DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
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College with Potential for excellence
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DEPARTMENT OF BIOCHEMISTRY

BSc Biochemistry

Program code 11

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

Syllabus effective from 2022-23 Batch onwards

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Course Title: ALLIED PRACTICAL -IV -MICROBIOLOGY-II

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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)
UNDER GRADUATE

Our programme will produce graduates who

PEO l	have a strong foundation to pursue higher academic degree of his /her choice.
PEO2	be well informed of the job/career option in healthcare and life science based e-sector jobs.
PEO3	Will exhibit effective communication and will be capable of working in teams.
PEO4	Will adopt ethical attitude towards social challenges and will be responsible towards environmental issues.

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

PO FOR B.Sc BIOCHEMISTRY

By the end of the programme, the graduates will be able to	
PO1	To participate in various types of employment, development activities and public discourses particularly in response to the needs of the community one serves
PO2	To understand the need and have the competencies to support local, regional and national development
PO3	To develop critical and analytical thinking
PO4	To develop conceptual understanding , problem solving and application of skills
PO5	To provoke entrepreneurship among the students along with strong ethics and communication skills
PO6	To develop a questioning mind in diverse environments for better outcomes
PO7	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	PO 6	PO7
PEO 1	3	3	3	3	3	3	3
PEO 2	3	3	3	3	3	3	3
PEO 3	3	3	3	3	3	3	3
PEO 4	3	3	3	3	3	3	3
PEO5	**2**	**2**	**2**	**2**	**2**	**2**	**2**

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

PROGRAM SPECIFIC OUTCOMES (PSO) IN RELATION TO GRADUATE ATTRIBUTES

B.Sc BIOCHEMISTRY

After successful completion of 3years BSc programme the students will be able to	
PSO1	Become knowledgeable in the field of Biochemistry and apply the principles of the same to the needs of the Employer / Institution
PSO2	Gaining a wide knowledge on role of proteins, carbohydrates, nucleic acids, enzymes in the cell with their clinical importance.
PSO3	Acquiring analytical and hands on skills to perform research in the area of Biochemistry.
PSO4	Students will be able to comprehend the knowledge in the biochemical, analytical, biostatistical , computational areas.
PSO5	Integrating the concepts of Metabolism, Clinical Biochemistry, and Immunology, nutritional to illuminate acquaintance on health and disease.
PSO6	Use library search tools to locate and retrieve scientific information about a technique or topic related to biochemistry Use online data bases and source appropriately to study genetic disease Equipped to record and interpret digital data
PSO7	Identify problems related to environment. Analyze and derive valid conclusions with contemporary knowledge in biochemistry and computers

Mapping of POs TO PSOs (BSc Program)

PSO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
PSO 1	3	3	3	3	3	3	3
PSO 2	2	3	2	3	3	3	1
PSO 3	3	2	3	3	2	2	2
PSO 4	2	2	2	2	1	1	1
PSO 5	3	2	3	3	3	1	3
PSO 6	3	1	3	3	1	3	3
PSO 7	2	3	3	3	2	3	3

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

SCHEME OF SEMESTER B.Sc., PROGRAM
B.Sc I SEMESTER

Part	Course Category	Course	Credit Distribution				Overall Credits	Total Contact hours	Marks		
			L	T	P	S			CIA	ESE	Total
Part –I	Ability enhancement compulsory skills	Language –I	4	0	0	0	3	5	50	50	100
Part –II	Ability enhancement compulsory skills	English –I	4	0	0	0	3	5	50	50	100
Part III	Core	Nutritional Biochemistry 2211101	3	0	1	0	4	5	50	50	100
	Allied	Chemistry- I 2211102	3	1	0	0	3	6	50	50	100
	Major Practical I	Practical I Nutritional Biochemistry - 2211104	0	0	3	0	2	3	50	50	100
	Allied Practical I	Chemistry Practical –I 2211105	0	0	3	0	2	3	50	50	100
Part IV	NME	Basics of Medical Terminologies 2211103	4	0	0	0	2	2	50	50	100
	Soft Skills	Soft Skills – I					3	1	50	50	100
Total							**22**	**30**	**400**	**400**	**800**

SCHEME OF I B.Sc., BIOCHEMISTRY

SEMESTER II

Part	Course Category	Course	Credit Distribution				Overall Credits	Total Contact hours / week	Marks		
			L	T	P	S			CI A	ESE	Total
Part I	Ability enhancement compulsory skills	Language – II	4	0	0	0	3	5	50	50	100
Part II	Ability enhancement compulsory skills	English –II	4	0	0	0	3	5	50	50	100
Part III	Core paper - II	Cell Biology 2211206	3	0	1	0	4	6	50	50	100
	Core Practical I	Major practical –II Cell Biology 2211209	0	1	3	0	2	3	50	50	100
	Allied II	Chemistry II 2211207	4	0	0	0	3	5	50	50	100
	Allied practical II	Allied Chemistry Practical –II 2211210	0	0	3	0	2	3	50	50	100
Part IV	NME II	Prevention and management of lifestyle disorders 2211208	2	0	0	0	2	2	50	50	100
	Soft skills	Soft skills II					3	1	50	50	100
TOTAL							**22**	**30**	**400**	**400**	**800**

SCHEME OF II B.Sc., BIOCHEMISTRY

SEMESTER III

Part	Course category	Course	Credit Distribution				Overll Credits	Total contact hours / week	Marks		
			L	T	P	S			CIA	ESE	Total
Part I	Ability enhancement compulsory skills	Language –III	4	0	0	0	3	5	50	50	100
Part II	Ability enhancement compulsory skills	English –III	3	1	0	0	3	5	50	50	100
Part III	Core paper/ skill Enhancement	Chemistry of Biomolecules 2211311	3	0	1	0	4	6	50	50	100
	Allied –II	Microbiology – I 2211312	3	0	0	1	3	6	50	50	100
	Majorpractical III	Major practical –III Chemistry of Biomolecules 2211313	0	0	3	0	2	3	50	50	100
	Allied- practical III	Microbiology -I Practical – III 2211314	0	0	3	0	2	3	50	50	100
Part -IV	Soft Skills	Soft Skills – III	2	0	0	0	3	1	50	50	100
		EVS						1			
Total							**20**	**30**	**350**	**350**	**700**

SCHEME OF II B.SC.,BIOCHEMISTRY

SEMESTER IV

Sl. NO	Course category	Course	Credits Distribution				Over all credits	Total Contact Hours/week	Marks		
			L	T	P	S			CIA	ESE	Total
Part I	Language	Language –IV	4	0	0	0	3	5	50	50	100
Part II	English	English –IV	3	1	0	0	3	5	50	50	100
Part III	Core paper -IV/ skill Enhancement	Biochemical Techniques 2211415	4	0	0	0	4	6	50	50	100
	Core Practical	Core practical –IV Biochemical Techniques 2211417	0	0	3	0	2	3	50	50	100
	Allied-II	Microbiology II 2211416	4	0	0	0	3	6	50	50	100
	Allied-Practical IV	Allied Practical IV Microbiology II 2211418	0	0	3	0	2	3	50	50	100
Part IV		Soft skill II	2	0	0	0	3	1	50	50	100
		EVS					2	1	50	50	100
		Internship/ Field work 2211526A/2211526 B					2		20	30	50
TOTAL							**24**	**30**	**420**	**430**	**850**

NOTE: Internship /fieldwork is offered in summer vacations, the credits and mark will be included in the grade sheet of the subsequent semester(V)

SCHEME OF III B.SCBIOCHEMISTRY

SEMESTER V

Part	Course category	Course	Credit Distribution				Over all Credits	Total Contact hours / week	Marks		
			L	T	P	S			CIA	ESE	Total
Part III	Core paper -V	Enzymes 2211519	3	0	1	0	4	5	50	50	100
	Core paper-VI	Intermediary Metabolism 2211520	3	1	0	0	4	5	50	50	100
	Core paper VII	Human Physiology 2211521	4	0	0	0	4	5	50	50	100
	Core paper-VIII/ skill Enhancement	Molecular Biology 2211522	3	0	1	0	4	5	50	50	100
	Elective paper-I	Principles of Biotechnology 2211523 (A)/ Basic in MLT(B) /Genetics(C)	4	0	0	0	5	4	50	50	100
	Core Practical	Major Practical V-Enzymes & Intermediary Metabolis2211524	0	0	3	0	2	3	50	50	100
	Core Practical	Major Practical VI-MOLECULAR BIOLOGY & PHYSIOLOGY2211525	0	0	3	0	2	3	50	50	100
Part IV	Value Education						2				
						TOTAL	**27**	**30**	**350**	**350**	**700**

SCHEME OF III B.SC., BIOCHEMISTRY

VI SEMESTER

	Course category	Course	Credit Distribution				Over all Credits	Total Contact Hours/Week	Marks		
			L	T	P	S			CIE	ESE	Total
Part III	Core paper-IX	Bioinformatics 22111627	3	0	1	0	4	4	50	50	100
	Core paper-X	Immunology 2211628	4	0	0	0	4	4	50	50	100
	Core paper-XI/ skill Enhancement	Clinical Biochemistry 2211629	4	0	0	0	4	4	50	50	100
	Elective paper-II	Pharmaceutical Biochemistry /2211630(A) Inteelectual property rights (B) / Plant Physiology & Biochemistry(C)	4	0	0	0	5	4	50	50	100
	Elective paper-III	Entrepreneurship in science & Technology2211631(A)/ First Aid(B) / Therapeutic Nutrition(C)	3	1	0	0	5	4	50	50	100
	Core Practical	Major Practical – VII-Clinical Biochemistry 2211632	0	0	3	0	2	3	50	50	100
	Core Practical	Major Practical – VIII Immunology & Bioinformatics 2211633	0	0	3	0	2	3	50	50	100
	Core	Project 2211634					2	4	20	30	50
Part V		Extension activity					1				
TOTAL							**29**	**30**	**370**	**380**	**750**

TOTAL NO OF CREDITS -BSc Biochemistry

Part	**Title**	**No of Subjects x No of credits**	**Total Credits**
I	Language	4X3	12
II	English	4X3	12
III	Core Subjects	11x 4	60
	Core Practicals	8X 2	
	Allied Subjects	4 x 3	20
	Allied Practicals	4 x 2	
	Electives	3X5	15
III	**Internship/ Field work**	**1 x 2**	**2**
	Project	**1 x 2**	**2**
IV	BASIC/ADVANCED TAMIL/NME	2 X2	4
	Soft Skill	4X3	12
	Environmental studies	1X2	2
	Value education	1X2	2
V	Extension Activity	1 x1	1
	Total	**144**	

Extra Credits- Value added courses – 2 Credits / 30 hours

FIRST SEMESTER

Course Title: NUTRITIONAL BIOCHEMISTRY (CORE PAPER –I)

		Credits	**: 04**
L:T:P:S	**: 3:0:1:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

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

CO NUMBER	CO Statement
CO1	Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value
CO2	Identify and explain nutrients in foods and the specific functions in maintaining health.
CO3	Exposure to the nature and biomedical significance of vitamins and minerals present in food
CO4	Analyzing the biological importance of major and minor trace elements (Minerals) inthe food
CO5	Understanding the correlation between importance of nutrients and life style disorders viz. diabetes mellitus, renal failure and cardiovascular diseasesApply knowledge of the role of nutrition and healthy diet for disease prevention.

Mapping of Course Outcomes to Program Outcomes:

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

Correlations : 3 Strong 2 Medium 1 Low

S.No	Content of Module	Hrs	Cos
MO1	Definition of Nutrition. Basic food groups - Energy yielding, Body building and protective foods. Basic concepts of energy expenditure, Unit of energy, BMR-Factors affecting BMR, Measurements of energy food Stuffs by bomb calorimeter. Calorific value of proteins, carbohydrates and fats, RQ of foods. SDA.	**12**	**CO1**
MO2	**N**utritional aspects of carbohydrates. Significance of fibre in the diet; Nutritional Aspects of proteins - Dietary sources, RDA, Physiological role; significance of essential aminoacids, Protein energy malnutrition in children; Nutritional Aspects of lipids – Dietary sources, RDA, Physiological role; significance of essential fatty acids, MUFAs, and PUFAs.	**13**	**CO2**
MO3	Vitamins- Classification. function, RDA dietary source & deficiency diseases of water soluble vitamins Vit B1, B2, B5,B6, B9 and B12 and Fat soluble vitamins – A, D, E& K	**17**	**CO3**
MO4	Minerals- Dietary source, RDA, function & deficiency symptoms of Calcium, Phosphorus, Iron, Iodine, Sodium, Chlorine and Potassium-Supplementation of calcium, Iron rich foods	**18**	**CO4**
MO5	Diabetes mellitus-Definition. Symptoms and types. Dietary management for Diabetes Mellitus.Renal failure- Definition, Causes and types (acute & chronic). Dietary management for renal failure patients	**15**	**CO5**

RECOMMENDED BOOKS

1. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271

2. Srilakshmi, B. (2019). *Dietetics* - (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201

3. B.Srilakshmi, B. (2017). *Food Science* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093

REFERENCE BOOKS

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

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

3. Krause's. (2013). *Food, Nutrition, & Diet Therapy* (11th ed.). W.B. Saunders - ISBN-10 : 0721697844, ISBN-13 : 978-0721697840

Course Title: ALLIED CHEMISTRY-1

(SEMESTER-I)

L:T:P:S : 3:1:0:0	**Credits : 03**
	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	Know the discovery of electron, proton and neutron and their characteristics (various atom models), formation of different types of bonds, geometry of simple molecules, calculate bond order of hetero homo atomic molecules.
CO2	Apply the fundamental principles of measurement, matter (pressure from a macroscopic and microscopic perspective), chemical bonding, general chemical reactivity and solution chemistry to subsequent courses in science.
CO3	To make students capable of understanding and studying organic reactions To have exposure to various emerging new areas of organic chemistry To develop skills required for the qualitative analysis of organic compounds
CO4	Recognize the basic terms of thermodynamic. Able to predict the energy change in heat capacities at constant volume and pressure and their relationship. Able to derive Joule's law and its applications. And to derive relationship between modification of distribution law when solute undergoes dissociation
CO5	To have basic idea about type of solutions and its fundamental concentration units. To know the fundamental properties of acid and base classifications and its importance in chemical reactions.

Mapping of Course Outcomes to Program specific Outcomes:

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

Correlations : 3 Strong 2 Medium 1 Low

S.No	Content of Module	Hrs	Cos
MO1	Atom-fundamental particles present in atom- electron proton and neutron-Arrangement of electrons in an atom-Bohr-Bury rule. Atomic models - Dalton Model, Thomson model, Rutherford and Bohr Model.Plancks quantum theory- postulates and limitations only. atomic number, mass number. Quantum numbers - orbitals types and shapes.	**14**	**CO1**
MO2	Matter characteristics-Mass, volume,(defInitions only). States of matter-solid, liquid and gases(only). Liquid-Density,evaporation,surface tension and Viscosity. Gas-Pressure, diffusion and compressibility and gas laws- boyle's law, charles law, avogadro's law. Intermolecular forces - definition of Vandewaal's force, dispersion forces, Hydrogen bonding, dipole-dipole, dipole induced dipole forces - ideal and real gases definition and equation for combined gas law - ideal gas equation.	**15**	**CO2**
MO3	Electronic displacement effects: Inductive, resonance and steric effects(Definitions only). Nucleophiles, Electrophiles. Homolytic and Heterolytic bond dissociations(Definitions only) .Nucleophilic substitution Reactions-Leaving group, Nucleophile, Kinetics and Mechanism of S_N2, S_N1 stereochemistry of S_N2 and S_N1 reactions of alkyl halides. Competition between S_N1 and S_N2. Role of Solvent. E_2 reaction-Zaitsev's and Hoffman rule E1reaction stereochemistry of E2 and E1 reactions.	**17**	**CO3,CO5**
MO4	Introduction-System and its types, surrounding, Basic concepts - Work, energy, heat, Intensive and extensive properties. State and path functions reversible and irreversible process. Exothermic and endothermic process. First law of Thermodynamics(definition only) - internal energy, Enthalpy, heat capacity and specific heat. Limitations of I law of thermodynamics Need for II Law – Different Statements of II Law – Entropy-,Third law of thermodynamics (only definition). Gibbs Free energy, conditions of spontaneity.	**16**	**CO4, CO5**
MO5	Standard solutions - Normality, molarity, molality - pH, pOH - Henderson Hasselbach equation -defenition, derivation and significance - Buffers - defenition and examples (phosphate buffer and chloride buffers)	**13**	**CO5**

RECOMMENDED BOOKS:

1. Puri, S. P. (2016). *Principles of physical chemistry.* Manav Book Distributers -
2. Puri, S. a. (2017). *Principles of Inorganic chemistry* (33rd ed.). Milestone Publishers and distributors - ISBN-10 : 8192143333 / ISBN-13 : 978-8192143330
3. James E. Huheey, E. A. (2014). *Inorganic chemistry, principles of structure and reactivity* (14th ed.). Dorling Kinersley india pvt Ltd - ISBN-10 : 006042995X / ISBN-13 : 978-0060429959
4. Claus Borgnakke (Author), R. E. (2008). *Mentals of Thermodynamics* (7th ed.). Wiley India Edition - ISBN-10 : 9788126521524 / ISBN-13 : 978-8126521524

REFERENCE BOOKS

1. Soni, P. L. (2013). *Fundamentals of Organic Chemistry.* Sultan Chand and sons -
2. Bahl, A. a. (2018). *A Textbook of Organic chemistry* (22nd ed.). Sultan Chand and sons - ISBN : 9789352837304

NON MAJOR ELECTIVE -1 (SEMESTER-I)

Course Title: BASICS OF MEDICAL TERMINOLOGIES

		Credits	**: 02**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	CO Statement
CO1	Define Medical Terminologies
CO2	Compare Different Human Diseases
CO3	Apply Medical Terms In Health Sectors Or Medical Reports
CO4	Analyse The Functions Of Different Parts of Human body
CO5	Interpret Normal Values Of Metabolic Parameters

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3-STRONG 2-MEDIUM 1-LOW

S.No.	Content of Module	Hrs	Cos
MO1	Parts of the human body- Head, neck, thorax, abdomen, pelvis, upper limbs and lower limbs. Important internal organs, glands, bones, nerves and muscles present in part. Head-eyes, ears, nose, mouth, sinuses, brain, cranialbones.	**15**	**CO1**
MO2	Human diseases- definition of terms, sings, symptoms, autopsy, biopsy,- artery, vein, nerve, muscle- medial, lateral, superior, inferior , dorsal, ventral, anterior, posterior-tissue, organ, ulcer, cirrhosis, necrosis, cancer , ischemia, angina pectoris, coma, anemia, edemia pus,, lymph, lymphoma, acidity, pyrexia, myopia, hypermetropia, hypoxia, cyanosis.	**15** ,	**CO2**
MO3	Medical terms- (Definition only) Metabolic diseases- diabetes mellitus, Diabetes insipidus, Kernicterus, Hypertension. Endocrine disorders- hyper and hypo secretions of thyroid, pituitary, reproductive hormones. Neurological disorders- alzhemiers disease, schizophrenia, parkinsons, paralysis, migraine, Respiratory disorders-asthma, wheezing, tuberculosis- problems due to smoking, pneumonia. Skin –leucoderma, psoriasis, spontaneous burning syndrome, complications in pregnancy, absortion, miscarriage.	**15**	**CO3,CO5**
MO4	Medical reports- definitions of normality, molarity, molality, osmoles, equivalents, milliequivalents, concept of positive and negative tests, examples for g/mol, mEq/mol, mg/dL, mg/mol – normal range for selected blood parameters- glucose, bilirubin, creatinine, cholesterol, triglycerides, hemoglobin, CRP, urea. Types of samples- whole blood, plasma, serum, urine, CSF, lymph, sweat, gastric juice, sputum, stools (faeces).Route of administration of drugs – oral, intravenous,subcutaneous, intraperitoneal, nasal, intramuscular.	**15**	**CO4, CO5**
MO5	Areas of application of medical terminologies- basic knowledge of medical coding, medical transcription, medical billing, insurance sectors, lab technicians, diagnostic labs.	**15**	**CO5**

RECOMMENDED BOOKS:

1. ChatterjeeRanashinde. (2012). *Medical Biochemistry.* Jaypee - ISBN : 9789350254844
2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
3. Kaplan. (2010). *Clinical Biochemistry* (6th ed.). Mosby - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846

REFERENCE BOOKS

1. ChatterjeeRanashinde. (2012). *Medical Biochemistry.* Jaypee - ISBN : 9789350254844
2. V.H., T. (2019). *Handbook Medical Laboratory Technology* (2nd ed.). CBS publishers and distribution - ISBN-10 : 8123906773 / ISBN-13 : 978-8123906775
3. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders.

B.SC BIOCHEMISTRY FIRST YEAR SEMESTER – I - MAJOR PRACTICAL I

Course Title: MAJOR PRACTICAL-1 NUTRITIONAL BIOCHEMISTRY

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

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

CO1	Quantify glycine by Sorensons formal titration
CO2	Quantify glucose in jaggery by Benedicts method
CO3	Quantify ascorbic acid in lemon by Dichlorophenol Indo phenol dye method, Know the methodology of extraction of lipids from seeds
CO4	Understand the principle of colorimeter and estimate the amount of carbohydrate and phosphorus by Colorimetery
CO5	Understand the importance of minerals and estimate the amount of minerals like calcium and chlorine

MAPPING OF CO vs PSO

	PSO1	**PSO 2**	**PSO 3**	**PSO4**	**PSO 5**	**PSO6**	**PSO7**
CO1	**2**	2	2	2	1	1	1
CO2	**2**	2	2	2	1	1	1
CO3	**2**	2	3	2	1	1	1
CO4	**2**	2	2	2	1	1	2
CO5	**2**	2	2	2	1	1	2

S.No.	Content of Module	Hrs	Cos
MO1	Estimation of Glycine by Sorenson formal titration.	45	CO1
MO2	Determination of reducing sugars, total sugars in jaggery/honey by Benedicts method.		CO2
MO3	Estimation of ascorbic acid using 2, 6 – dichlorophenol indophenol as link solution, present in lemon		CO3
MO4	Extraction of lipids from oil seeds		
MO5	Colorimetric estimation of carbohydrate by anthrone method in food sample		
MO6	Colorimetric estimation of inorganic Phosphorus by Fiske Subbarow method in water sample.		CO4
MO7	Estimation of Calcium in milk		
MO8	Estimation of Chloride by Mohr's method		
	DEMONSTRATION EXPERIMENT		
MO9	Determination of ash and moisture content in food sample		CO5

RECOMMENDED BOOKS:

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

2. H.Saegal, I. (1991). *Biochemical calculations.* Liss, Newyork -

3. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd - ISBN 10: 8173193029 / ISBN 13: 9788173193026

B.SC BIOCHEMISTRY FIRST YEAR

SEMESTER – I

Course Title: ALLIED PRACTICAL-1 (CHEMISTRY)

ORGANIC QUALITATIVE ANALYSIS and DETECTION OF ADULTERANTS IN FOOD

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

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

CO1	Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals.
CO2	Identify the glassware commonly used in the Chemistry laboratory and know how to properly utilize the glassware (K1)
CO3	Perform qualitative analysis unknown samples and semi micro qualitative analysis of organic compounds functional group identification.
CO4	Recognize the colors and adulterants present in foods and beverages Differentiate the chemical substances as acid, base, oxidizing and reducing agents.
CO5	Classify the food additives and discuss their functions, Explain the reactions involving the organic compounds and analyse the food products and identify the adulterants.

MAPPING OF CO vs PSO

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

S.No.	Content of Module	Hrs	Cos
	LIST OF EXPERIMENTS. **Organic** Qualitative **Analysis:** a) Identification of acidic, phenolic, basic and neutral organic substances b) Detection of N and S c) Test for aliphatic and aromatic nature of substances. d) Test for saturation and unsaturation. e) Identification of functional groups i) Carboxylic acid (Mono and Dicarboxylic acid) ii) Phenols iii) Aromatic Aldehyde (Benzaldehyde) iv) Ketones v) Carbohydrates (Monosaccharides) vi) Aromatic amines (Aniline) vii) Diamide (Urea) viii) thiourea **ADULTERATION** Exercise 1 : Detection of Metanil Yellow in a Given Food Sample Exercise 2 : Check the Presence of Rhodamine B in the Given Food Sample Exercise 3 : Test the Presence of Sugar in Honey Exercise 4 : Detection of NaHCO3 (Chalk) in Flour Exercise 5 : Check for the Presence of Vanaspati and Rancidity in the Ghee Exercise 6 : Check the Milk for Presence of Proteins, Urea, Sugar and Starch	**45**	**CO1 CO2,CO3,CO4,CO5**

RECOMMENDED BOOKS:

1. Giri, D. O. (2016). *PRACTICAL CHEMISTRY.* S Chand - ISBN: 9788121908122, 9788121908122
2. Clarke, H. T. (2007). *A hand book of Oraganic: Qualitative and quantitative Analysis - ISBN : 9780713124606, 0713124601*
3. Ramamurthy, N. G. (1998). *Organic chemistry Lab manual* . S.Viswanathan Co. Pvt. Ltd -

SECOND SEMESTER

Course Title: CELL BIOLOGY(CORE PAPER II)

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

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

CO NUMBER	CO Statement
CO1	Identify and explain the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially the organelles
CO2	Demonstrate familiarity with various elements of cytoskeleton
CO3	State the structure, function and composition of cell membrane and communicate the types and mechanism of membrane transport
CO4	Illustrate the phases of cell cycle; in particular mitosis and describe the significance of meiosis in genetic diversity
CO5	Relate the structure and biological role of extracellular matrix and cell -cell junction with physiological processes

Mapping of Course Outcomes to Program SpecificOutcomes:

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PSO7
CO1	3	3	3	1	3	3	3
CO2	3	3	2	1	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3
CO5	3	3	3	1	3	3	3

Correlations : 3 Strong 2 Medium 1 Low

S.No.	Content of Module	Hrs	Cos
MO1	Architecture of cells- Structural organization of prokaryotic and eukaryotic cells – microbial, plant and animal cells. The ultrastructureof nucleus, mitochondria, RER, SER, golgi apparatus, lysosome, peroxisome and their functions.	**15**	**CO1**
MO2	Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions.	**15**	**CO2**
MO3	Biomembranes- Structural organization of bilipid layer model and basic functions- transport across cell membranes- uniport, symport and antiport. Passive and active transport.	**15**	**CO3**
MO4	Cell cycle- Cell division- mitosis and its significance, meiosis (definitions and overview) ,basic characteristics of cancer cells.	**15**	**CO4**
MO5	Extracellular matrix – Collagen, laminin, fibronectin and proteoglycans- structure and biological role. Structure and role of cadherin, selectins, integrins, gap junction and tight junction.	**15**	**CO5**

RECOMMENDED BOOKS:

1. Arumugam.N. (2019). *Cell biology.* Saras publication (10ed, paperback) -
2. Devasena.T. (2012). *Cell Biology.* Oxford University Press India - ISBN: 9780198075516, 0198075510
3. S.C, R. .. (2008). *Cell Biology.* Newage Publishers - ISBN-10 : 8122416888 / ISBN-13 : 978-8122416886

REFERENCE BOOKS

1. Cooper, G. a. (2013). *The Cell: A Molecular Approach.* Sinauer Associates, Inc - ISBN 10: 0878931066 / ISBN 13: 9780878931064
2. E.M.F., D. R. (2006). *Cell and Molecular Biology.* Lippincott Williams & Wilkins Philadelphia - ISBN : 0781734932 9780781734936

SECOND SEMESTER

Course Title: ALLIED CHEMISTRY-II

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

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

CO NUMBER	**CO Statement**
CO1	To have a basic idea about nuclear Chemistry and its applications, nuclear reactions and radioactivity and their medical importance (isotopes).
CO2	To study the various factors which affect the rate of a chemical reaction such as concentration, temperature, solvent, catalyst etc. and theories of chemical kinetics, and also to describe a reaction rate in terms of a change in concentration divided by a change in time (at constant volume) and a general form of a(differential) rate law
CO3	Recognize the bonding in transition compounds by VBT and CFST theories. Able to predict the geometry of coordination compounds and type of hybridization. Able to recognize the biological reaction alkali and alkaline earth metals, nitrogen fixation, hemoglobin and myoglobin.
CO4	Acquire basic knowledge of electrode conduction. Determine the solubility of sparingly soluble salts. Explain the various methods for the determination of transport number. Understand theories of electrochemical cell reactions, and also learn about chemical and physical equilibrium of the electrolytes. To study the various types of cells and functionalities.
CO5	To study the behaviour of binary liquid mixtures, CST, azeotropes, colligative properties, solubility of gases in liquids, ionic equilibria and electrical properties of ions in solutions.

Mapping of Course Outcomes to Program Specific Outcomes:

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

Correlations : 3 Strong 2 Medium 1 Low

S.No.	Content of Module	Hrs	Cos
MO1	Fundamental particles of nucleus, isobars, isotopes, isotones, and Mass defect. Nuclear fission- fission chain reaction and critical mass. Differences between chemical and nuclear reactions. Artificial radioactivity (definition only) Application of radio isotopes – Radioactive tracers carbon dating and medical applications	**12**	**CO1**
MO2	Rate of chemical reaction – average and instantaneous rate (definitions only), factors affecting rate of reactions order and molecularity (definitions only)– integrated rate expression for first, second and zero order reactions (no derivation) Half life period – Activation energy. Arrhenius equation. Arrhenius theory – Homogeneous and heterogeneous catalysis (Definition and Examples only)	**18**	**CO2**
MO3	Differences between Double salts, co-ordination compounds. Werner Theory of co-ordination compounds terminologies-, Complex, Ligand and its types, coordinations sphere, charge of the complex, chelation, Nomenclature, Homoleptic and heteroleptic complex. Isomerism- isomers, structural and stereo (definition and examples only). Bonding in Co-ordination compounds- VBT and CFT (postulates only). Colour, paramagnetism and diamagnetism of Co-ordination complexes.– Applications of co-ordination of compounds.	**16**	**CO3,CO5**
MO4	Conductor of electricity-Electrolytic, metallic and mixed conductors. Kohlrausch's law and its applications. Electrochemical cells- Electrolytic cells (definitions only). Galvanic cells – emf – standard electrode potential, half cell reactions,(definitions and examples only) electrochemical series and its applications. Nernst equation, equilibrium constant and Gibbs energy of reaction - reference electrodes.	**17**	**CO4, CO5**
MO5	**VOLUMETRIC TITRIMETRY-AN OVERVIEW** Solutions, suspensions, colloids- definitions only. colloids- types with examples dispersed phase, dispersion medium- properties - tyndall effect , brownian movement, electroosmosis,- donnan membrane equilibrium	**12**	**CO5**

RECOMMENDED BOOKS:

1. Puri, S. P. (2016). *Principles of physical chemistry.* Manav Book Distributers -

2. Puri, S. a. (2017). *Principles of Inorganic chemistry* (33rd ed.). Milestone Publishers and distributors - ISBN-10 : 8192143333 / ISBN-13 : 978-8192143330

3. James E. Huheey, E. A. (2014). *Inorganic chemistry, principles of structure and reactivity* (14th ed.). Dorling Kinersley india pvt Ltd - ISBN-10 : 006042995X / ISBN-13 : 978-0060429959

4. R. Gopalan (Author), V. R. (2008). *Coordination Chemistry* . Vika's pubishing pvt Ltd.

REFERENCE BOOKS

1. Soni, P. L. (2013). *Fundamentals of Organic Chemistry.* Sultan Chand and sons -

2. Bahl, A. a. (2018). *A Textbook of Organic chemistry* (22nd ed.). Sultan Chand and sons - ISBN : 9789352837304

NON MAJOR ELECTIVE-II (SEMESTER- II)

PLANT BIOACTIVE COMPOUNDS IN TRADITIONAL MEDICINE

		Credits	**: 02**
L:T:P:S	**: 2:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	**CO Statement**
COI	Define and classify bioactive compounds with proper examples
CO2	Differentiate traditional and modern medicine
CO3	Discuss the plants used in traditional medicine of Ayurveda, siddha, Unani and Greek medicine
CO4	Identify the plants used in the treatment of diabetes, arthritis and immune Modulation
CO5	Analyse the plants with different biochemical techniques

Mapping of Course Outcomes to Program Specific outcomes

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

Correlations : 3 Strong 2 Medium 1 Low

S.No.	Content of Module	Hrs	Cos
MO1	Definition of bio active compounds, types, glycosides, saponins, flavonoids, proanthrocyanidins, tannins, terpenoids ,resins, lignans, alkaloids, coumarins and other healing compounds their composition with examples.	**15**	**CO1**
MO2	Ethnopharmacology and Types of traditional medicine in India and other countries, ayurveda, siddha, unani, Chinese, greek, roman, Arabic, monastery and scientific medicine. Traditional and modern medicine (Difference)	**15**	**CO2**
MO3	Plants and bioactive compounds used in traditional medicine Ayurveda , Siddha and Unani - tulsi, turmeric, neem, ashwagandha, brahmi, amla, liquorice, coriander, ginger, Aloe barbadensisNilavembukashayam preparation.	**15**	**CO3,CO5**
MO4	Plants proved to be effective in the treatment of Diabetes, respiratory disorders, nervous disorders, heart functioning, digestive system, excretory system, arthritis and immune modulation. Plantscompounds in combating oxidative stress – Vitamin-A, C, D, E, K, selenium, carotenoids and polyphenols.	**15**	**CO4, CO5**
MO5	Biochemical techniques in isolation purification and analysis of plant bioactive compounds (Definition and abbreviations only.) PC, TLC, GLC, HPLC, UV, IR, NMR, MS. Toxicological assay – Brine shrimplethality assay (Procedure)	**15**	**CO5**

RECOMMENDED BOOKS

1. Harborne, J. B. (2013). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Springer Netherlands,- ISBN-10 : 0412572702/ISBN-13 : 978-0412572708

2. Bernhoft, A. (2008). *Bioactive Compounds in Plants: Benefits and Risks for Man and Animals.* Proceedings from a Symposium Held in Norwegian Academy of Science and Letters - ISBN 10: 8270995835 / ISBN 13: 9788270995837

3. Chattopadhyay, M. S. (2018). *New Look to Phytomedicine 1st Edition Advancements in HErbal Products as Novel Drug.* Acadenic Press - ISBN : 9780128146200, 0128146206

REFERENCE BOOKS

1. Ajay Kumar Meena, P. B. (2009). *Plants-herbal wealth as a potential source of ayurvedic drugs.* Asian Journal of Traditional Medicines -

2. Saroya, A. S. (2017). *Contemporary Phytomedicines.* CRC Press - ISBN9781315367071

3. Thangaraj, P. (2020). *Phytomedicine Research and Development.* CRC Press - ISBN 10: 0367857596 / ISBN 13: 9780367857592

NON MAJOR ELECTIVE-II (SEMESTER- II)

Course Title: PREVENTION AND MANAGEMENT OF LIFESTYLE DISORDERS-

		Credits	**: 02**
L:T:P:S	**:2:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	CO Statement
CO1	Define Life Style And Balanced Diet
CO2	Identify Lifestyle Prone Disorders
CO3	Categorize Communicable And Non-Communicable Disease
CO4	Prioritize Improved Life Style
CO5	Develop Healthy Habits Illustrate The Importance Of Nutrition In Prevention And Management OfLife Style Prone Disorders

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3-STRONG 2-MEDIUM 1-LOW

S.No.	Content of Module	Hrs	Cos
MO1	**Lifestyle and balanced diet:** Definition-Biological clock-Routine-Dress, Personal hygiene Food, Exercise, Drink, technology, Balanced diet, Macro and micronutrients, carbohydrates, proteins, fats.Vitamins and minerals, RDA, Sources. Role of non energy yielding foods, water and Importance of Fibre intake.	**15**	**CO1**
MO2	**Lifestyle disorders:** Lack of Physical activity, Incompatible food, irregular food habits, Substance abuse-Alcohol, cigarette smoking, drugs, technology-Computer vision syndrome, mobile vision syndrome.	**15**	**CO2**
MO3	**Physiological psychological and social disorders** **Physiological disorders:** Food poisoning-Signs and symptoms, Vomiting, diarrhea, head ache, stomach ache, dizziness, lethargy, hormonal imbalance, premensural syndrome, kidney stones and gall stones. **Psychological disorder-** Memory dysfunction, stress. Depression, mood swings, bipolar disorder, Lack of motivation Accidents, Drowning, suicides, Self medications. **Social disorders:** Avoiding family and friends, Voilence, physical assault o weaker section, Hyper tension in Early pregnancy in adolescent girls/ Abortion- Definition-signs, symptoms-preventions. Basic life support- Deaddiction.	**15**	**CO3,CO5**
MO4	**Risk factors Non-communicable diseases and communicable diseases. Non-communicable diseases-** Etiology, Metabolic risk factors, modifiable risk factors, type 2 diabetes, cancer, Heart diseases, Strokes, PCOD, Infertility, Obesity. **Communicable diseases-** AIDS, Tuberculosis, Cholera, typhoid, Jaundice.	**15**	**CO4, CO5**
MO5	**Control and Prevention Treatment** Improved lifestyle, Food habits, Proper sleep, Exercise-Yoga, Swimmin Walking, Outdoor games, Stress management-Meditation, Music, Painting, Propermedication, Nutrigenomics.	**15**	**CO5**

REOMMENDED BOOKS

1. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271

2. Srilakshmi, B. (2017). *Dietetics* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093

3. Srilakshmi, B. (2019). *Dietetics* - (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201

REFERENCE BOOKS

1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. Swaminathan. (2005). *Advanced Textbooks of food and Nutrition.* BAPP CO PRESS.

3. B. Kumar, M. K. (2004). *Guide to prevention of lifestyle diseases b. kumar.* Deep and Deep Publications, --ISBN 10: 8176295183 ISBN 13: 9788176295185

I BSC Biochemistry
SEMESTER – II
Course Title: MAJOR PRACTICAL II-CELL BIOLOGY

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

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

CO	Description
CO1	Identify the parts of microscope
CO2	Preparation of Slides &determine the animal and plant cell
CO3	Identify the stages of mitosis & meiosis
CO4	Visualize nucleus and mitochondria by staining methods
CO5	Identify the spotters of cells, organelles stages of cell division

Mapping of COs TO PSOs (BSc Program)

PSO/CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	3	3	2	3	2	2
CO2	2	1	2	3	3	1	1
CO3	3	3	3	3	3	1	2
CO4	3	**2**	3	3	3	2	2
CO5	3	3	3	3	3	2	1

S.No	Contents of Modules	Hrs	Cos
MO1	Compound Microscope	45	CO1
MO2	Preparation of Slide		CO2
MO3	Visualization of animal and plant cell by methylene blue		
MO4	Identification of different stages of mitosis in onion root tip		CO3
MO5	Identification of different stages of meiosis in onion bulbs		
MO6	Visualization of nuclear fraction by acetocarmine stain		CO4
MO7	Staining and visualization of mitochondria by Janus green stain		
MO8	Spotters a)Nerve,plant & Animal cell b) b) Mitochondria, Chloroplast, Endoplasmic reticulum, c) Mitosis stages – Prophase, Anaphase, Metaphase, Telophase		CO5

Referenc Books:

1. Essential practical handbook of Cellbiology ,Genetics and Microbiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition2017
2. Cell biology Practical, Dr.Venugupta ISBN 8193651219, Prestige publisher, 1st Jan 2018.
3. Cell and Molecular biology, DeRobertis, 8th edition,1st June, 1987

I BSC Biochemistry

SEMESTER – II – ALLIED CHEMISTRY -PRACTICAL -II

Course Title: ALLIED PRACTICAL-I1 (CHEMISTRY)

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

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

To impart basic knowledge in estimation of acid- base, various metal ions by volumetric analysis, preparation of simple inorganic compounds

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

CO	
CO1	Estimate the amount of metal ions like Mg, Zinc, Ca present in the solution
CO2	Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals.
CO3	Show the preparation of various concentrations of solutions from stock solution.
CO4	Differentiate the chemical substances as acid, base, oxidizing and reducing agents. Assess the choice of indicators according to the pH involved in the titrations
CO5	. Explain the volumetric laws and concept of normality, molarity, molality, and equivalent mass.

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

S.No.	Content of Module	Hrs	Cos
	1. Estimation of sodium hydroxide using standard Sodium carbonate. 2. Estimation of borax using standard Sodium carbonate. 3. Estimation of HCl using Standard Oxalic Acid 4. Estimation of Oxalic acid using standard Ferrous ammonium sulphate. 5. Estimation of total hardness of water*. Permanganometry 6. Estimation of $KMnO_4$ Using Standard NaOH. 7. Estimation of Ferrous ion using standard Oxalic acid 8. Complexometry Estimation of Magnesium sulphate using EDTA as link and Zinc sulphate as standard	**45**	**CO1 CO2, CO3, CO4, CO5,**

RECOMMENDED BOOKS:

1.Giri, D. O. (2016). *PRACTICAL CHEMISTRY.* S Chand - ISBN: 9788121908122, 9788121908122

2.Clarke, H. T. (2007). *A hand book of Oraganic: Qualitative and quantitative Analysis - ISBN : 9780713124606, 0713124601*

3.Ramamurthy, N. G. (1998). *Organic chemistry Lab manual .* S.Viswanathan Co. Pvt. Ltd -

THIRD SEMESTER

Course Title: CHEMISTRY OF BIOMOLECULES (CORE PAPER III)

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

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

CO1	Explain the structure, biological importance and physico chemical properties of carbohydrates, from monosaccharides to polysaccharides
CO2	Identify the structure of amino acids, classify proteins and explain their properties
CO3	Relate the structural levels of organization of proteins and describe the forces stabilizing the structure of proteins
CO4	Illustrate the structure of nucleotides, distinguish DNA and RNA and describe the structure of DNA, 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 and sterols

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Carbohydrates: Classification of carbohydrates, stereoisomerism and optical isomerism of sugars, anomeric forms and mutarotation. Occurrence, structure and biological importance of mono, di (Lactose, maltose, sucrose) and polysaccharides (starch, cellulose, glycogen, dextrin, inulin). Physical and chemical properties of carbohydrates reactions (oxidation, reduction, reaction with henylhydrazine, esterification, etherification). Heteropolysaccharides (Structure not needed).	**20**	**CO1**
MO2	Classification and structure of amino acids. Physical and chemical properties of amino acids. Protein- classification based on solubility and composition, shape, and function. Properties of proteins. Denaturation and renaturation of proteins..	**15**	**CO2**
MO3	Determination of amino acid sequence of a polypeptide chain. Protein structure- primary, secondary, (α-helix and β-pleated sheet), tertiary and quaternary structures of proteins (basic concepts). Structure ofpeptide bonds. Forces stabilizing the secondary, tertiary and quaternary structure of proteins.	**10**	**CO3**
MO4	Structure of purine and pyrimidines, nucleosides and nucleotides. Differences between DNA and RNA, double helical structure of DNA, Types of RNA –m-RNA, t-RNA r- RNA and their biologicalfunctions.	**15**	**CO4**
MO5	Definition and classification of lipids- chemical properties of fats-iodine value, saponification value, acid number, rancidity, RM value. Structure and biological functions of Lecithin, Cephalin, Phosphatidyl inositol, Plasmalogen, Sphingomyelin, Cerebrosides Gangliosides. Sterols (Cholesterol only), bile acids and bile salts.	**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

REFERENCE BOOKS

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

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

THIRD SEMESTER

Course Title: ALLIED MICROBIOLOGY-1

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

Course Outcomes

CO1	Able to explain the basic structure of bacteria and able to identify the gram positive and negative organisms. To relate the evolutionary relatedness of organisms by phylogenetic tree.
CO2	Graduates acquire skills to handle the microscope, staining procedures, isolate the pure cultures of bacteria by applying the various methods of sterilization
CO3	Graduates achieve the skills in characterizing the fungi, protozoa and viruses.
CO4	Graduates able to characterize the bacteria.
CO5	Graduates able to define the soil microbiology and their application in biofertilizer formation. Graduates capable of differentiating the symbiotic and a symbiotic nitrogen fixation.

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Evolution of microbiology. Classification of microorganisms (Bergey's system of classification). Structural characteristics of Bacteria. Actinomycetes.	**16**	**CO1**
MO2	Basic microbiological techniques- Cleaning of glassware. Sterilization of glassware and media. Streak plate, spread plate and pour plate, enrichment culture, single spore isolation, serial dilution, standard plate count. Lyophilization. Types of culture media. Staining techniques- simple and differential.	**16**	**CO2**
MO3	Structural characteristics of fungi (molds and yeasts) and Protozoa- Entamoeba, plasmodium, mycoplasma and viruses (general structure), HIV Structure	**15**	**CO3**
MO4	Cultivation of bacteria- Nutritional requirements and nutritiona types of bacteria, physical conditions for growth, bacterial growth curve. Measurement of microbial growth (turbidity, biomass, cell count)	**14**	**CO4**
MO5	Microbiology of soil. Microbes in soil, rhizosphere and rhizoplane. Nitrogen fixation- symbiotic and asymbiotic. Rhizobial Biofertilizers.	**14**	**CO5**

RECOMMENDED BOOKS:

1. Michael J. Pelczar I.R., C. E. (5th ed 2004). *Microbiology.* Tata McGRAW-Hill, New Delhi - ISBN 10: 0070492409 / ISBN 13: 9780070492400

2. Klein, H. &. (5th ed 2002). *Microbiology: Presscot.* McGraw Hill, New york -

3. RM, A. (2014). *Principles of microbiology.* McGraw Hill Education.

REFERENCE BOOKS

1. Woolverton., J. W. (2017). *Microbiology –Prescott.* Sarup & Sons , New Delhi.

2. Abraham J Domb, K. R. (n.d.). *Antimicrobial Materials for Biomedical Applications - ISBN 10: 1788011880 / ISBN 13: 9781788011884*

SEMESTER – III

Course Title : MAJOR PRACTICAL III- CHEMISTRY OF BIOMOLECULES

		Credits	**: 02**
L:T:P:S	**0: 0: 3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 50**

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

CO1	Qualitatively analyze the carbohydrates and report the type of carbohydrate based on specific tests
CO2	Qualitatively analyze amino acids and report the type of amino acids based on specific tests
CO3	Understand the preparation of starch from potatoes
CO4	Understand the preparation of casein, lactalbumin from milk, albumin from eggs
CO5	Determine the SAP, Iodine and acid number of edible oil

MAPPING OF CO vs PSO

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

S.No	Content of Module	Hrs	Cos
	I) Qualitative analysis of Carbohydrates	45	CO1-CO2 CO3 CO4 CO5
MO1	Qualitative analysis of Glucose		
MO2	Qualitative analysis of Fructose		
MO3	Qualitative analysis of Arabinose		
MO4	Qualitative analysis of Maltose		
MO5	Qualitative analysis of Sucrose		
MO6	Qualitative analysis of Starch		
	II) Qualitative analysis of Amino acids		
MO7	Qualitative analysis of Arginine		
MO8	Qualitative analysis of Cysteine		
MO9	Qualitative analysis of Tryptophan		
MO10	Qualitative analysis of Tyrosine		
MO11	Qualitative analysis of Histidine		
MO12	Qualitative analysis of Proline		
	III) BIOCHEMICAL PREPARATION		
MO13	Preparation of starch from potatoes		
MO14	Preparation of casein from milk		
MO15	Preparation of albumin from eggs		
MO16	Preparation of Lactalbumin from milk		
	IV. DEMONSTRATION EXPERIMENT (Any two)		
	Determination of SAP number of an edible oil		
	Determination of Iodine number of an edible oil		
	Determination of Acid number of an edible oil		

Sl.No	Authors	Title	Publishers	Year of Publication
1	Jones Evangeline	Manual of Practical Medical Biochemistry	Jaypee Publishers	2011
2	Damodaran Geetha K	Practical Biochemistry-paperback	Jaypee Brothers Medical Publishers	2016
3	DM Vasudevan Subir Kumar Doss	Practical textbook of Biochemistry for medical students	Jaypee Brothers Medical Publishers	2020
4	Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees	A Practical book on Biochemistry	Everest publishing house	1st Edition, 2019

III SEMESTER

Course Title: ALLIED PRACTICAL -II (MICROBIOLOGY 1)

	Credits : 02
L:T:P:S : 0:0:3:0	**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	By the end of this course, students will be able to demonstrate the practical skills in handling microscope and staining procedures.
CO2	Graduates acquire knowledge in sterilization techniques and be able to perform routine culture handling tasks safely and effectively.
CO3	Students will be able to know various Culture medias used in isolating Pure culture of bacteria, perform in pathological samples.
CO4	Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
CO5	Students will be able to isolate and enumerate bacteria from soil

Mapping of Course Outcomes to Program Outcomes:

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

Correlations : 3 Strong 2 Medium 1 low

S.No.	Content of Module	Hrs	Co
1.	Principles of Microscope-Light, compound microscope	3	CO1 CO2 CO3 CO4 CO5
2.	Preparation of Nutrient Agar- MHA, MHA Broth	3	
3.	Preparation of slants.	3	
4.	Streak plate, Pour plate and Spread Plate Culture techniques	3	
5.	STAINING TECHNIQUES i) Preparation of Bacterial Smear ii) Simple Staining iii)Differential Staining iv)Endospore Staining	6	
6.	Hanging drop method for testing motility of bacteria.	3	
7.	Enumeration of bacteria from soil by Standard plate count.	3	
8.	FOOD MICROBIOLOGY • Determination of fungal and yeast count in given food sample. • Identification of fungi -Preparation of temporary mounts- Lactophenol cotton blue staining.	3	
9.	DEMONSTRATION • Sterilization techniques • Preparation of pure culture from mixed culture • Culture of root nodule bacteria • Effect of temperature on the growth of microbes.		
10.	SPOTTERS Inoculation loop,Petriplate, Incubator,Autoclave,Microscope Slant,Spread plate,Streak Plate,L rod,Spreader.Petriplate carrier Penicillin,Rhizopus,Mucor,Aspergillus	3	

REFERENCE BOOKS/ TEXTBOOKS

- Parija, S. C. (2007). *Textbook Of Practical Microbiology* (2007 ed.). Ahuja Publishing House -
- Welsh, J. G. (2017). *Microbiology: A Laboratory Manual* (11th ed.). Pearson Publishers - ISBN-13: 9780134298597
- Green, E. G. (2015). *Practical Handbook of Microbiology* (3rd ed.). CRC Press Taylor & Francis Group - ISBN 10: 1466587393 / ISBN 13: 9781466587397

REFERENCE BOOKS

1.Panicker.J, A. R. (1986). textbook of microbiology. Orient Longmans - ISBN 10: 9386235250 / ISBN 13: 9789386235251

2.pandey, v. k. (2019). Lab practical micro-biology Notion Press 2019. Notion Press

3.Dr.RC.Dubey. (2010). Practical Microbiology. S.Chand Publishers - ISBN : 97881219262

II BSC Biochemistry

FOURTH SEMESTER

Course Title: BIOCHEMICAL TECHNIQUES (CORE PAPER IV)

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

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

CO NUMBER	**CO Statement**
CO1	A practical knowledge on the separation of biological sample by centrifugationSeparation of subcellular organelles by differential centrifugation
CO2	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 chromatographyDetection of sugars using thin layer chromatographySeparation and purification of proteins using affinity chromatography
CO3	Know the structure of atoms and molecules. The larger the number of wave length 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 about the interactions of electromagnetic radiation and matter and their applications in spectroscopy Analyze and interpret spectroscopic data collected by the methods Assay of biomolecules using UV spectroscopy
CO4	The students will be able to demonstrate the methodology involved in separation of proteins, Nucleic acid by various electrophorectic techniques.
CO5	Acquire knowledge on atomic structure. Radiation, types of radioactive decay, Detection and measurement of radioactivity using GM counter and Scintillation counter.Biological hazards of radiation and safety measures in handling radio isotopes.

Mapping of Course Outcomes to Program Specific Outcomes:

CO	**PSO 1**	**PSO 2**	**PSO 3**	**PS O4**	**PS O5**	**PSO 6**	**PS O7**
CO1	3	3	3	2	2	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	1	3	1
CO4	3	3	3	3	3	2	2
CO5	3	2	2	2	3	2	3

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No	Content of Module	Hrs	COs
MO1	**CENTRIFUGATION** Basic principles of centrifugation, RCF, Types of Rotors, Principle, procedure and applications of differential and densitygradient centrifugation, Preparative and analytical ultracentrifugation Determination of Molecular weight (Derivation excluded).	**15**	**CO1**
MO2	**CHROMATOGRAPHY:** Principles of chromatography, Paper chromatography, Thin layer chromatography, Ion exchange, ,Affinity chromatography, Gel permeation chromatography, HPLC and GLC	**15**	**CO2**
MO3	**PRINCIPLES OF SPECTROSCOPY**, Basic principles of electro magnetic radiation energy , wavelength, wavenumber and frequency-absorption and emission spectra, - Beer- Lambert law,Light absorption and transmittance. UV and Visible spectrophotometry, Principle Instrumentation , and applications on enzyme assays and kinetic assays, Protein structural studies. Applications of MALDI and NMR.	**15**	**CO3**
MO4	**ELECTROPHORETIC TECHNIQUES:** Definition, Factors affecting electrophoresis – Principle procedure and applications of Paper,Cellulose acetate/Nitrate, Agarose gel electrophoresis, SDS PAGE and Its applications.	**15**	**CO4**
MO5	**RADIOACTIVITY** Atomic structure, radiation, types of radioactive decay, half life, units of radio activity. Detection and measurement of radioactivity - methods based upon ionization (GM counter), methods based upon excitation (Scintillation counter).Autoradiography and isotope dilution techniques. Applications of radioisotopes in the elucidation of metabolic pathways, clinical scanning and radio dating. Biological hazardsof radiation and safety measures in handling radio isotopes.	**15**	**CO5**

RECOMMENDED BOOKS:

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

REFERENCE BOOKS

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

FOURTH SEMESTER

Course Title: Allied Microbiology-II

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

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

CO NUMBER	CO Statement
CO1	By the end of this course, students will be able to list out the microbes used in water treatment, and air purification. They can able to compare and explain different air sampling devices.
CO2	Analyze and understand the types of microbes in Food microbiology; the factors and kind of microbes in food spoilage and can categorize various food preservation techniques used in microbiology.
CO3	Identify various sources of microbes in milk and demonstrate experiments with pasteurization, phosphatase and reductase tests. Able to understand the formation of dairy products- Cheese and Yogurt.
CO4	Explain the importance of microbial fermentation in the production of organic acids, antibiotics and alcoholic beverages such as citric acid & Vinegar, Penicillin & Streptomycin, Beer & Wine.
CO5	Predict the role of microbes in human disease, the role of microbes in issues of health, and the human immune response to microbial infection.

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3-STRONG 2-MEDIUM 1-LOW

S.No.	Content of Module	Hrs	Cos
MO1	Microbiology of water. Municipal water purification. Sewage water treatment-primary, secondary and tertiary. Microbiology of air-Microbes in air, Methods of Purification of air & air sampling devices.	**15**	**CO1**
MO2	Food Microbiology.Types of food, factors affecting number and kind of microbes in food.Microbial spoilage of meat and fish.Food preservation techniques-Asepsis, canning, bottling, smoking, pasteurization, salting, dehydration (hot and cold).	**15**	**CO2**
MO3	Microbiology of Milk. Microbes in milk and their sources. Pasteurization, phosphatase and reductase tests. Dairy products-cheese and Yoghurt.	**15**	**CO3**
MO4	Industrial Microbiology. Microbes in the production of organic acids (citric acid, vinegar), antibiotics (Penicillin & Streptomycin) and alcoholic beverages (Beer, Wine).	**15**	**CO4**
MO5	Microbes and diseases- microbial flora of healthy human host infection and its types. Immunity (native, acquired). Vaccines (live, attenuated & recombinant).Pathogenesis-bacterial pathogens (Salmonella, Mycobacterium tuberculosis, E.Coli, HIV-Life cycle and AIDS.	**15**	**CO5**

RECOMMENDED BOOKS:

1. Pelzar, C. a. (2007). *Textbook of Microbiology.* 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. Woolverton., J. W. (2017). *Microbiology –Prescott.* Sarup & Sons , New Delhi.
2. Abraham J Domb, K. R. (n.d.). *Antimicrobial Materials for Biomedical Applications - ISBN 10: 1788011880 / ISBN 13: 9781788011884*

II BSC Biochemistry

SEMESTER – IV

Course title: MAJOR PRACTICAL IV- BIOCHEMICAL TECHNIQUES

		Credits	**: 02**
L:T:P:S	**0: 0: 3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 50**

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

CO1	Assess the absorption spectrum of proteins and nucleic acids using UV Spectroscopy
CO2	Evaluate the pH of biological samples using glass electrode
CO3	Learn the estimation of phosphorus and aminoacids using colorimetric method
CO4	Gain expertise in basic separation technique like paper chromatography, thin layer chromatography and column chromatography for detection of aminoacids, sugars, lipids and plant pigments
CO5	Demonstrate the principle and working of SDS PAGE and Spectrofluorimetry

Mapping of Course Outcomes to Program Specific Outcomes:

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

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

S.No	Course Statement	COs
1	Determination of ultraviolet absorption spectra of proteins and Nucleic acid	CO1 CO2 CO3 CO4 CO5
2	Determination of pH of biological samples (blood, plasma, urine, saliva) phosphate buffer by glass electrode.	
3	Colorimetric Estimation of protein by Biuret method.	
4	Colorimetric estimation of amino acids by ninhydrin method.	
5	Paper chromatographic separation and detection of amino acids	
6	Paper chromatographic separation and detection of simple sugars	
7	Separation of polar and non-polar lipids by thin layer chromatography	
8	Chromatographic separation of plant pigments using column Chromatography	
	Demonstration Experiments	
9.	Separation of serum proteins by SDS-PAGE.	
10	Determination of Thiamine /Riboflavin by Spectro fluorimetry	

TEXT BOOKS/ REFERENCE BOOKS:

Sl.No	Authors	Title	Publishers	Year of Publication
1	J. Jayaraman	Laboratory Manual in Biochemistry	New Age International (P) Limited	Fifth edition 2015
2	S. Sadasivam A. Manickam	Biochemical Methods	New age International Pvt Ltd publishers	third edition 2018
3	Keith Wilson and John Walker	Principles and techniques of Practical Biochemistry	Cambridge University Press	2010, Seventh edition,
4	S. K. Sawhney and Randhir Singh	Introductory Practical Biochemistry	Alpha Science International, Ltd	2nd edition, 2005

II BSC Biochemistry

Semester IV

Course Title: ALLIED PRACTICAL -II (MICROBIOLOGY II)

Course Code :	**Credits : 02**
L:T:P:S : 0:0:3:0	**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	Graduates acquire knowledge in sterilization techniques and be able to perform routine culture handling tasks safely and effectively.
CO2	Students will be able to know various Culture medias used in isolating Pure culture of bacteria, perform in pathological samples.
CO3	Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
CO4	Students will be able to isolate and enumerate bacteria from, water and air.
CO5	It provides the knowledge of antibiotic sensitivity and various biochemical characterizations of bacteria.

Mapping of Course Outcomes to Program Outcomes:

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

S.No	Content of Module	Hrs	Cos
	STAINING TECHNIQUES	30	CO1, CO2, CO3, CO4 CO5
1	Bacterial Endospore staining		
	ISOLATION AND ENUMERATION STUDIES		
2	Enumeration of bacteria from water		
3	Enumeration of bacteria from air		
	BIOCHEMICAL CHARACTERIZATION		
4	Test for Caesinase		
5	IMVIC test		
6	Effect of temperature on the growth of microbes		
7	Antibiotic sensitivity test		
	QUALITATIVE ANALYSIS		
8	Identification of quality of Milk -Methylene blue reductase test		
	SPOTTERS		
	DEMONSTRATION		
9	Water analysis test		
10	Isolation of Root nodule bacteria		

REFERENCE BOOKS/ TEXTBOOKS

- Parija, S. C. (2007). *Textbook Of Practical Microbiology* (2007 ed.). Ahuja Publishing House -
- Welsh, J. G. (2017). *Microbiology: A Laboratory Manual* (11th ed.). Pearson Publishers - ISBN-13: 9780134298597
- Green, E. G. (2015). *Practical Handbook of Microbiology* (3rd ed.). CRC Press Taylor & Francis Group - ISBN 10: 1466587393 / ISBN 13: 9781466587397

III BSC Biochemistry
FIFTH SEMESTER
Course Title: ENZYMES (CORE PAPER V)

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

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

CO NUMBER	**CO Statement**
CO1	Understand about the structure, function, composition and classification of enzyme.
CO2	Analyse and interpret MM plot and LB plot based on kinetics data as well as gain knowledge on enzyme inhibition and its types.
CO3	Interpret the theories of mechanism of enzyme action and explain the principles behind enzyme catalysis.
CO4	Describe the structure and functions of various coenzymes and cofactors in the biological system
CO5	Comprehend the various methods for production, purification, characterization of immobilized enzymes and discuss the application of industrially important enzymes.

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3- Strong 2- Medium 1- Low

S.No.	Content of Module	Hrs	Cos
MO1	**Introduction:** Nomenclature, IUB system of enzyme classification, specificity, turn over number Enzyme units (IU and Katal), active site,allosteric site.	**15**	**CO1**
MO2	**Enzyme Kinetics**: Rate and order of reactions, factors affecting the enzyme activity, derivation ofMichaelis-Menton Equation, Significance of Km, Line-Weaver and Burk plot.Enzyme inhibition – Competitive, non-competitive and uncompetitive inhibitors (kineticderivations excluded) with suitable examples.	**15**	**CO2**
MO3	**Mechanism of enzyme action:** Fischer's Lock and key model, Koshland's Induced fit hypothesis – Activation energy. Acid base catalysis, metal ion and covalent catalysis.	**15**	**CO3**
MO4	**Cofactors & coenzymes Prosthetic group:** Structure and functionsof NAD, FAD, CoA, biotin, cobamide, TPP, PLP, THF **.**	**15**	**CO4**
MO5	**Enzyme application:** Industrial uses of enzymes –Amylase, Proteaseand Lipase-Immobilized enzymes production and applications. Abzymes and ribozymes.	**15**	**CO5**

RECOMMENDED BOOKS

1. Trevor Palmer, P. B. (2007). *Enzymes.* Wood head Publishing - ISBN : 9780857099921, 0857099922

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

3. David L. Nelson, M. M. (2017). *Principles of Biochemistry*(7th ed.). Macmillian Education -

REFERENCE BOOKS

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

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

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

BSc FIFTH SEMESTER

Course Title: INTERMEDIARY METABOLISM (CORE PAPER VI)

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

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

CO NUMBER	**CO Statement**
CO1	Define the terms Metabolism-Catabolism and Anabolism Write chemical reactions involved in biochemical pathways of carbohydrate metabolism that produce ATP such as glycolysis, TCA cycle, ETC
CO2	To describe ETC & 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
CO3	To explain the metabolic pathways of Protein – Transmination, deamination, decarboxylation and urea cycle.
CO4	Describe the metabolism of, lipids. Write chemical reactions for the individual steps in each pathways
CO5	Exemplify the role of ribose5phosphate and the steps involved in the synthesis of adenine and guanine Detailed information in the formation of uric acid upon purine catabolism. Recall the steps involved in the biosynthesis and degradation of pyrimidine.

Mapping of Course Outcomes to Program Specific Outcomes:

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

Correlations : 3- strong2 - Medium 1- Low

S.No.	Content of Module	Hrs	C os
MO1	Introduction to Intermediary metabolism. Metabolism-Catabolism and Anabolism. Carbohydrates metabolism: The glycolytic pathway – aerobic and anaerobic glycolysis, energetics, Pyruvate to acetyl CoA and its energetics, citric acid cycle and its energetics. Glycogenesis andglycogenolysis –Reactions and its regulation, Pentose phosphate pathway Reactions and its significance.	**15**	**CO1**
MO2	Electron transport chain - components and reactions of ETC. Oxidative phosphorylation – Chemi osmotic hypothesis, Uncouplersof Oxidative phosphorylation. Energetics. High energy compounds- Definition and examples ATP, SAM	**15**	**CO2**
MO3	Protein metabolism – Introduction- catabolism of amino acids- Phenyl alanine, Leucin Transamination, Oxidative and Non-oxidativeDeamination, Decarboxylation – Urea cycle and its regulation. Biosynthesis of creatinine.	**15**	**CO3**
MO4	Lipid metabolism –Biosynthesis of saturated fatty acids. Oxidation offatty acids – Beta oxidation-Role of carnitine, Energetics of Palmitic acid Oxidation, alpha oxidation and omega oxidation. Biosynthesisof cholesterol. Ketogenesis.	**15**	**CO4**
MO5	Nucleic acid metabolism- Biosynthesis of purine nucleotides – Denovo synthesis and salvage pathways, regulation of purine biosynthesis. biosynthesis of pyrimidine nucleotides - Denovo synthesis and salvage pathways, regulation of pyrimidine synthesis. Catabolism of purine nucleotides and pyrimidine nucleotides - regulation.	**15**	**CO5**

RECOMMENDED BOOKS

1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. J. L. Jain, N. J. (7th ed 2016). *Fundamentals of Biochemistry 7th edition.* S. Chand @ Co.Ltd - ISBN: 9788121924535
3. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .

REFERENCE BOOKS

1. Donald Voet, C. W. (2012). *Principles of Biochemistry.* Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446
2. David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry .* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116
3. Robert K.Murray, D. A. (2018). *Harper's Illustrated Biochemistry* (28th ed.). The McGraw- Hill Companies - ISBN-10 : 0071625917 / ISBN-13 : 978-0071625913

BSc FIFTH SEMESTER

Course Title: HUMAN PHYSIOLOGY (CORE PAPER VII)

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

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

CO NUMBER	CO Statement
CO1	Gaining a complete knowledge in the physiology of life
CO2	Be aware of the functional relationships between various organ systems of the body
CO3	Classify blood groups so as to identify the blood groups of patients and donors for thepurpose of safe blood transfusion
CO4	Cognizance of various systems of the body which support life viz. Circulatory, digestive, respiratory, nervous and excretory systems
CO5	Explain the structure and functions of neuron, transmission of nerve impulse, Understand neuromuscular coordination

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Blood composition and function, types of blood cells, morphology and function. Blood groups- ABO and Rhesus system. Composition and function of lymph and lymphatic System.Respiratory system- structure & function of differentcomponents of respiratory units. mechanism of respiration. Gaseous Exchange, Bohr's effect.	**15**	**CO1**
MO2	Circulatory System- heart- ,structure, properties of cardiac muscle overview of systemic and pulmonary circulation, conducting system of the heart, heart rate, cardiac cycle, cardiac output, Systolic andDiastolic pressure.	. **15**	**CO2**
MO3	Digestive systems: Structure of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salt in digestion of lipids, Mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive process.	**15**	**CO3,CO5**
MO4	Excretory system-Structural components of urinary system: Kidneystructure and its organization. Mechanism of urine formation- Glomerular filtration rate (GFR), Tubular Secretion and reabsorption.	**15**	**CO4, CO5**
MO5	Brief outline of nervous system-brain (parts and ventricles), spinal cord, nerve fibres, synapses, chemical and electrical synapses, Transmission of nerve impulses, action potential and neurotransmitters-Cholinergic and Adrenergic Neurotrasnmitters.Muscles-Types of muscles and their functions: myofilamentation and contraction and relaxation of skeletal muscles.	**15**	**CO5**

RECOMMENDED BOOKS:

1. Sembulingam, K. S. (2019). *Essentials Of Medical Physiology.* Jaypee Brothers Medical Publishers, - ISBN 10: 9352706927 ISBN 13: 9789352706921

2. Derrickson, G. J. (2017). *Principles of Anatomy and Physiology - ISBN: 978-1-119-40006-6*
3. Hall, G. A. (2019). Text book of MEdical physiology. Elsevier india - ISBN-10 : 8131257738 - ISBN-10 : 8131257738.

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). *Textbook of Medical Physiology.* 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

BSC FIFTH SEMESTER

Course Title: MOLECULAR BIOLOGY (CORE PAPER VIII)

		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	Infer the central dogma of molecular biology, Show how DNA acts as vehicle of inheritance through experimental evidences
CO2	Outline the steps involved in replication and explain the events, enzymology, fidelity and inhibitors of replication in E.*coli*
CO3	Summarize the process of prokaryotic transcription
CO4	Define genetic code, list its basic features and show how it can be deciphered Relate genetic code to translation process and explain protein biosynthesis
CO5	Illustrate 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	PSO6	PSO7
CO1	3	3	1	3	3	3	3
CO2	3	3	1	3	3	3	3
CO3	3	3	1	1	3	3	3
CO4	3	3	1	2	3	3	3
CO5	3	3	1	3	3	3	3

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Central Dogma of Molecular Biology. DNA as the vehicle of inheritance – experimental evidence – Griffith, McLeod, McCarty andAvery, Hershey – Chase experiments.	**10**	**CO1**
MO2	DNA replication -semi conservative mode of replication, replication fork, semi discontinuous replication-Okazaki fragments. Enzymes of replication – DNA polymerases I, II, III, topoisomerases, helicases binding proteins and ligases. Replication in E.coli – replisomes, events at OriC (initiation), eventson the replication fork (elongation) and termination. Fidelity of replication, Inhibitors of replication.	**20** ,	**CO2**
MO3	Transcription – Structure and functions of prokaryotic RNA polymerases. Initiation, elongation and termination –Rho dependant and Rho independent termination-Hair Pin loop Formation.Inhibitors of Prokaryotic transcription.	**15**	**CO3**
MO4	Genetic code –Codons and anticodons. Basic features of genetic code. Deciphering of genetic code. Wobble hypothesis. Protein biosynthesis-Prokaryotic ribosomes-Shine dalgarno sequence, Aminoacyl tRNA synthetases. Stages involved in protein biosynthesis- Initiation, elongation and termination. Inhibitors of translation.	**20**	**CO4**
MO5	Regulation of gene expression in prokaryotes. Operon concept – Inducible operon, Positive and negative regulation of lac operon-role of cAMP and glucose and 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. David.L.Nelson, M. M. (7th ed 2017). *Lehninger principles of Biochemistry .* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116
3. V.Malathi. (2012). *Essentials of Molecular Biology* (1st ed.). Pearson Education - ISBN-10 : 8131773213 / ISBN-13 : 978-8131773215

REFERENCE BOOKS

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

BSc FIFTH SEMESTER

Course Title: PRINCIPLES OF BIOTECHNOLOGY (Elective Paper I)

		Credits	**: 05**
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	To Discuss the basic requirements and tools employed in genetic engineering process
CO2	Demonstrate the basic and recent techniques applied in the field of Recombinant DNA technology
CO3	Apply the basic rDNA technique to produce transgenic animal, discuss gene transfer methods, their application in pharmaceutical industry, cloning and its importance
CO4	Design experiments on plants using rDNA techniques
CO5	Handle the equipments employed in DNA amplification, describe about gene therapy and antisense RNA therapy

Mapping of Course Outcomes to Program Specific Outcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Biotechnology – Introduction, Scope, definition, History and application–Brief history of recombinant technology- Restriction endonuclease- DNA cutting enzymes, DNA ligase- DNA joining enzyme, alkaline phosphatase, DNA modifying enzymes.	**15**	**CO1**
MO2	Vectors- the cloning vechiles – plasmids, bacteriophages, cosmids, artificial chromosome vectors, shuttle vectors, preparation of r-DNA, insertion of r-DNA into vector, methods of transfer, selection of recombinants and screening- genetic methods, abeli chemical methods, South- Western screening, Nucleic acid hybridization methods, radio-active and non-radioactive abeling of probes.	**15**	**CO2**
MO3	Animal Biotechnology – animal call culture, tissue culture- gene transfer methods in animals- transfection microinjection,electroporation, cell viability, cell transformation- transgenic animals-applications.	**15**	**CO3,CO5**
MO4	Plant Biotechnology: Agro bacterium- mediated gene transfer to plant cells, microprojectiles, transgenic plant technology- for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins.	**15**	**CO4, CO5**
MO5	PCR – types and applications. Gene therapy, antisense therapy- production of insulin in E.coli.	**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, O. a. (2003). *Principles of gene manipulation .* Business service 2003- *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. H.K.Das. (2010). Textbook of Biotechnology. Willey -ISBN: 9788126564040
3. Loroch, R. R. (2016). *Biotechnology for Beginners.* Academic Press - ISBN: 9780128012246

BSc FIFTH SEMESTER

Course Title: BASICS IN MEDICAL LABORATORY TECHNOLOGY
(Elective Paper-I)

		Credits	**: 05**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO1	Develop a good conduct in lab and prepare of laboratory reagents
CO2	Analyze the samples using various microscopes and Maintain lab wares
CO3	Identify the significance of normal and abnormal constituents of urine.
CO4	Examine the stool specimen
CO5	Estimate the hematological parameters

Mapping of Course Outcomes to Program specific Outcomes:

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	3	3	3
CO 2	3	2	2	2	2	2	3
CO 3	3	3	3	3	3	3	3
CO 4	3	2	2	3	3	3	3
CO 5	2	2	2	2	2	2	2

Correlation : 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	**Laboratory care:** Code of conduct for laboratory personnel - safety measures in handling laboratory chemical/Reagents, labelling, storage and usage.	**12**	**CO1**
MO2	**Laboratory equipments:** Working of microscope - Phase contrast, Fluorescence, Electron microscope. Centrifuge, analytical balance, colorimeter - Usage and care. Glass wares, water bath, incubator. Reporting laboratory tests and keeping records. Sterilization-Autoclave	**13**	**CO2**
MO3	**Urine Analysis**: Collection and preservation of urine sample. Composition of urine, Normal and abnormal constituents of urine. Urinalysis-Procedure. Examination of glucose, ketone bodies, bile pigments in urine. Hematuria.	**17**	**CO3,CO5**
MO4	**Stool**-Composition. Collection and examination of stools - inspection of faeces- odour, pH, Interfering substance. Test for occult blood, faecal fat, microscopic examination of stool specimen.	**18**	**CO4, CO5**
MO5	**Hematology** - Collection and preservation of blood sample - Anticoagulant, Heamtological parameters- Estimation of Hb, PCVWBC, RBC, Platelets, ESR. Clotting time, bleeding time - norma value, clinical interpretation.	**15**	**CO5**

RECOMMENDED BOOKS:

1. V.H., T. (2019). *Handbook Medical Laboratory Technology* (2nd ed.). CBS publishers and distribution - ISBN-10 : 8123906773 / ISBN-13 : 978-8123906775
2. V.H., T. (2014). *Practical Textbook of Laboratory Medicine.*CBS publishers and distribution - ISBN-10 : 8123918720 / ISBN-13 : 978-8123918723
3. Praful B. Godkar, D. P. (2014). *Textbook of Medical Laboratory Technology.* bhalani Publishing House - ISBN-10 : 9780074632239 / ISBN-13 : 978-0074632239

REFERENCE BOOKS

1. ChatterjeeRanashinde. (2012). *Medical Biochemistry.* Jaypee - ISBN : 9789350254844
2. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders -
3. Sood, R. (2009). *Medical Laboratory Technology Methods and Interpretations.* Jaypee - ISBN 10: 9351523330 / ISBN 13: 9789351523338

BSc FIFTH SEMESTER

Course Title: GENETICS (Elective Paper-I)

		Credits	**: 05**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	CO Statement
CO1	Explain the law of segregation, law of independent assortment. Mendel's monohybrid and dihybrid cross with examples.
CO2	Define the Features of Inheritance, discrete inheritance, cytoplasmic inheritance and sex linked inheritance. Draw Notation and diagrams- Integration of multiple genes.
CO3	Understand the concepts of linkage and types of linkage and its significance.
CO4	Explain and relate the basic concepts of crossing over, types and significance.
CO5	Explain and apply the key concepts in DNA and chromosomes, and mutations with examples.

Mapping of Course Outcomes to Program specific Outcomes:

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

CORRELATION: 3-STRONG 2-MEDIUM 1-LOW

S.No.	Content of Module	Hrs	Cos
MO1	History: Mendelian and classical genetics - Mendel's material and crossing over technique, phenomenon of dominance, incomplete dominance, codominance, law of segregation, law of independent assortment, Mendel's monohybrid and dihybrid cross, test cross with examples.	**15**	**CO1**
MO2	Features of inheritance - Discrete inheritance, cytoplasmic inheritance, and sex linked inheritance and its significance – Notationand diagrams - Interactions of multiple genes	**15**	**CO2**
MO3	Linkage – Bateson and Punnet's coupling and repulsion hypothesis, Morgan's view on linkage , types of linkage – complete linkage incomplete linkage , linkage groups , significance of linkage.	**,15**	**CO3,CO5**
MO4	Crossing over - Types of crossing over – somatic or mitotic crossing over, germinal or meiotic crossing over, mechanism, duplication,breakage and union, terminalization, significance of crossing over.	**15**	**CO4, CO5**
MO5	DNA and chromosomes mutations – types – point, multiple, spontaneous, induced, sex linked mutations with example, significance of mutation.	**15**	**CO5**

RECOMMENDED BOOKS

1. P.S.Verma. (2006). *Cell Biology, Genetics, Molecular Biology, Evolution & Ecology;.* S Chand - ISBN 10: 8121924421 / ISBN 13: 9788121924429
2. Neil A. Campbell, J. (2007). *Biology* (8th ed.). Pearson - ISBN 10: 0805368442 / ISBN 13: 9780805368444
3. Raven, P. H. (2005). *Biology* (7th ed.). McGraw-Hill Companies - ISBN: 9780072921649

REFERENCE BOOKS

1. Griffiths, A. J. (2009). *Introduction of Genetic Analysis* (9th ed.). W.H.Freeman and Company - ISBN 10: 0716768879 / ISBN 13: 9780716768876
2. Russell, P. J. (2000). *Fundamentals of Genetics* (2nd ed.). Benjamin Cummings - ISBN 10: 0321048687 ISBN 13: 9780321048684
3. B.D.Singh. (2014). *Fundamentals of Genetics.* Kalyani Publishers - ISBN : 9789327296075, 9327296079

III BSC Biochemistry

SEMESTER -V

Course Title :MAJOR PRACTICAL ENZYMOLOGY & INTERMEDIARY METBOLISM

Course code	Credits : 02
L:T:P:S : 0:0:3:0	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	Determine the effect of pH, temperature and substrate concentration on the activity of salivary amylase
CO2	Assay the activity of SGOT and SGPT and relate their clinical importance
CO3	Assay the activity of Acid phosphatase and alkaline phosphatase and relate their clinical importance
CO4	Estimate the amount of pyruvate
CO5	Estimate the amount of tryptophan

Mapping of Course Outcomes to Program specific Outcomes:

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

S.No	Contents of Modules	Hours	CO's
MO1	Determination of optimum pH of salivary amylase.	45	CO1, CO2 CO3, CO4, CO5
MO2	Determination of optimum temperature of salivary amylase.		
MO3	Assay of SGPT		
MO4	Assay of activity of SGOT.		
MO5	Assay of Acid phosphatase		
MO6	Assay of Alkaline phosphatase		
MO7	Estimation of pyruvate		
MO8	Estimation of tryptophan		
	Demonstration Experiments		
MO9	Effect of substrate concentration on the activity of salivary amylase -		
M10	Assay of enzyme activity and specific activity of Amylase		

RECOMMENDED BOOKS

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

2. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026

3. Ashwood, B. a. (2001). *Tietz Fundamentals of Clinical chemistry.* WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 9780721686349

REFERENCE BOOKS

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

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

3. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry.* Tata Mc Graw Hill - ISBN: 9780070841659

III BSC Biochemistry

SEMESTER-V

Course Title : MAJOR PRACTICAL VI MOLECULAR BIOLOGY & PHYSIOLOGY

Course code	Credits : 02
L:T:P:S : 0:0:3:0	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
CO 1	Isolate nucleic acids from various sources and estimate the same
CO 2	Examine blood samples and interpret the results in hematology
CO 3	Examine blood smear for cell count
CO 4	Use the stethoscope to determine the pulse
CO 5	Measure blood pressure using sphygmomanometer

Mapping Course Outcomes with Program Outcomes

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

S.No	Contents of Modules	Hours	CO's
MO1	Isolation of DNA from (Plant/animal/ Microbial source	45	CO1, CO2, CO3, CO4, CO5
MO2	Estimation of DNA(unknown)		
MO3	Isolation of RNA from Yeast		
MO4	Estimation of RNA(Unknown)		
MO5	RBC count		
MO6	WBC count – TC, DC		
MO7	Determination of ESR and PCV		
MO8	Determination of bleeding time		
MO9	DEMO EXPERIMENTS Detection of heart sounds using stethoscope		
M10	Measurement of Blood Pressure using Sphygmomanometer		

RECOMMENDED BOOKS

1.Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

2.Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026

3.Ashwood, B. a. (2001). *Tietz Fundamentals of Clinical chemistry.* WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 9780721686349

REFERENCE BOOKS

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

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

6. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry.* Tata Mc Graw Hill - ISBN: 978007084

III BSC Biochemistry
SIXTH SEMESTER

Course Title: BIOINFORMATICS (CORE PAPER IX)

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

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

CO NUMBER	CO Statement
CO1	Introduce the fundamentals of Bioinformatics and its applications explain the components of Bioinformatics Genome, metabalome & Transcriptome.
CO2	Discuss the concepts of sequence alignment and its types. Understand the tool used to detect the expression of genes.
CO3	Develop algorithms for interpreting biological data.
CO4	Classify biological database and to correlate the different file formats used by nucleic acid, protein database, structural and metabolic database.
CO5	Apply the various tools employed in genomic study and protein visualization. Analyse the entire genome by shot gun method.

Mapping of Course Outcomes to Programspecific Outcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Introduction to Bioinformatics – Bioinformatics and its applications. – Genome, Metabolome-Definition, and its applications. Metabolome-Metabolome database-E.Coli metabolome database, Human Metabolome database.Transcriptome-Definition and any three applications.	**15**	**CO1**
MO2	Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genebank, DDBJ) Protein sequence database- Swiss Prot, TrEMBL, Structural Database-PDB,Metabolic database-KEGG	**15**	**CO2**
MO3	Sequence Alignment-Local and Global alignment-Dot matrix analysis, PAM, BLOSUM. Dynamic Programming, Needleman-Wunch algorithm, Smith waterman algorithm	**15**	**CO3**
MO4	Heuristic methods of sequence alignment-BLAST-fearures, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNAMicroarray-Procedure and applications.	**15**	**CO4**
MO5	Structural genomics-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and precomputed tools. Molecular visualizationtools. RAsmol, Swiss PDB viewer. Nutrigenomics- Definition.	**15**	**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 978-1-4471-6702-0

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

Sixth Semester

Course Title: IMMUNOLOGY (CORE PAPER X)

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

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

CO NUMBER	CO Statement
CO1	Associate structure and function of the organs involved in our body's natural Defense
CO2	Classification of antigens and antibodies on the basis of their properties
CO3	Explain the cooperation between the different lymphocytes in defending the Host
CO4	Examine the immunological tests and relate it to the immune status of an Individual
CO5	Understand the immune related diseases and mechanism of transplantation

Mapping of Course Outcomes to Program specificOutcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Structure and function of primary lymphoid organs (thymus ,bone marrow), secondary lymphoid organs (spleen, lymph node), reticuloendothelial cells, phagocytosis.	**15**	**CO1**
MO2	Antigens – Nature, immunogens, haptens. Immunoglobulin types structure and function. Cells involved in antibody formation, differentiation of T and B lymphocyte, Clonal selection theory, co- operation of T-cell with B-cell. Monoclonal antibody – Production andapplication in biology.	**-15**	**CO2**
MO3	Immunity and its types-Innate, Acquired, active and passive. Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA vaccines. Humoral and cell mediated immunity.Complement proteins-Definition, Classical pathway	**15**	**CO3,CO5**
MO4	Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immunodiffusioin, Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Outerlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA.	**15**	**CO4, CO5**
MO5	Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Auto-immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure& functions of MHC, graft Vs host reaction, immunosuppressive Agents.	**15**	**CO5,**

RECOMMENDED BOOKS:

1. Kuby, J. (2018). *Immunology(5th ed).* W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701
2. Roitt, I. (2017). *Immunology(13th ed).* Wiley Black Well - ISBN-10 : 1118415779 / ISBN-13 : 978- 1118415771
3. AK, A. (2011). *Cellular and Molecular immunology.* Elsevier Health Sciences - ISBN 10: 0808921355 / ISBN 13: 9780808921356

REFERENCE BOOKS

1. Paniker. (2017). *Immunology* (10th ed.). University Press - ISBN 10: 1847558569 / ISBN 13: 9781847558565
2. Judy Owen, J. P. (2013). *Kuby Immunology.* International Edition W. H. Freeman - ISBN-10 : 1319114652, ISBN-13 : 978-1319114657
3. Rao, C. V. (2017). *Immunology* (3rd ed.). chennai: Alpha Science Int. Ltd - ISBN-10 : 1842652559 / ISBN-13 : 978-1842652558

Sixth Semester

Course Title: CLINICAL BIOCHEMISTRY (CORE PAPER XI)

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

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

CO NUMBER	CO Statement
CO1	Understand the pathophysiology and molecular basis of Diabetes mellitus and will be able to interpret the biochemical manifestation in galactosemia, fructosuria and glycogen storage disease.
CO2	Discuss the inherited disorders like cystinuria, phenylketonuria, albinism and gout.
CO3	Explain the pathophysiology and differential diagnosis of jaundice.
CO4	Relate the clinical significance of GFT's and KFT's in the assessment of gastric function.
CO5	Demonstrate the diagnostic importance of serum enzymes and Isozymes in assessment of liver damage,bone disorders and myocardial infarction.

Mapping of Course Outcomes to Program specificOutcomes:

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

CORRELATION: 3-STRONG 2-MEDIUM 1-LOW

S.No.	Content of Module	Hrs	Cos
MO1	Blood glucose relation, hypo and hyperglycemia. Diabetes mellitus- types, clinical features and metabolic changes.Glycosuria,galactosemia and fructosuria. Glycogen storage diseases.	**15**	**CO1**
MO2	Etiology and clinical manifestation of phenylketonuria, Cystinuria, Albinism, Maple Syrup Urine diseases, Hypo and hyperuricemia, Gout. Clinical features of atherosclerosis.	**15**	**CO2**
MO3	Liver Function Tests-Jaundice-types-hemolytic, hepatic and obstructive. Differential diagnosis of Jaundice. Test based on excretory function (BSP), Test based on bile pigment metabolism.	**15**	**CO3**
MO4	Renal Function Tests- Clearance tests-Urea, Creatinine, Inulin, PAH test, Concentration and dilution tests. Gastric Function Tests Collectionof gastric contents, examination of gastric residium, FTM, stimulation tests, Tubeless gastric analysis.	**15**	**CO4**
MO5	Clinical Enzymology- Definition of functional and non-functional plasma enzymes. Isozymes and diagnostic tests, enzyme patterns in liver damage, bone disorders, Myocardial infarction.	**15**	**CO5**

RECOMMENDED BOOKS

1. T.M.Devlin. (2006). *Textbook of Biochemistry with Clinical Correlations.* CBS Publishers and Distributers - ISBN 10: 0471513482 / ISBN 13: 9780471513483
2. Gupta, P. P. (2013). Textbook of Biochemistry with Biomedical significance (2nd ed.). CBS Publishers and distributors - ISBN 10: 8123922450 / ISBN 13: 9788123922454
3. U.Chakrapani, U. (2013). *Biochemistry (with Clinical Concepts and Case Approach)* (7th ed.). Elsevier Publishers - ISBN: 9788131237137 8131237133

REFERENCE BOOKS

1. M.N.Chatterjea. (2011). *Textbook of Medical Biochemistry .* Jaypee Brothers.Medical Publishers (P)Ltd - ISBN-13: 978-9350254844, ISBN-10: 9789350254844
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

Sixth Semester

Course Title: PHARMACEUTICAL BIOCHEMISTRY (Elective Paper –II)

		Credits	**: 05**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	**CO Statement**
CO1	Identify the chemistry of drug molecules.
CO2	Explain the routes of drug administration
CO3	Appraise on the novel drug delivery systems compared to the conventional routes.Illustrate the mechanism of drug absorption, distribution and metabolism
CO4	Justify the use of synthetic drugs for different disease systems.
CO5	Highlight the importance of organic phytochemicals in pharmaceuticals

Mapping of Course Outcomes to Program specific Outcomes:

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

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

S.No.	Content of Module	Hrs	Cos
MO1	Drug – Structural feature and pharmacology activity, prodrug concept. Absorption –first –pass effect. Distribution, metabolism- Phase I, I reactions, action of cytochrome p450 & elimination of drug receptor-localization, type and subtypes, models and their drug – receptorinteraction, agonist & antagonist.	**15**	**CO1**
MO2	Adverse response to drugs, IC 50,LD50, of a drug – Drug tolerance, Drug intolerance, Idiosyneracy (pharmacogenesis), drug allergy-allergic responses to sulphadrugs. Drug abuse.	**15**	**CO2**
MO3	Novel drug delivery systems– role of liposomes and nanoparticles indrug delivery – non conventional routes of administration. Anti-AIDS drug development.	**15**	**CO3,CO5**
MO4	Mechanism of action of drugs used in therapy of GI tract disorder – Digestants, appetizers vomiting, constipation suppressants. Hypolipidemic agents, and peptic ulcer. Antibiotics – sulfonamides, trimethoprim, cotrimoxazole and penicillin. Insulin and Oralantidiabetic drugs – sulphonyl ureas, biguanides.	**15**	**CO4 , CO5**
MO5	Bioactive components of plant origin: flavonoids, alkaloids, terpenoids, glycosides, saponins, Home remedies- traditional medicine-Diabetes mellitus and Cancer. Chemotherapy – Cytotoxic drug. Biological analysis of active compounds using HPLC, GC-MS(Basic principles only).	**15**	**CO5**

RECOMMENDED BOOKS:

1. R.S. Satoskar, S. B. (2017). *Pharmacology and pharmacotheraphy.* Elsevier - ISBN-10 : 9788131248867 / ISBN-13 : 978-8131248867

2. Tripathi, K. (2018). *Essentials of Medical Pharmacology.* Jaypee - ISBN-10 : 9350259370 / ISBN-13 : 978-9350259375

3. Katzung, B. G. (2015). *Basic and clinical pharmacology.* Tata Mc Qrahill -

REFERENCE BOOKS

1. Whalen, k. (2018). *Lippinocott Illustrated Reviews: Pharmacology.* Wolters Kluwer India Pvt.Ltd – ISBN-10 : 9388313208 / ISBN-13 : 978-9388313209

2. Trever, A. J. (2015). *Basic and clinical pharmacology.* New York : McGraw-Hill Education – ISBN 10: 0071764011 / ISBN 13: 9780071764018

3. smith, D. G. (2008). *Oxford textbook of clinical pharmacology and drug theraphy* (3rd ed.) -ISBN 10: 0195697316 / ISBN 13: 9780195697315

Sixth Semester

Course Title: INTELLECTUAL PROPERTY RIGHTS (ElectivePaper-II)

Course credits		**Credits**	**: 05**
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	Comprehend Concepts, kinds and economic importance of IPR in India and world
CO2	Differentiate IPR and patent and copyright
CO3	co-relate objectives, rights, infringement and domain defense of trademark and geographical indications
CO4	Explain the protection of traditional knowledge
CO5	Elaborate on protection of plant varieties.

Mapping of Course Outcomes to Program specific Outcomes:

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

CORRELATION: 3- Strong 2- Medium 1- Low

S.No.	Content of Module	Hrs	Cos
MO1	Introduction to Intellectual Property Rights. Definition, scope, economic importance ,IPR in India and World,WTO,TRIPS,WIPO	**15**	**CO1**
MO2	Intellectual Property Protection – Patent Act 1970 and its amendments, procedure for obtaining patents in India, Infringement .Copyrights,Trademarks,Geographical indications, India's position in GI, World treaties,ParisConvention,Budapest Treaty and others international Patent treaties.	**15**	**CO2**
MO3	Patenting of Biological Organisms, Genetically Modified Organisms, Patenting of Pseudomonas putida, Patenting Challenges Faced by Indian scientist Ananth Mohan Chakraborthy,Role of GMM in bioremediation of Oil spills.	**15**	**CO3, CO5**
MO4	Protection of Plant varieties and Farmers Rights Act, 2001.Plant variety protection in india, National gene bank, Justification of plant variety protection	**15**	**CO4, CO5**
MO5	Traditional Knowledge - Definition, holders,bio- prospecting, biopiracy,need for Sui-Generisregime, Digitallibrary,Traditional knowledge international	**15**	**CO5**

RECOMMENDED BOOKS:

1. T.G.Agitha, N. &. (2009). *Principles of intellectual Property.* Eastern Book Company Lucknow - ISBN 10: 8170121132 / ISBN 13: 9788170121138
2. Acharya, N. (2014). *Text book of Intellectual property rights.* Asia Law House .
3. Maxwell, S. a. (2017). *Kerlys Law of trademarks and Trade names* (14th ed.). Thomson.

REFERENCE BOOKS

1. B.L.Wahedra. (2000). *Law relating to patents, Trade marks, Copy Rights, Designs and Geographical Indications.* Universal Law Publishing Pvt.Ltd, India - ISBN-10 : 8175343826 / ISBN-13 : 978-8175343825
2. P.Narayanan. (2010). *Law of Copy Rights and Industrial designs.* Easternlaw House, Delhi - ISBN 10: 8171771904 / ISBN 13: 9788171771905
3. D'Souza, A. P. (2006). *Indian patents Law-Legal and Business implications.* Macmillan India Ltd - ISBN : 1403930368 9781403930361

Sixth Semester

Course Title: PLANT PHYSIOLOGY AND BIOCHEMISTRY

(Elective Paper-II)

Course Code		**Credits**	**: 05**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

At the end of the course students will be able to

CO NUMBER	**CO Statement**
CO1	Define the significance of water and summarize the mechanism of transpiration
CO2	Illustrate the events in photosynthesis
CO3	Explain Nitrogen Fixation by symbiosis biochemistry of nitrogen fixation
CO4	Classify Plant Hormones And Explain Their Functions. Discuss Secondary Metabolites In Plants
CO5	Describe the nitrogen cycle and nitrogen fixation in plants

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO 1	3	3	3	3	3	3	2
CO 2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	1
CO 4	3	3	3	3	3	3	2
CO 5	2	1	3	3	3	2	2

Correlation: 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	Water, its biological significance, water relationship of the plants, osmosis, permeability, diffusion, chemical potential, water potential, metric potential, pressure potential. A general account of absorption and translocation of water, solutes and assimilates. Transpiration and stomatal mechanism.	15	CO1
MO2	Photosynthesis- Definition. Chlorophyll-structure. Structure and functions of chloroplast. Organization of thylakoids. Photosynthetic pigments and functions. An outline of chlorophyll biosynthesis. Mechanism of photosynthesis-light reaction, and dark reactions. Role of Rubisco Emersons effect, photophosphorylation, glycolate metabolism and its significance.	15	CO2
MO3	Respiration-glycolysis, energy conversion stages of glycolysis, metabolism of fats and storage proteins to carbohydrates, regulation of glycolysis, and outline of pentose phosphate pathway. Pyruvate metabolism,TCA cycle, electron transport system coupled with oxidative phosphorylation, inhibitors of electron transport system.	20	CO3
MO4	Phytohormones-Definition, their types and functions. Structure, action, transport, distribution and physiological functions of Auxin, Gibberillin, Cytokinins, Abiscic acid and Ethylene. Phytochemicals-Definition. Types of phytochemicals – Flavonoids, alkaloids, tannins, terpenoids and anthocynanins- their biological functions	15	CO4
MO5	Nitrogen fixation in plants. Nitrogen cycle. Nitrate assimilation, Nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Nitrogen fixation – nodule formation – regulatory factors involved in modulation – Role of nif genes.	10	CO5

RECOMMENDED BOOKS:

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

REFERENCE BOOKS

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

III B.Sc Biochemistry

Sixth Semester

Course Title: Entrepreneurship in Science and technology (Elective Paper III)

Course code		**Credits**	**: 05**
L:T:P:S	**: 3:0:1:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	CO Statement
CO1	Understand the concept and scope for entrepreneurship
CO2	Identify various operations involved in a venture creation
CO3	Gather funding and launching a winning business
CO4	Nurture the organization and harvest the rewards
CO5	Utilize the schemes promoted through knowledge centres and various agencies. Illustrate about the Business incubator centres and Bioentrpreneurship

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	PSO2	PSO 3	PS O 4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	2
CO2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	1
CO4	3	3	3	2	2	2	1
CO5	2	3	2	2	2	2	2

Correlation : 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	**Introduction to Bioentrepreneurship** Introduction to Bioentrepreneurship; Types of industries – Biopharma, Bioagriculture and CRO; Introduction to Patents, Trademarks & Copyrights	10	CO1
MO2	**Business Plan, Budgeting and Funding** Idea or opportunity; Business proposal preparation; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and make in India Initiative; dispute resolution skills; external environment/ changes; avoiding/managing crisis; Decision making ability.	15	CO2
MO3	**Market Strategy** Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding and market; Introduction to information technology for business administration and Expansion	10	CO3
MO4	**Legal Requirements, Finance and Accounting** Legal requirements for starting a company; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: introduction to concepts of balance sheet, profit and loss statement, double entry, bookkeeping; finance and break-even analysis; difficulties ofentrepreneurship in India	10	CO4
MO5	Role of knowledge centres such as universities, innovation centres, research institutions (public & private) and business incubators in Entrepreneurshipdevelopment; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP	15	C O5

RECOMMENDED BOOKS

1. Adams, D. J. (2008). *Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences.* Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361

2. Shimasaki, C. (2014). *Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies.* Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303

3. Onetti, A. &. (2015). *Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge.* Routledge - ISBN 10: 1138616907 / ISBN 13: 9781138616905

REFERENCE BOOKS

1. Jordan, J. F. (2014). *Innovation, Commercialization, and Start-Ups in Life Sciences.* London: CRC Press - ISBN-10 : 812243049X ,ISBN-13 : 978-8122430493
2. Desai, V. (2009). *The Dynamics of Entrepreneurial Development and Management New Himalaya.* New Himalaya House Delhi:pub - ISBN : 9789350440810 9350440814
3. Ono, R. D. (1991). *The Business of Biotechnology, From the Bench of the Street.* Butterworth-Heinemann - ISBN 10: 1138616907 / ISBN 13: 9781138616905
4. Kapeleris, D. H. (2006). *Innovation and entrepreneurship in biotechnology: Concepts, theories & cases - ISBN-13: 978-1482210125, ISBN-10: 1482210126*

III B.Sc., Biochemistry
SEMESTER VI

Course Title : FIRST AID (Elective Paper- III)

		Credits	**: 05**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO NUMBER	**CO Statement**
CO1	Illustrate the importance of first aid
CO2	Analyze the symptoms and treatment for various medical emergencies
CO3	Illustrate the causes and effects of poisoning and its treatment
CO4	Identify the causes and treatment for various aches in the body
CO5	Identify the treatment for various wounds

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	3	3	3	3	3	3	2
CO2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	1
CO4	3	3	3	2	2	1	1
CO5	3	3	2	2	1	1	2

Correlation : 3 strong 2 medium 1 low

S.No.	Content of Module	Hrs	Cos
MO1	**BASIC PRINCIPLES AND TECHNIQUES OF FIRST AID** First aid-Definition and principles of First Aid. Important rules of first aid. Content of first aid kit .First Aid Techniques: Dressings, Bandages and Transport techniques.	15	CO1
MO2	**MEDICAL EMERGENCIES** Choking – symptoms, signs and treatment, Asphyxia – causes, symptoms, signs and treatment, Drowning effects – symptoms, signs and treatment, Suffocation by poisonous gases, Diabetic emergencies – Hyperglycemia,Hypoglycemia – symptoms, signs and treatment.	10	CO2
MO3	**INJURIES AND ANAPHYLACTIC SHOCK** Poisoning - various Routes of poisoning, Effects poisoning, treatment and measures. Stroke and Heart attack, Coronary obstruction and Cardiac arrest– signs, symptoms and treatment. Skin Allergies- treatment. Insect bite Snake bites, Dog bites – symptoms and treatment. Injuries – Head injuries, burns and scalds, Chemical burns, Electric burns, Radiation burns and coldburns – signs, symptoms and treatment.	15	CO3
MO4	**COMMON AILMENTS** Head ache, Tooth ache, Ear ache, - causes and treatment, Common Cold, Cough, Diarrhoea and Dysentery – causes, symptoms, signs and treatment.Blood Pressure, Constipation, Irritable bowel syndrome - signs, symptoms and treatment.	10	CO4
MO5	**WOUNDS AND SAFETY MEASURES IN EMERGENCY** Wounds – Types- Open and Closed wounds. Emergency care for general wounds. Wound with foreign body, Special wound, Wounds to the palm ofhand, abdominal wounds. Head injuries during accidents	10	CO5

RECOMMENDED BOOKS

1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. American Red Cross, K. (1992). *First aid and Safety Handbook* .Little brown and company Boston - ISBN 10: 0316736465 / ISBN 13: 9780316736466
3. Abhitab, L. (2004). *Manual of First aid.* Jaypee brothers, medical publishers - ISBN 10: 8171793843 / ISBN 13: 9788171793846

REFERENCE BOOKS

1. Hubbard, J. (2013). Living Ready Manual - First Aid: Fundamentals for Pocket Survival. Krause Publications- ISBN: 9781440333583
2. Goswami, S. N. (2014). *First aid and Emergency Care Book for Survival.* Kumar Publishing House -
3. *ACEP First Aid Manual : The Step-by-Step Guide for Everyone (Dk First Aid Manual)* (5th ed.). (2014). DK - ISBN 10: 1465419500 ISBN 13: 9781465419507

SEMESTER VI
Course Title: Therapeutic Nutrition (Elective Paper III)

		Credits	**: 05**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

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

CO1	Describe the nature of fever, nutritional requirements define diet during fever
CO2	Apply the nutrition knowledge in weight management
CO3	Classify hypertension and able to trace the root cause, suggest diet for hypertension
CO4	Critically discuss about gastrointestinal disorders and summarize the disease management
CO5	Apply the knowledge of biochemistry in treating metabolic disorders.

Mapping of Course Outcomes to Program specific Outcomes:

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO 1	3	3	1	3	3	3	3
CO 2	3	3	1	3	3	3	3
CO 3	3	3	2	2	3	3	1
CO 4	2	2	2	2	2	2	1
CO 5	2	2	2	2	2	2	1

Correlations : 3 Strong 2 Medium 1 Low

S.No.	Content of Module	Hrs	Cos
MO1	Metabolism, treatment, nutritional requirement and dietary modification during acute, chronic and convalescent stage of fevers. Liquid diets, elemental and synthetic diet. Recent trends in nutrition support.	**12**	**CO1**
MO2	Weight Imbalance- obesity- assessment, risk, etiology and management of a) dietary, b) behaviour, c) pharmaceutical, d) children e) eating disorders. Dietary intake and management- focus on- fat discrimination- SFA, MUFA, PUFA and omega- 3 and 6-fatty acids,	**13**	**CO2**
MO3	Classification, prevalence, morbidity and mortality. Diet related factors influencing development of hypertension. Management- lifestyle, weight, salt restriction and other dietary modifications.	**10**	CO3
MO4	Gastro intestinal system- Disorders ,Classification of disorders- indigestion, acute gastritis and duodenal ulcers. a)Liver disease- hepatitis and alcoholic liver disease (cirrhosis). End stage liver disease (ESLD). Liver function tests. Dietary management and nutritional care. b)Gall bladder disease- cholelithiasis, cholecystitis, cholestasis – acute & chronic conditions. Dietary management and care. c)Pancreas- pancreatitis- acute & chronic. Dietary management and care of the patient.	**15**	**CO4**
MO5	Diabetes Mellitus- IDDM and NIDDM. Malnutrition Related. Diabetes Mellitus. Diagnosis and Management. Gout – Nutritional care, purines, alcohol pharmacological therapy. Dietary modification. Phenyl Ketonuria – Diagnosis and outcome. Nutritional care and management – Ketogenic diet, Homocystinuria	**10**	**CO5**

RECOMMENDED BOOKS

1. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271
2. Srilakshmi, B. (2019). *Dietetics* - (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201
3. B.Srilakshmi, B. (2017). *Food Science* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 8122438091 / ISBN 13: 9788122438093
4. Krause's. (2013). *Food, Nutrition, & Diet Therapy* (11th ed.). W.B. Saunders - ISBN-10 : 0721697844, ISBN-13 : 978-0721697840

REFERENCE BOOKS

1. Swaminathan. (2005). *Advanced Textbooks of food and Nutrition.* BAPP CO PRESS.
2. M.N.Chatterjea. (2011). *Textbook of Medical Biochemistry .* Jaypee Brothers.Medical Publishers (P)Ltd - ISBN-13: 978-9350254844, ISBN-10: 9789350254844
3. Ayling, M. &. (2014). *Clinical Biochemistry* (3rd ed.). Metabolic and Clinical Aspects - ISBN 10: 0702051403 / ISBN 13: 9780702051401

B.SC., BIOCHEMISTRY THIRD YEAR

SEMESTER-VI

Course Title : MAJOR PRACTICAL VII- CLINICAL BIOCHEMISTRY

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

CO NUMBER	CO Statement
CO1	Estimate creatinine by Jaffe's method, urea by DAM-TSC method, cholesterol by Zak's method, protein by Lowry's method
CO2	Estimate the amount of hemoglobin
CO3	Qualitatively analyze urine sample for normal and abnormal constituents
CO4	Demonstrate the collection of blood sample
CO5	List the conditions essential for collection of urine and other clinical samples

Mapping of Course Outcomes to Program specific Outcomes:

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

S.No	Contents of Modules	Hours	CO's
MO1	Estimation of creatinine by Jaffe's method (in serum & urine)	45	CO1, CO2, CO3, CO4, CO5
MO2	1. Estimation of urea by diacetyl monoxime method (in serum & urine)		
MO3	2. Estimation of cholesterol by Zak's method		
MO4	3. Estimation of Glucose by OrthoToluidine method		
MO5	1. Estimation of protein by Lowry's method		
MO6	2. Estimation of Haemoglobin		
MO7	Qualitative analysis of urine for Normal constituents (Chloride, sulphate, phosphate, Urea, Creatinine and Calcium)		
MO8	Qualitative analysis of urine for Abnormal constituents: Glucose, fructose, Protein, Ketone bodies, calcium, Amino acids (Tryptophan, and cysteine)		
MO9	Collection and Preservation of Blood sample		
M10	Collection and preservation of urine sample.		

RECOMMENDED BOOKS

1.Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493

2.Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026

3.Ashwood, B. a. (2001). *Tietz Fundamentals of Clinical chemistry.* WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 9780721686349

REFERENCE BOOKS

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

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

6.Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry.* Tata Mc Graw Hill - ISBN: 978007084165

III BSC Biochemistry

SEMESTER – VI

MAJOR PRACTICAL VIII- BIOINFORMATICS AND IMMUNOLOGY

Course code		**Credits**	**: 02**
L:T:P:S	**: 0:0:3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 50**

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

CO	Description
CO1	Identify blood groups, test for complement fixation,RA factors
CO2	Test for quantitative determination of antigens
CO3	Analyze and Interpret nucleotide,protein sequences using biological database tools
CO4	Examine the structure of proteins using computational tool , Interpret the relationship between species by sequence alignment
CO5	Examine homology search using Bioinformatics tool ,Predict 3D structure of proteins using RASMOL

Mapping of COs TO PSOs (MSc Program)

PSO/CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	**3**
CO2	3	3	3	3	3	3	**3**
CO3	3	3	3	3	3	3	**3**
CO4	3	3	3	3	3	3	**3**
CO5	3	3	3	3	3	3	**3**

S.No.	Content of Module	Cos
MO1	ABO Blood grouping and Rh factor typing by agglutination technique	CO1
MO2	Detection of Rhematoid arthritis (RA) factors by agglutination	
MO3	Widal Test-Slide & tube agglutination Test	CO2
MO4	Precipitatio reaction-RID – Radial Immuno Diffusion	
MO5	Precipitation reaction-.DID – Double Immuno Diffusion	
MO6	Sequence Database	CO3
	a. Nucleotide – NCBI GenBank	
	b. Protein – PrEMBL	
MO7	Structure Database – PDB	
MO8	Sequence alignment – Global and Local	CO4
MO9	Homology search tools : Blast p, Blast n	
MO10	Visualization Tool – Rasmol	CO5

RECOMMENDED BOOKS

1. Immunology: Overview and Laboratory Manual TobiliSam-Yellowe, Springer,1st editio,2020
2. Laboratory Manual on Immunology and Molecular biology- Deepak Diwedi and Vinod – Lambert Academic Publishing, 2013
3. Bioinformatics practical Manual:SequencingPractical- Mohammed Iftekhar,Mohammed Ghalib, Kindle edition,2015