functions and Regulation of Anterior Pituitary hormones - GH, Pituitary tropic hormones (LH, FSH and ACTH) and Posterior Pituitary hormones - Vasopressin and Oxytocin. Hypothalamus and hypothalamic releasing factor	**15**	**CO2**
MO3	**Thyroid hormones** - Biosynthesis, Secretion, Functions and Regulation of T3 and T4. **Pancreatic hormones** – Biosynthesis, Functions and Regulations of Pancreatic hormones (Insulin and Glucagon**)**	**15**	**CO3**
MO4	**Adrenal cortex hormones** (glucocorticoids and mineralocorticoids) - Biosynthesis, Secretion ,Functions **Adrenal medullary hormones** (Epinephrine and Nor-Epinephrine**)**- Biosynthesis, Secretion and Functions.	**15**	**CO4**
MO5	**Gonadal hormones** - Testosterone, Estrogen and Progesterone- structure and function. Ovarian cycle and its regulation.	**15**	**CO5**

RECOMMENDED 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.Shlomo Melmed, 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

Course Material: website links, e-Books and e-journals

Website links:

1..https://www.uc.edu/content/dam/uc/ce/docs/OLLI/Page%20Content/The%20Endocrine%20System.pdf
2https://dosequis.colorado.edu/Courses/MCDB3145/Docs/Karp-617-660.pdf
3.https://courses.lumenlearning.com/suny-ap2/chapter/the-pituitary-gland-and-hypothalamus/
4.https://www.hopkinsmedicine.org/health/conditions-and-diseases/adrenal-glands

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M.SC.,BIOCHEMISTRY

SECOND SEMESTER

Course Title: BIOETHICS, IPR AND HUMAN RIGHTS (ELECTIVE PAPER - IIIA)

Course code	**2424212 (A)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 pf SHRC AND NHRC and Philosophies of Adam smith 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

SNo.	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.	**15**	**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 .	**15**	**CO2**
MO3	Student 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.	**15**	**CO3**
MO4	Bioethics- Definition; Ethical concerns regarding transgenesis. 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.	**15**	**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.	**15**	**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

I MSC BIOCHEMISTRY
SEMESTER II

Course Title: DEVELOPMENTAL BIOLOGY- ELECTIVE III B

Course code	**2424212 (B)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

Course outcome	Course outcome statement
CO1	Classify hormones based on nature, mechanism of action and understand the functions of receptors
CO2	Understand the structure ,biological action and regulation of hypothalamic and pituitary hormone.
CO3	Obtain knowledge on the chemistry and functions of thyroid and pancreatic hormones.
CO4	Student will be able to understand the actions of adrenal hormones.
CO5	Compare the structure and metabolic effects of adrenal hormones.

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION : 3-STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs
MO1	Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants	**15**
MO2	Gametogenesis and Fertilization: Production and structure of gametes, cell surface molecules in sperm egg recognition in animals, , fast and slow block to polyspermy, zygote formation	**15**
MO3	Activation of sperm and egg– interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes. acrosome reaction .Post–fertilization changes.	**15**
MO4	Embryo development- cleavage-types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis	**15**
MO5	Aging and Senescence: Biology of aging & Senescence, Programmed cell death.	**15**

REFERENCE BOOKS:

1. Gilbert, Scott's. 10 edition (2014). Developmental biology. Sinauer Association, Inc., Publishers.

2. Chattopadhyay.S. 2016. An Introduction to Developmental Biology, Books and Allied (P) Ltd, Kolkata. First Edition.

I MSC BIOCHEMISTRY

SECOND SEMESTER

Couse Title: BIOCHEMICAL PHARMACOLOGY AND TOXICOLOGY ELECTIVE IIIC

Course code	**2424212 (C))**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

Course outcome	**Course outcome statement**
CO1	To understand about basic principles involved in pharmacokinetics and routes of drug administration processes.
CO2	To gain knowledge on metabolism and excretion of drugs K1, K2
CO3	To understand mechanism of drug action, drug receptor interactions, Factors affecting the drug receptor interaction
CO4	To obtain knowledge on drug discovery process, ethical issues and able to understand the scope and applications of AI in drug discovery
CO5	To gain knowledge in preclinical toxicological studies

Mapping of Course Outcomes to Program Specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	2	2
CO2	3	3	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
MO1	**Drug metabolism:** Drug, Definition-Basic principles of drug action-Pharmacokinetics: Absorption, distribution , metabolism(Phase I and Phase II reactions) and elimination of drugs, First BY pass effect. Various routes of drug administration-conventional and nonconventional routes of drug administration.	**15**
MO2	**Pharmacodynamics** - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs.	**15**
MO3	**Phytochemicals & allopathic drugs**-Classification-Flavonoids, alkaloids, saponins, tannins and glycosides-Structures and functions, their use as medicine. Allopathic drugs for treatment of fever & Pain, Ulcer, asthma, diabetes and cancer. Antibiotics (Pencillin, Chloramphenicol and streptomycin). Drugs for Skin infections. COVID drugs	**15**
MO4	**Application for New Drug Discovery (NDD)** according to Indian Control Authority and USFDA guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki‟s declaration. Regulatory requirements for conducting clinical trials. Overview of drugs and cosmetics act. Regulatory process for export of pharmaceutical products and medicines from India.	**15**
MO5	**Toxicology:** Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non metallic environmental toxicants. Role of Artificial intelligence in drug discovery. Preclinical toxicological studies: Calculation of LD50 and ED50.Acute, subacute and chronic toxicity studies; Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski‟s rule for drug like molecule, High throughput screening (in-vitro and in-vivo) for pre-clinical pharmacokinetic and pharmacodynamic studies	**15**

. **RECOMMENDED BOOK(S)**

1.Satoskar, R.S and Bhandarkar, S.D. (2000) Pharmacology and Pharmacotherapeutics, 13th edition, Vol. I and II, Popular Prakeshan PVT Ltd, Mumbai.

2.Tripathi, K.D. (2013) Essentials of Medical Pharmacology, 7th edition, Jaypee brothers medical publishers, New Delhi.

3.Rang, H.P., Dale, M.M., Ritter, J. and Flower, R.J. (2007) Pharmacology, 6th edition, Churchill Living Stone Elsevier

4.Brenner, G.M. and Stevens, C.W. (2010) Pharmacology, Reed Elsevier India Pvt. Ltd.

5.Sharma, P.D. (2003) Toxicology, 2nd edition, Rastogi Publications, Meerut.

REFERENCE BOOKS

1.Barar, F.S.K. (2013) Text Book of Pharmacology, 1st edition, S.Chand and Company Pvt. Ltd.

2.Shargel,L. et al., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6 th Edition, McGraw-Hill Medica

I MSC BIOCHEMISTRY

II SEMESTER

Course title : CORE PRACTICAL III-

ANALYTICAL BIOCHEMISTRY ,MOLECULAR BIOLOGY AND BIOINFORMATICS

Course code	**2424213**	**Credits**	**03**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**06**	**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	Isolate DNA and RNA from plant/ animal source and Estimate.
CO 3	Determine the molecular weight of protein by standard electrophoretic technique ,namely SDS PAGE

Mapping Course Outcomes with Program specific 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

CORRELATION : 3-STRONG 2- MEDIUM 1- LOW

S.No	CONTENTS	CO's
1	Separation of identification of amino acids and sugars by paper chromatography	CO1-CO3
2	Separation of identification of lipids by thin layer chromatography	
3	Separation and identification of plant pigment by column Chromatography	
4	Determination of melting temperature Tm and % GC content of DNA sample	
5	Isolation and estimation of DNA from animal tissue / Plant / Bacteria	
6	Isolation and estimation of RNA from yeast	
7	To retrieve the nucleotide/ protein sequence of interest from biological database	
8	Retrieval of protein structure using PDB and identification of its active site using RASMOL	
9	Homology search- BLAST n/ p	
Demonstration experiments		
10	Determination of molecular weight of the proteins by SDS PAGE	
11	Protein motif and domain analysis using Prosite	

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 : 978-110871698

II M.SC., BIOCHEMISTRY

THIRD SEMESTER

Course Title: ADVANCED CLINICAL BIOCHEMISTRY (CORE PAPER VII)

Course code	**2424314**	**Credits**	**04**
L:T:P:S	**4:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 intervention on 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 – hyper lipoproteinemias 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**

RECOMMENDED 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

II MSC BIOCHEMISTRY

THIRD SEMESTER

Course Title: BIOTECHNOLOGY (CORE PAPER – VIII)

Course code	**2424315**	**Credits**	**04**
L:T:P:S	**4:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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.	**15**	**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)	**15**	**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.	**`15**	**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.	**15**	**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.	**15**	**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

IIM.SC., BIOCHEMISTRY
THIRD SEMESTER

Course Title: Core paper IX -MICROBIOLOGY

Course code	**2424316**	**Credits**	**04**
L:T:P:S	**4:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

CO1	Acquire knowledge on the history of microbiology and the instrumentation of microscopy
CO2	Gain knowledge on the ultrastructure of bacteria and the transfer of genetic information.
CO3	Acquire knowledge on the normal microbial flora and types of infections.
CO4	Develop a lucid understanding of various industrial products using microbes.
CO5	Acquire, invent and practice, the theories and principles of food microbiology in currentworldwide 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	3	2	3	3	3
CO2	3	2	1	3	3
CO3	3	2	3	3	2
CO4	3	3	2	3	3
CO5	3	3	2	3	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

	Content of Module	Hrs	CO
MO1	**Introduction to Microbiology** History and scope of Microbiology. Germ theory of disease, Koch's postulates. Microscopy – principle and applications bright field, dark field, fluorescence, phase contrast and electron microscopes. Principle and uses of simple, differential, negative and spore staining techniques. Carl Woese's three domain system of classification. Major groups of bacteria- Archaebacteria, Eubacteria	**15**	**CO1**
MO2	**Structural features of prokaryotes** Ultrastructure of bacteria. 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.DNA organization, extra chromosomal genetic elements – transfer ofgenetic information, conjugation,Hfr strains, transformation and transduction. General characteristics of fungi, algae and protozoa.	**15**	**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,Mycobacterium* and HIV	**15**	**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. Bioremediation. Fermented foods - cheese, yoghurt, pickles, bread. Water Microbiology – microbes in waste treatment-Domestic and industrial. Bacteriological analysis of water.	**15**	**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 (Fundamentals only)	**15**	**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 ISBN13: 9781847558565

2.W.C, F. (2014). *Food Microbiology.* Mc Graw Hill Boston - ISBN-10 : 1259281590 / ISBN13 : 978-1259281594

IIM.SC., BIOCHEMISTRY
THIRD SEMESTER

Course Title: IMMUNOLOGY (CORE PAPER X)

Course code	**2424317**	**Credits**	**04**
L:T:P:S	**4:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 specific Outcomes:

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

II M.SC., BIOCHEMISTRY

THIRD SEMESTER

COURSE TITLE: HEALTHCARE MANAGEMENT (OPEN ELECTIVE PAPER)

Course code	**2424318**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 analyze 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:

	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**

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.	**15**	**CO1**
MO2	Health care systems in India ,Health planning in India including various committees and national health policy and health goals set from time to time . publication 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.	**15**	**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	**15**	**CO3**
MO4	Hospital operation management- Management of Indian hospitals- challenges & strategies. Modern techniques 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	**15**	**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.	15	**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

II MSC BIOCHEMISTRY

THIRD SEMESTER

Course Title CORE PRACTICAL IV- ADVANCED CLINICAL BIOCHEMISTRY

Course code	**2424319**	**Credits**	**03**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**06**	**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

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

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 serum 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

IIMSC BIOCHEMISTRY

THIRD SEMESTER

Course Title CORE PRACTICAL V-

MICROBIOLOGY , IMMUNOLOGY AND BIOTECHNOLOGY

Course code	**2424320**	**Credits**	**03**
L:T:P:S	**0:0:3:0**	**CIA Marks**	**50**
Exam Hours	**06**	**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	Examine the microbiological quality of milk,water and food
CO4	Analyze the sensitivity of bacteria towards antibiotics
CO5	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**
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

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No	Contents	CO's	Hrs
1	Biochemical characterization -Screening test a) Amylase b) Protease	CO1-CO5	**45**
2	Bacteriological analysis of water by standard plate		
3	Bacteriological analysis and identification of quality of milk		
4	Microbiological examination of food		
5	ABO blood grouping and Rh factor typing by slide agglutination Test		
6	Complement fixation test		
7	Quantitative determination of antigen -Single Radial Immuno diffusion		
8	Quantitative determination of antigen -Double Immuno diffusion		
9	Antibiotic sensitivity Test		
10	Extraction of Plasmid DNA and Agarose Gel Electrophoresis		
	Demonstration Experiments		
11.	Purification of Antibody IgG by Ion exchange chromatography		
12	Identification of gene expression by RTPCR		
13	Gene cloning		

RECOMMENDED BOOKS

1.Immunology: Overview and Laboratory Manual TobiliSam-Yellow, Springer,1st edition,2020

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

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

II MSC BIOCHEMISTRY

FOURTH SEMESTER

Course Title BIOSTATISTICS AND RESEARCH METHODOLOGY - EXTRA DISCIPLINARY PAPER II

Course code	**2424421**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 of data collection and presentation
CO2	Examine the usage of statistical tools like measure of central tendency, measure of dispersion and infer the results of skewness, kurtosis, correlation and regression
CO3	Evaluate the concept of hypothesis testing and deduce t, z, chi square test and ANOVA to make statistical decision
CO4	Analysis of components of research and factors affecting research design
CO5	Appraisal about thesis writing and scientific conduct

Mapping of Course Outcomes to Program specific Outcomes:

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

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

SNo.	Content of Module	Hrs	Cos
MO1	**Introduction to Statistics**- Definition, scope and limitations of Biostatistics. Statistical Investigations. Types of Data-Primary, Secondary, categorical and numerical data. Methods of Data Collection, Classification, Tabulation of data. Presentation of Data-Graphical (histogram, frequency polygon and ogive) and Diagrammatic representation (bar diagram and pie diagram). Population and Sample. Census and Sampling method- Random Sampling and Non random Sampling.	**15**	**CO1**
MO2	**Statistical Measures**- Statistical Series. Measure of Central tendency– Mean, Median and Mode of grouped and ungrouped data. (problems included). Measure of Dispersion– Range, Quartile deviation, Standard deviation of grouped and ungrouped data. Standard error. (problems included). Measure of skewness and kurtosis. Correlation and regression (concept only)	**15**	**CO2**
MO3	**Tests of Statistical Significance (for the mean)**– Steps involved, null and alternate hypothesis, level of significance, degrees of freedom, critical value, type I & type II errors. Normal distribution. Properties, application and limitations of Z test, Student's t test, Chi square test, ANOVA (One way). Use of MS Excel and SPSS in Statistical analysis.	**15**	**CO3**
MO4	**Fundamentals of Research**- Definition, Objectives of research , general characteristics of research. Types of research: Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, Empirical. Problems encountered in research. Research design- contents and types of research design, factors affecting research design. Steps in research design	**15**	**CO4**
MO5	**Thesis Writing and Scientific Conduct-**Thesis- Components of a thesis – format for writing thesis (Abstract, introduction, review of literature, materials and methods and discussion), reference styles (APA, Chicago, MLA). Layout of a Research Paper. Impact factor of Journals. Research misconduct- Falsification, Fabrication, and Plagiarism (FFP) Definition, consequences, Preventive measures. Antiplagiarism open software-quill bot.	**15**	**CO5**

TEXT BOOKS/REFERENCE BOOKS:

1. Ramakrishnan.P. (2015). *Biostatistics.* Saras publication - ISBN-10 : 9384826049 / ISBN-13 : 978-9384826048
2. Pranabkumar Banerjee. (2011). *Introduction to Biostatistics.* S.Chand& Co Ltd -
3. Sundaram. (2014). *Medical Statistics.* Wolters Kluwer India Pvt. Ltd -
4. Gurumani, N. (2006). *Research Methodology for Biological Science.* MJP Publisher - ISBN 10: 8180940160 / ISBN 13: 9788180940163
5. Jerrold H Zar, (2003) *Biostatistical analysis* – Pearson Publishers Fourth Edition , First Indian Reprint
6. S. P. Gupta (2012) *Statistical Methods*, ,Sultan Chand & Sons ,ISBN10: 8180549313,ISBN-13: 978-8180549311

7. Kothari CR (2004).*Research methodology*: methods and techniques, 2nd edition-, New Age International (P) Ltd Publishers, New Delhi,

WEB LINKS:

1.https://testbook.com/learn/maths-mean-median-mode/
2.https://web.cortland.edu/andersmd/STATS/corr.html
3https://en.wikipedia.org/wiki/Normal_distribution
4.https://www.investopedia.com/terms/a/anova.asp
5.https://towardsdatascience.com/the-statistical-analysis-t-test-explained-for-beginners-and-experts-fd0e358bbb62

II MSC BIOCHEMISTRY

SEMESTER IV

Course Title : GENE EDITING and GENE THERAPY -ELECTIVE PAPER IV A

Course code	**2424422(A)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

Course outcome	Course outcome statement
CO1	Ability to read, and evaluate scientific articles within the subjects of immune therapy, gene therapy and cell therapy.
CO2	To clone gene of their interest for several downstream purposes with a robust comprehension about wide variety of applicable gene delivery vectors.
CO3	Provide examples of diseases that can be treated with immune therapy, gene therapy and cell therapy.
CO4	Identify knowledge gaps and need for further research within their chosen topic of immune therapy, gene therapy or cell therapy.
CO5	Critically discuss and reflect on ethical and social aspects of using immune, gene or cell therapy. The student will be persuaded to contemplate on upcoming technologies for futuristic benefits.

Mapping of Course Outcomes to Program Specific Outcomes:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	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 1- LOW

SNo.	Content of Module	Hrs	Cos
MO1	**Gene Editing:** Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, Nonhomologous End-Joining (NHEJ), Homology directed repair, Programmable nucleases for gene editing, Meganucleases, Zinc-Finger nucleases, Transcription Activator-Like Effector Nucleases (TALEN), CRISPR-Cas systems, gene editing using CRISPR-Cas	**15**	**CO1**
MO2	**Gene and cell therapy:** Basics of Gene and cell therapy, types of gene therapy, gene therapy strategies, therapeutic targets for gene therapy, choice of the therapeutic target, administration routes, delivery systems, expression of transgene, persistence of the gene therapy, cell targeting, immunological response to the therapy	**15**	**CO2**
MO3	**Vectors for Gene therapy:** Non-viral and viral vectors for gene therapy, Physical methods of gene delivery, Polymer, Lipid and inorganic material based chemical systems for gene delivery, Viral vectors, Lentiviral, Adenoviral, Adeno-associated virus, Gene therapy applications, Gene therapy for cancer, suicide and oncolytic gene therapy.	**15**	**CO3**
MO4	**Stem cells and tissue regeneration:** Adult and fetal stem cells, embryonic stem cells, cell reprogramming, induced pluripotent stem cells (iPSC), Chemically induced pluripotent stem cells (CiPSC), reprogramming factors, iPSC derived progenitors 'cells, Organoids, three dimensional (3D) bioprinting.	**15**	**CO4**
MO5	**Regulatory and Ethical Considerations of stem cell and Gene Therapy,** pluripotent stem cell-based cell replacement therapies. Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies. Technological challenges towards development of pluripotent stem cell-based cell replacement therapies	**15**	**CO5**

RECOMMENDED BOOK

1.Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press

2.Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press

3.Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler,

REFERENCE BOOK

1.An Introduction to Human Molecular Genetics (2nd Edition), J.J. Pasternak, 2005

2.An Introduction to Molecular Medicine and Gene Therapy 1st Edition by Thomas F. Kresina

Upadhyay, S. K. (Ed.). (2021).

3.Human Molecular Genetics (4th Edition), Tom Strachan & Andrew Read, 2010.

4.Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,

IIMSC BIOCHEMISTRY

FOURTH SEMESTER

Course Title: ELECTIVE IVB- MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES

Course code	**2424422 (B)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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

CO NUMBER	CO Statement
CO1	Identify the the risk factors that contribute to diabetes mellitus and overall view about the complications of diabetes mellitus and its management.
CO2	Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts.
CO3	Analyze and understand the pathophysiology of conditions that affects the nervous system
CO4	Relate the renal diseases with emphasis related to mechanistic aspects and therapeutic interventions.
CO5	Use biochemical and molecular tools for diagnostic and therapeutic intervention on hereditary and acquired disorders.

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
CO6	3	3	3	1	3

CORRELATION : 3-STRONG 2- MEDIUM 3- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Glucose homeostasis- Mechanism of blood sugar regulation, Pathophysiology of diabetes mellitus, Diabetes – investigation methods. Nutritional care. Complications related to diabetes – Diabetic cardiovascular disease, retinopathy, neuropathy and nephropathy. Management of Type I and Type II diabetes. Oral anti diabetic treatment of diabetes.	**15**	**CO1**
MO2	Biology of cancer: Overview of cancer. Tumorigenesis,Tumor progression and mechanism of Metastasis. Proto-oncogene to oncogene. Oncogene- myc and src family. Tumor suppressor gene-Rb and p53 pathway in cancer. Diagnosis- Non-invasive imaging techniques, Tumor diagnosis, Interventional radiology, New imaging technique, Molecular techniques in cancer diagnosis.- treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy. Drugs for cancer.	**15**	**CO2**
MO3	Brain- neuronal network- memory- Neurogenerative diseases- Parkinson and Alzheimer Disease- molecular understanding of the neurodegenerative diseases- treatment modalities.	**15**	**CO3**
MO4	Acute and chronic renal failure, glomerular diseases–glomerulonephritis, nephritic syndrome, diagnosis of kidney diseases, Dialysis, hemo and peritoneal dialysis.	**15**	**CO4**
MO5	Introduction to cardiovascular diseases, Lipids and lipoproteins in coronary heart disease-cardiac enzymes, Molecular changes during cardiac remodeling, hypertrophy of hearts – heart failure- treatment modalities. Hypolipidemic agents.	**15**	**CO5**

RECOMMENDED BOOKS:

1. Kaplan. (2010). *Clinical Biochemistry* (6th ed.). Mosby - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846
2. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders
3. Wills' Biochemical Basis of Medicine: 2nd edition, Thomas H, Gillham B;Elsevier
4. Molecular Biochemistry of Human Diseases,2021, Feuer G ,de la Iglesia F; CRC Press
5. Chatterjee Ranashinde. (2012). *Medical Biochemistry(8th ed).* Jaypee - ISBN : 9789350254844

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 ClinicAspects- ISBN 10: 0702051403 / ISBN 13: 9780702051401

II MSC BIOCHEMISTRY

FOURTH SEMESTER

Course Title: NUTRIGENOMICS - ELECTIVE PAPER IV C

Course code	**2424422 (C)**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIA Marks**	**50**
Exam Hours	**03**	**ESE Marks**	**50**

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 specific Outcomes:

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

Correlations : 3 Strong 2 Medium 1 Low

Module	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 aging. Nutrition, 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 Analysis .Genetics Vs. Genomics	10	CO2
MO3	Nutrigenomics – Introduction -Rationale and aims of Nutrigenomics - Genes associated with various diseases- Genes associated with Lipid Metabolism, Antioxidant ,Function 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 acids. Effect 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 lipo toxicity – Biomarkers - Genetic Tests – Ethical Issues	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/projects/GeneTests/static/about/whatis/mission.shtml