

तार : विश्वविद्यालय
Gram : UNIVERSITY



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बुन्देलखण्ड विश्वविद्यालय, झाँसी BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ: BU/Biochem/2022/015

दिनांक 25/06/2022

The Minutes of Meeting of BOS

In reference to the BOS of department of
Biochemistry....., Institute of Life Sciences
..... held on 25/06/2022 regarding the
revision of syllabus in tune with CBCS/NEP-2020 and subsequent
approval from Academic Council. This is to certify that the syllabus is
100% revised.

Ap
Registrar
Bundelkhand University
JHANSI

Shahina
HOD/Coordinator
Dr. Shahina Kalim
Co-Ordinator
Department of Biochemistry
Bundelkhand University, Jhansi

- ③ Names of few papers have been changed.
- ④ CBCS system has been implemented/proposed.
- ⑤ Some of the paper's Title has been changed: Biomolecules to General Biochemistry; Bioinformatics to Bioinformatics & Biostatistics; Molecular biology & bioinformatics to Molecular Biology; Biotechnology as Genetic Engineering.
- ⑥ Syllabus of General Biochemistry, Bioinstrumentation & Analytical Techniques, Bioinformatics & Biostatistics, Immunology, Molecular Biology and Genetic Engineering has been modified/updated as discussed in the meeting with Academic Director.

(Signature)
 08/08/18

Shahina
 08/08/18

(Signature)
 08/08/18

201014

DEPARTMENT OF BIOCHEMISTRY

J.C. BOSE INSTITUTE OF LIFE SCIENCES

BUNDELKHAND UNIVERSITY, JHANSI (U.P.) - 284128



SYLLABUS for M.Sc. in Biochemistry

Under

NATIONAL EDUCATION POLICY-2020

(Effective from the Session: 2022-2023)

COURSE CURRICULUM

Master of Science (Biochemistry)

Year	Semester	Subject Code	Subject Title	Type	Credits	Marks		
						Internal	External	Total
Year - I	Semester -I	BCH-101	Bioinstrumentation and Analytical Techniques	Core	4	25	75	100
		BCH-102	General Biochemistry	Core	4	25	75	100
		BCH-103	Human Physiology and Molecular Endocrinology	Core	4	25	75	100
		BCH-104	Molecular Cell Biology	Core	4	25	75	100
		BCH-105	Practical I	Core	2	25	75	100
		BCH-106	Practical II	Core	2	25	75	100
		BCH-107	Minor Elective* ¹	Core	4	25	75	100
		BCH-108	Research Project/Industrial training/Survey/Field Training	Core	4	25	75	100
	Total Credits: 28					Total Marks: 800		
	Semester -II	BCH-201	Bioinformatics and Biostatistics	Core	4	25	75	100
		BCH-202	Molecular Biology	Core	4	25	75	100
		BCH-203	Plant Biochemistry	Elective 1	4	25	75	100
		BCH-204	Microbiology	Elective 2	4	25	75	100
		BCH-205	Health Awareness	Elective 3	4	25	75	100
		BCH-206	Practical III	Core	2	25	75	100
BCH-207		Practical IV	Core	2	25	75	100	
BCH-208		Research Project/Industrial training/Survey/Field Training	Core	4	25	75	100	
Total Credits:24					Total Marks:700			
Bachelor (Research) in Biochemistry (52 Credits)								
Year - II	Semester -III	BCH-301	Genetic Engineering	Core	4	25	75	100
		BCH-302	Immunology	Core	4	25	75	100
		BCH-303	Bioenergetics and Intermediary Metabolism	Elective 1	4	25	75	100
		BCH-304	Physicochemical Aspects of Biology	Elective 2	4	25	75	100
		BCH-305	Medical Biochemistry	Elective 3	4	25	75	100
		BCH-306	Practical V	Core	2	25	75	100
		BCH-307	Practical VI	Core	2	25	75	100
		BCH-308	Research Project/Industrial training/Survey/Field Training	Core	4	25	75	100
	Total Credits:24					Total Marks:700		
	Semester -IV	BCH-401	Enzymology	Core	4	25	75	100
		BCH-402	Industrial Bioprocess Technology	Core	4	25	75	100
		BCH-403	Proteomics	Core	4	25	75	100

		BCH-404	Medicinal and Pharmaceutical Biochemistry	Core	4	25	75	100	
		BCH-405	Practical VII	Core	2	25	75	100	
		BCH-406	Practical VIII	Core	2	25	75	100	
		BCH-407	Research Project/Industrial training/Survey/Field Training	Core	4	25	75	100	
		Total Credits:24				Total Marks:700			
Master of Science in Biochemistry (100 Credits)									

*1 Student have to select one Minor Elective Course as Minor subject from any other faculty (except own faculty) or interdisciplinary subject from list of Minor Elective Course (point vi).

*2 Student have to select any two elective in second and third s

National Education Policy -2020

**DEPARTMENT OF BIOCHEMISTRY
BUNDELKHAND UNIVERSITY, JHANSI**

SYLLABUS FOR THE DEGREE OF

“BACHELOR OF RESEARCH IN BIOCHEMISTRY”

(In continuation of B.Sc (Hons.) BIOCHEMISTRY)

(First year)

(Total Credits in First Year: 52)

Title of Paper: BIOINSTRUMENTATION AND ANALYTICAL TECHNIQUES

Type: BCH – 101 CORE

SEMESTER – I

TOTAL CREDITS: 4

TOTAL HOURS: 48L+12T+0P

Course Objectives

- The primary objectives of this course are to develop the skills to understand the theory and practice of bioanalytical techniques and bioinstrumentation
- To provide scientific understanding of analytical techniques and detail interpretation of results

Course Learning Outcomes

- Understanding the applications of biophysics and principle involved in bioinstruments, methodology involved in biotechniques
- Applications of bioinstruments

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Chromatography Principle, types and applications-partition, adsorption, gel filtration, paper, thin layer, gas chromatography, ion exchange, molecular sieve, supercritical fluid and HPLC	8L+2T
2.	2.	Electrophoresis Principle, instrumentation and applications of moving boundary and zonal electrophoresis, including paper and gel (SDS-PAGE and Agarose) electrophoresis, iso electrofocusing, PFGE and Capillary electrophoresis.	8L+2T
3.	3.	Centrifugation Principles of sedimentation & centrifugation, types of centrifuge, differential and density gradient centrifugation	8L+2T
4.	4.	Microscopy Principles and applications of light microscope, fluorescence, Phase contrast, Dark field, electron (TEM and SEM), interference, polarization, inverted and stereomicroscope. Freeze fracture, fixation	8L+2T

		and staining	
5.	5.	Spectroscopy Principle, Instrumentation and applications of UV-Visible, IR, NMR, atomic absorption Fluorescence spectroscopy, X-ray Crystallography and Mass Spectrometry.	8L+2T
6	6.	Radiation Biology Radioisotope Techniques: Radio-tracers, interaction of radiation with matter, GM counter, Scintillation counters, autoradiography and radioimmunoassay.	8L+2T

List of Reference Books

1. Instrumental Analysis : D. Skoog
2. Biophysical Chemistry: David Sheehan
3. Principles of Biophysical Chemistry: David Frifelder
4. Biophysics: Upadhyay & Upadhyay
5. Methods of Instrumental Analysis: Willard
6. Principles and techniques of practical Biochemistry, by Wilson / Walker: Wiley Publication (2010)

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: GENERAL BIOCHEMISTRY

Type: BCH-102 CORE

SEMESTER – I

TOTAL CREDITS: 4

TOTAL HOURS: 49+11T+0P

Course Objectives

Students will learn the fundamental of Biochemistry and the structure and function of various bio molecules. The objective of this paper is to provide students with a basic understanding of Structural, chemical biology and functions of macromolecules (Nucleic acids, proteins, carbohydrates and lipids). They shall also learn and explore about porphyrins, vitamins and enzymes

Course Learning Outcomes

After successful completion of the course student will be able to understand

- Classification and structural properties of carbohydrates and lipids, glycoproteins and glycolipids and proteo glycans their significance in biological systems.
- Structure and Classifications of aminoacids and protein based on different criteria, ramachandran plot and fibrous and globular protein. Evolution of proteins
- Structure and conformations of nucleic acids, physical and functional property of DNA and RNA
- Understand importance of porphyrins
- Understand classification and properties of enzymes

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Carbohydrates Classification of Structure of Glucose, fructose, mannose, galactose, lactose, sucrose, glycogen, starch and cellulose. Isomerism, Structural and stereoisomers, optical, geometric. Mutarotation, Enantiomers, epimers and Diastereoisomers. Anomers.	8L+2T
2.	2.	Lipids Classification. Triglycerides, Waxes, Phospholipides,	8L+2T

		<p>sphingolipids, sterols, cholesterol. Fats and oils. Classification of fatty acids, essential fatty acids.</p> <p>Lipoproteins. Glycoproteins and Glycolipids. Self-assembly of lipids, micelle, biomembrane organizations.</p>	
3.	3.	<p>Protein</p> <p>Classification of proteins-Amino acids, Classification and structure. Essential amino acids, non-protein and non-standard amino acids.</p> <p>Protein structure, Determination of amino acid sequences of proteins. Primary secondary, tertiary and quaternary structure of proteins. Forces stabilizing structure of proteins. Salting in and salting out of proteins. Denaturation and renaturation of proteins. Protein degradation and molecular pathways controlling protein degradation Basic principles of protein purification, Protein folding, Chaperons. Diseases associated with protein folding. Ramachandran plot. Evolution of protein structure.</p>	9L+2T
4.	4.	<p>Nucleic acids</p> <p>Structure and properties of purine and pyrimidine bases and DNA and RNA. Functions of nucleic acids. Physical properties, Secondary structure, tertiary structure of nucleic acids. Base composition. Base pairing. Helix coil transitions. T_m and relation to GC content. Physical properties and Classes of RNA.</p>	8L+2T
5.	5.	<p>Porphyrins</p> <p>Porphyrin nucleus, classification and structures of porphyrins. Metalloporphyrins. Bile pigments-chemical nature and their physiological significance.</p>	7L+1T
6	6.	<p>Vitamins and Enzymes</p> <p>Fat soluble and water soluble vitamins General characteristics of enzymes. Definition of coenzymes, holoenzymes, prosthetic group, cofactors, activators. Nomenclature and classification. Enzyme kinetics and Michaelis and Menton equation and inhibition.</p>	9L+2T

List of Reference Books

1. Principles of Biochemistry: Lehninger
2. Biochemistry: Lubert Stryer

3. Biochemistry: Voet and Voet

4. Biochemistry: B. D. Singh

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: HUMAN PHYSIOLOGY & MOLECULAR ENDOCRINOLOGY

Type: BCH-103 CORE

SEMESTER - I

TOTAL CREDITS: 4

TOTAL HOURS: 47 L+14T+0P

Course Objectives

To provide a course of study in mammalian, principally human, systems physiology, building on knowledge of basic physiological principles

Course Learning Outcomes

- To understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems
- To understand how these separate systems interact to yield integrated physiological responses

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Nerve Mechanism of conduction of nerve impulse along axon and synapse. Physiology of vision. olfaction and taste, hearing, neurotransmission, neurotransmitter inhibitors and their receptors.	7L+2T
2.	2.	Blood Composition and function, structure and function of RBC, WBC and platelets, blood volume, blood grouping and blood transfusion. Mechanism of blood coagulation. Hemoglobin, anaemias, erythrocyte sedimentation rate (ESR), lymph, haemopoiesis	6L+2T
3.	3.	Respiration Principles governing exchange of gases in the lungs and in tissues transport of oxygen and carbon dioxide, and regulation of respiration. Role of 2, 3- BPG, Bohr effect and chloride shift, pulmonary volumes	7L+2T
4.	4.	Digestion Digestion and absorption of food, composition and functions of saliva, gastric juice , pancreatic juice, bile and intestinal juice,	6L+2T

		zymogen activation	
5.	5.	Excretion Urine and feaces formation.Regulation of water and electrolyte balance. Regulation of body temperature, Acid-base balance and its regulation by kidney	7L+2T
6.	6.	Hormones General characteristics and classification of hormones. Secretion and function of hormones secreted by pituitary gland, hypothalamus, thyroid gland, parathyroid glands, adrenals, islets of langerhans, testis and ovary. Pheromones, Mechanism of action of homones	7L+2T
7.	7.	Introduction to Behavioral Physiology, circadian rhythms Stress and adaptation: Effects, defense mechanisms and coping strategies	7L+2T

List of Reference Books

1. Principles of anatomy and physiology: Tortora and Derrickson
2. Medical physiology: Guyton and Hall
3. Review of medical physiology: W.F. Ganong

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture.
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-Voce
3. Main Semester Examination

Title of Paper: MOLECULAR CELL BIOLOGY

Type: BCH-104 CORE

SEMESTER - I

TOTAL CREDITS: 4

TOTAL HOURS: 50L+10T+0P

Course Objectives

The purpose of the course is to give the students a molecular understanding of cell biological mechanisms and their regulation.

Course Learning Outcomes

Understanding Biological Membranes, Membrane transport, Protein Targeting and Sorting, Cell Signaling.

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Introduction Plant and animal cell, Eukaryotic and prokaryotic cell	5L+1T
2.	2.	Structural organization and function of intracellular organelles Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, Endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast and cytoskeleton. Role of cytoskeleton in maintain cell shape. erythrocyte cytoskeleton, cell motility	6L+2T
	3.	Membrane Biochemistry (i) Biological Membranes Physicochemical properties of cell membranes, molecular constituents of membranes, super molecular architecture of membrane, artificial membranes, micelles, bilayer, monolayer, liposomes, Gap and tight junction. Different models of cell membranes- a histochemical perspective. (ii) Membrane transport Solute transport across membranes, simple, passive, facilitated diffusion, ficks law, Active transport-primary and secondary	11L+3T

		group translocation, transport ATPases, molecular models of transport, mechanism, mobile carriers and pores mechanism, transport by vesicle formation , membrane biogenesis and regulation of cell membrane components, cell-cell interaction.	
4.	4.	Protein Targeting and Sorting Post translational import of proteins to mitochondria, lysosomes, plasma membrane, nucleus, secretory vesicles, chloroplast, peroxisomes	8L+1T
5.	5.	Cell Signaling Characterstics and function of receptor, Molecular basis of signal transduction in bacteria, plants and animals, G-proteins and kinase, secondary messengers	8L+1T
6	6.	Cell cycle and cell division Mitosis, meiosis and their regulation, cell senescence and death	6L+1T
7	7.	Cellular basis of differentiation and development, gametogenesis and fertilization, organogenesis. Stem cell and its applications	6L+1T

List of Reference Books

1. Molecular cell biology: James Darnell, Paul Matsudaira, Lawrence Zipursky, Harvey Lodish, Arnold Berk, David Baltimore.
2. Molecular biology of The Cell: Albert Jhonson, Lewis Rafe, Robert Walter
3. Molecular Cell Biology: P.K. Gupta
4. Cell and molecular Biology: D Robertis

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PRACTICALS - I

Type: BCH – 105 CORE

SEMESTER - I

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+0 Hrs.+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Isolation of chloroplast from spinach leaves	60 hours
2) Estimation of chlorophyll content	
3) Separation of photosynthetic pigments by TLC	
4) Separation of RBC membrane proteins by SDS-PAGE	
5) Determination of total iron binding capacity	

List of Reference Books

1. Practical Textbook of

BIOCHEMISTRY

DM Vasudevan,

Subir Kumar Das

2. Introduction to Practical Biochemistry

György Hegyi

József Kardos

Mihály Kovács

András Málnási-Csizmadia

László Nyitray

Gábor Pál

László Radnai

Attila Reményi

István Venekei

3. Biochemistry Practical Manual

Soundravally Rajendiran, Pooja Dhiman

Title of Paper: PRACTICAL - II

Type: BCH-106 CORE

SEMESTER- I

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+0 Hrs+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Pulmonary function tests	60 hours
2) Spirometry and measurement of blood pressure	
3) Separation of isoenzymes of LDH by electrophoresis	
4) Case study : Renal clearance	
5) Case study : ECG	

List of Reference Books

1. Practical Textbook of
BIOCHEMISTRY

DM Vasudevan,
Subir Kumar Das

2. Introduction to Practical Biochemistry

György Hegyi

József Kardos

Mihály Kovács

András Málnási-Csizmadia

László Nyitray

Gábor Pál

László Radnai

Attila Reményi

István Venekei

3. Biochemistry Practical Manual

Soundravally Rajendiran, Pooja Dhiman

Title of Paper: BIOINFORMATICS AND BIOSTATISTICS

Type: BCH-201 CORE

SEMESTER - II

TOTAL CREDITS: 4

TOTAL Hours: 49 L+11T+0P

Course Objectives

- Demonstrate the basic knowledge of computers and Bioinformatics
- How the biological data can be search online
- Application of statistics in biological data

Course Learning Outcomes

- Knowledge of basic computer tools that help in biological data analysis and storage and the application of biostatistics in it.
- Understanding the knowledge of various online biological data platform

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Introduction to computers and Bioinformatics Software and Hardware, storage and memory devices, input and output devices, internet and e-mail. Bioinformatics-History, scope and applications	7L+1T
2.	2.	Biological databases EMBL, GENBANK, DDBJ, PIR, PDB, SWISSPROT and TRMBL. Understanding the structure of each source and using it on the web	9L+2T
	3.	Sequence alignments Pairwise sequence Alignments, FASTA and BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment and Phylogenetic Analysis. Open reading frame. Protein Secondary structure prediction methods, and homology modeling	7L+2T

4.	4.	<p>Descriptive Statistics</p> <p>Introduction of Statistics, Applications and drawback of Statistics, Concept of variables in biological systems, Collection, classification, tabulation, graphical and diagrammatic representation of numerical data</p> <p>Measures of central tendency: Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Quartiles.</p> <p>Measures of Dispersion: Range, Quartile deviation, Mean deviation, Standard deviation and Coefficient of variation.</p> <p>Correlation and Regression: Correlation coefficient, Rank correlation, Regression coefficients, Regression lines (Yon X and X on Y)</p>	10L+2T
5.	5.	<p>Probability theory and Tests of Significance</p> <p>Probability: Introduction, Random experiment, Sample space, Events, Definition of Probability, Addition and Multiplication Law of Probability, Conditional Probability, Bayes theorem, Applications of probability. Probability Distributions: Random variables, Binomial distribution, Poisson distribution and Normal distribution, Applications of distributions.</p> <p>Tests of Significance: Based on t, F, Z and Chi- square distributions</p>	8L+2T
6	6.	<p>Analysis of Variance and Design of Experiment</p> <p>ANOVA: One-Way and two way classifications.</p> <p>Design of Experiment: Principles of Design of Experiment, Completely Randomized Design (CRD), Randomized Block Design, (RBD), Latin Square Design (LSD). Statistical and graphic software- their use in research for data analysis, interpretation and presentation</p>	8L+2T

List of Reference Books

1. Bioinformatics. Baxevanis, A.D. and Quçlette, B.F.F
2. Bio informatics. Des Higgins & Willie Taylor
3. Bioinformatics. Methods and protocols. Macsewer, S.
4. Bioinformatics. Sequence and genome analysis. Mount, D. W

5. Computer fundamentals. Nagpal, D.P.
6. Methods in Biostatistics. Mahajan, B.K.
7. Biostatistics. Arora, P.N. and Malhan, P.K
8. Elements of Biostatistics. Prasad,S.
9. Practical in statistics. Sharma, H.L.
10. Fundamentals of Mathematical Statistics. Gupta, S.C. and Kapoor, V.K.
11. Mathematics for Biosciences- **Arya J.C and Lardner, R.W**

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: MOLECULAR BIOLOGY

Type: BCH-202 CORE

SEMESTER-II

TOTAL CREDITS: 4

TOTAL HOURS: 48 L+12T+0P

Course Objectives

Molecular biology deals with nucleic acids (replication and transcription) and proteins and how these molecules interact within the cell to promote proper growth, division, and development. This course will emphasize the molecular mechanisms of DNA replication, repair, and protein synthesis. The main objective of course to provide with the core principles of molecular biology.

Course Learning Outcomes

Upon successful completion of this course student should be able to:

- Learning and understanding the concepts of central dogma of molecular biology.
- Explain the concept of DNA and RNA as genetic material through experimental techniques.
- To discuss the mechanism of DNA replication and DNA repair in prokaryotes and eukaryotes.
- .To explains the transcription mechanism in prokaryotes and eukaryotes.
- To explains the protein synthesis mechanism in prokaryotes and eukaryotes.
- To discuss the regulation of gene expression and mutation

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Introduction of nucleic acids Nucleic acid as genetic information carriers, experimental evidenced: Bacterial genetic transformation, Harshey Chase experiment, TMV reconstitute experiment. Central dogma of molecular biology, Reverse transcription Organization of prokaryotic and eukaryotic genome, DNA supercoiling, chromatin-histone and non-histone proteins. General properties of histones, Nucleosome model, solenoid structure, C- value and C-value paradox	8 L+2T
2.	2.	Replication and DNA repair	8 L+2T

		Various modes of replication, Semiconservative replication- Messelson and Stahl experiment, Primase and primosome, prokaryotic and eukaryotic DNA replication, Role of different proteins and enzymes involved in DNA replication, Rolling circle model of replication ØX I74 Phase, inhibitors of Replication. Photoreactivation repair, Base excision repair, nucleotide excision repair, Mismatch repair, SOS and recombination repair	
	3.	Transcription Transcription in Prokaryotes and Eukaryotes, initiation, elongation and termination, RNA polymerase, Promoters, Operators, post-transcriptional processing of RNA in eukaryotes (RNA splicing, poly A tailing, 5'- capping). Concept of intron and exon, Maturation of rRNA, tRNA. mRNA, inhibitors of transcription	8 L+2T
4.	4.	Translation Genetic code- Basic features of genetic code, codon and anticodon Wobble hypothesis. Mechanism of translation in prokaryotes and eukaryotes-initiation, elongation and termination, charged tRNA, Shine-Dalgarno sequences, role of EF-Tu, EF-Ts in protein synthesis, non-sense codons and release factors, inhibitors of protein synthesis	8 L+2T
5.	5.	Regulation of gene expression Constitutive genes. Operon concept, negative and positive regulation, <i>lac</i> , <i>trp operons</i> , DNA methylation, Histone modification, Post transcriptional gene silencing	8 L+2T
6	6.	Mutation Mutagenesis-chemical and physical, types of mutation eg. Transition and transversion, spontaneous and induced, germinal and somatic, frame shift and substitution mutation, backward and forward mutation. Lederberg's replica plating experiment, Random and site directed mutagenesis. Ames's testing	8 L+2T

List of Reference Books

1. Molecular biology of the gene Watson *et al.*
2. Lehninger Principles of Biochemistry. Nelson and Cox.
3. Gene. VIII Lewin, B.

4. Principles of Genetics. Gardner, Simmons and Snustard
5. Molecular Biology and Genetics engineering. Gupta, P.K.
6. Molecular Cell Biology, Lodish *et al*

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PLANT BIOCHEMISTRY

Type: BCH-203 ELECTIVE - 1

SEMESTER - II

TOTAL CREDITS: 4

TOTAL HOURS: 48 L+12T+0P

Course Objectives

The main objective of this course is to impart students an understanding of Plant biotechnology and its application in various field such as agriculture

Course Learning Outcomes

- Students understand the plant cell structure, morphology and function.
- The various factor that involve in plant life

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Structure and functions of plant cell (including cell wall, plasmodesmata, meristematic cell, vacuoles, and secretory system and root quiescent zone). Isolation of cell organelles, Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem, transpiration, mechanisms of loading and unloading of photoassimilates	8L+2T
2.	2.	Structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transport in chloroplast of plants and in purple bacteria. Light receptors, chlorophyll, light harvesting complex, bacteriorhodopsin, rhodopsin as ion pump	8L+2T
3.	3.	Photosystem I & II, their location, mechanism of quantum capture and energy transfer between photosystem-ferredoxin, plastocyanin, plastoquinone, carotenoids. Hill reaction, Photophosphorylation and reduction of carbon dioxide, Calvin cycle, C3, C4 and CAM metabolism, light and dark reaction, light activation of enzymes, regulation of photosynthesis, photorespiration	8L+2T
4.	4.	Structure and function of nitrogenase complex, mechanism of nitrogen fixation; nitrate reduction. Structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Sulphate reduction and its incorporation into amino acids	8L+2T

5.	5.	Special features of secondary plant metabolism: terpenes (classification, biosynthesis), phenols, nitrogenous compounds, flavonoids, lignin, tannins, pigments, phytochrome, waxes, Alkaloids, biosynthesis of nicotine, functions of alkaloids, cell wall components	8L+2T
6	6.	Seed Physiology: Biochemistry of seed development, dormancy-mechanism and uses. Biochemistry of fruit ripening. Artificial seeds-preparation and their uses	8L+2T

List of Reference Books

1. Plant Biochemistry by Hans Walter Heldt
2. A Text book of Plant Physiology & Biochemistry by S. K. Verma
3. Plant Physiology- Salisbury and Ross
4. Plant Physiology by Purohit

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture.
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: MICROBIOLOGY

Type: BCH - 204 ELECTIVE-2

SEMESTER – II

TOTAL CREDITS: 4

TOTAL HOURS: 50 L+10T+0P

Course Objectives

- To understand the microbial world
- Effect of micro-organism on health, environmental, social, cultural, industrial and economic benefits

Course Learning Outcomes

- Apply the knowledge to understand the microbial physiology and to identify the microorganisms.
- Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Types of microorganisms, general characteristics of main groups of microorganisms, criteria used in the classification of microorganisms, cytology, genetics, host specialization	10L+2T
2.	2.	Structure, classification, reproduction and economical importance of virus, bacteria and fungi	10+2T
3.	3.	Culturing of bacteria, continuous culture, different phases of growth, growth curve, and factors influencing growth, synchronous growth, sterilization methods, pure culture and preservation strategies. Nutrition, physiology and growth of microbial cells. Gram positive and gram negative bacteria, structure and function of peptidoglycal in gram positive and gram negative bacteria. Special features of bacterial metabolism, food spoilage, fermentation, food borne infections	12L+2T
4.	4.	Bioreactors and production of antibiotics, enzymes, organic acids,	6L+2T

		alcohols, hormones and vitamins	
5.	5.	Microbiology of degradation of xenobiotics, ecological consideration, decay behaviour, degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, and pesticide. Bioremediation of contaminated soils and wastelands. Immobilization of m3	12L+2T

Lst of Reference Books

1. Principles of Microbiology: R.M. Atlas
2. Text book of Microbiology : Prescott
3. Microbiology: M.J. Pelczar, E.C.S. Chan and N.R. Krieg
4. General Microbiology: R.Y. Stanier, J.L. Ingraham, M.L. Wheelis and P.R. Painter

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture.
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: HEALTH AWARENESS

Type: BCH-205 ELECTIVE-3

SEMESTER - II

TOTAL CREDITS: 4
TOTAL HOURS: 51L+9T+0P

Course Objectives

- The aim of this course is to give you a basic level of understanding relating to the essentials of physical and mental health.
- Raises awareness of the kinds of health risks

Course Learning Outcomes

- Understand and implement hazard identification and risk of physical and mental health
- Understand the importance of mental health

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Introduction to the most common mental disorders, Identifying Risk Factors associated with poor mental health, Defining internalizing and externalizing behaviors, Diagnosing mental health problems.	7L+1T
2.	2.	Definition of Personality, Development of Personality, Assessment of Personality, The Power of Personality, Personality Disorders, Personality Traits and Abilities and Seafaring. Definition of Stress: Eustress and Distress, Work related stress factors, Effects of Stress, Stress Management, Definition of Anger, hostility and Aggression understanding the difference and dealing with anger effectively and productively, Anger as a Social Script. Emotional literacy- Develop Self Awareness, Empathy, Social Awareness.	10L+2T
	3.	Techniques for mastering emotional literacy: Ability to identify , affirm, value and validate feelings, Reconstructing and Reframing emotions, Waking up techniques for emotional literacy, ABC of emotions, Navigating emotions : Breathe, concentrate, balance, Exercise Optimism – Positive Experience Recall	10L+2T

	4.	Food habits for good health, food and water contamination, Balanced diet, importance of vitamins, home and workplace hygiene, Harmful effects of excessive uses of computer and cellphone, radiation from mobile affecting human health, addiction towards social network, protection from UV rays, protection from sound effects, heat and cold season precautions, pollution affecting human health. Precautions during travelling, good and bad cholesterol, body weight, first aid for home	10L+2T
	5.	Biological clock, importance of sleep, requirement and importance of exercise, Age related disorders, routine body checkup, consultation with physician, medicine/antibiotic courses, healthy maintenance and awareness about each important organ of human body such as ear, mouth, teeth, tongue, heart, lungs, stomach, thyroid, genital organs, blood, awareness to control emerging infectious diseases, vaccination requirement & importance, BMI, BMR, detoxification	14L+2T

Lst of Reference Books

1. Eat to Beat Disease: The New Science of How Your Body Can Heal Itself by William W Li
2. A Guide To Mental Health & Psychiatric Nursing by Sreevani R
3. Textbook of Nutrition and Dietetics, Sharda Gupta, Santosh Jain Passi, Rama Seth, Ranjana Mahna, Seema Puri and Kumud Khanna

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture.
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PRACTICAL - III

Type: BCH-206 CORE

SEMESTER - II

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+0 Hrs+60 Hrs)

Practicals

List of Practical	No. of Hours (L+T+P)
1) Case study : LFT 2) Case study :EEG 3) Learn the technique of plant/animal tissue culture 4) Study of pinocytosis by paramecium under microscopy 5) Differential centrifugation of cell and validation of separated organelles by enzyme markers	60 hours

List of Reference Books

1. Practical Textbook of
BIOCHEMISTRY

DM Vasudevan,
Subir Kumar Das

2.Introduction to Practical Biochemistry

György Hegyi

József Kardos

Mihály Kovács

András Málnási-Csizmadia

László Nyitray

Gábor Pál

László Radnai

Attila Reményi

István Venekei

3.Biochemistry Practical Manual

Soundravally Rajendiran, Pooja Dhiman

Title of Paper: PRACTICAL - IV

Type: BCH-207 CORE

SEMESTER - II

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+0 Hrs+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Microbiology Laboratory Practices and Bio-safety. 2) To study the principle and applications of important instruments (Laminar air flow, autoclave, incubator, hot plate stirrer, hot air oven, water bath, microscope, pH meter, colony counter, spectrophotometer) 3) Cleaning of glassware, sterilization techniques. 4) Preparation and sterilization of culture media for bacterial cultivation. 5) Preparation of agar plate, slant and deep tube 6) Smear preparation, staining of bacteria using simple staining, differential staining	60 hours

List of Reference Books

1. Practical Textbook of

BIOCHEMISTRY

DM Vasudevan,

Subir Kumar Das

2. Introduction to Practical Biochemistry

György Hegyi

József Kardos

Mihály Kovács

András Málnási-Csizmadia

László Nyitray

Gábor Pál

László Radnai

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3. Biochemistry Practical Manual

Soundravally Rajendiran, Pooja Dhiman

National Education Policy -2020

**DEPARTMENT OF BIOCHEMISTRY
BUNDELKHAND UNIVERSITY, JHANSI**

SYLLABUS FOR THE DEGREE OF
“MASTER OF SCIENCE IN BIOCHEMISTRY”

(M.Sc. Second year)

(Total Credits in Second Year: 48)

IN CONTINUATION OF M.Sc. FIRST YEAR

(Total Credit For M.Sc. BIOCHEMISTRY: First Year (52)+ Second Year
(48)=100)

Title of Paper: GENETIC ENGINEERING

Type: BCH-301 CORE

SEMESTER - III

TOTAL CREDITS: 4

TOTAL HOURS: 48 L+12T+0P

Course Objectives

- Demonstrate the basic knowledge Of Recombinant DNA Technology, PCR and Isolation and purification of DNA

Course Learning Outcomes

Understanding the basic structure of DNA, how DNA recombinant and how gene transfer could take place

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Recombinant DNA Technology 1.Enzymes used in DNA technology: DNA manipulating enzymes (Restriction Endonucleases, Polymerases, Ligase, Kinases and Phosphatases Nucleases). Linker, Adaptor, Homopolymer tailing. Cloning vectors: Plasmids, Phasmids, Cosmids, Artificial chromosomes, Shuttle vectors and Expression vectors, Viruses as vectors. 2. Application of Recombinant DNA technology in agriculture, health and industry.	8L+2T
2.	2.	1. Polymerase Chain Reaction (PCR): Principle, types and its application 2. Principle and techniques of hybridization: Western, Northern and Southern blotting. Microarray based detection, DNA finger printing	8L+2T
	3.	1. Isolation and purification of DNA, Gel electrophoresis 2.Molecular Markers: Principles, types and application, Restriction Fragment Length Polymorphism (RFLP). Amplified Fragment Length Polymorphism (AFLP). Random Amplified Polymorphic DNA (RAPD), Single Nucleotide Polymorphism	8L+2T

		(SNP)	
4	4.	1. Gene transfer methods: Electroporation, Microinjection, calcium phosphate co-precipitation, lipofection. 2. Analysis of protein-DNA and protein-protein interactions: Gel retardation assay, DNA footprinting. Modification interference assay, Deletion analysis, Phage display and yeast two hybrids assay	8L+2T
5	5.	1. DNA sequencing method: Sanger's method. Maxam and Gilbert Method, Automated method: 2. Transgenic technologies and their applications	8L+2T
6	6.	1. DNA libraries: construction of genomic and cDNA, screening method of DNA libraries 2. Molecular diagnostic Methods, Biosafety and Ethical considerations	8L+2T

List of Reference Books

1. DNA Technology: The Awesome Skill by Alcamo IE. (2001). 2nd Elsevier Academic Press, USA.
2. Gene Cloning and DNA Analysis by TA Brown. Blackwell Publishing, Oxford, UK
3. Molecular Biotechnology by Glick BR and Pasternak JJ. ASM Press Washington D.C.
4. Principle of gene cloning by Old and primrose Vth Eds.
5. S B Primrose and R M Twyman Principles of Gene Manipulation and Genomics Seventh edition 2006 Blackwell Publisher, Australia
6. Watson J D, Candy AA , Myers RM and Witkowski JA , Recombinant DNA (Gene and Genome- A short course) WH Freeman and Company, New York, IInd Edition, 1992.
7. Biotechnology. Singh, B. D. Chromatography Principle, types and applications partition, Adsorption, paper, thin layer, ion exchange, molecular sieve, supercritical fluid, gas chromatography and HPLC

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: IMMUNOLOGY

Type: BCH-302 CORE

SEMESTER - III

TOTAL CREDITS: 4

TOTAL HOURS: 51L+9T+0P

Course Objectives

To understand the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell

Course Learning Outcomes

- Define enzyme structure
- Define differences between enzymes and normal catalytic substances
- Explain cofactor and coenzymes chemical structure
- Express Important coenzymes and the groups they transfer
- Define factors that affect enzyme activity
- Define enzyme kinetics

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	History of immunology, Immune response- Innate and Adaptive Immunity and Characteristics, Anatomical organization of immune system- Primary and secondary lymphoid organs, secondary lymphoid organs, Cells of the immune System, lymphocyte traffic. Hematopoiesis, Antigens Characters, Haptens, Antigenicity and Immunogenicity, Factor affecting immunogenicity, Properties of T and B cell epitopes, Super antigens	4L+1T
2.	2.	Complement System Components, activation pathways and their regulation, Complement deficiencies and role of complement system in immune response. Immunoglobulins - structure and functions, Organisation and expression of immunoglobulin genes. Mechanisms of antibody diversity, Class switching, immunoglobulin Superfamily	10L+2T
3.	3.	Organization of MHC I and II molecules, polymorphism, distribution and function, organization of MHC complex in Mouse and Humans. Role of MHC in tissue transplantation. T - Cell receptor-Structure and function, T- cell accessory membrane molecules, activation of T- cells B- Cell receptor - Structure,	10L+2T

		types and functions, activation of B- cells. Antigen presentation - Processing and presentation of exogenous and endogenous antigens	
4	4.	Structure and functions, cytokine receptors, signal transduction mediated by cytokine receptors, cytokine related diseases and their therapeutic applications. Hypersensitivity - Definition, Type I, II, III and IV type hypersensitivity, delayed type of hypersensitivity	10L+2T
5	5.	Autoimmunity- Organ specific and systemic diseases, mechanisms of autoimmunity and therapeutic approaches, Immunodeficiency Syndromes- Primary and secondary immunodeficiencies, their diagnosis and therapeutic approach	7L+1T
6	6.	Antigen and Antibody interactions- Affinity, Avidity. Cross reactivity, forces involved in Ag- Ab interaction, Vaccines- Active and passive immunization, whole organism vaccines, Magomolecules as vaccines, Recombinant - vector vaccines, DNA vaccines, synthetic peptide Vaccine and subunit vaccines. Hybridoma technology and production of monoclonal antibodies and its applications in diagnosis and therapy	10L+1T

Lst of Reference Books

1. Immunology. Roitt, Brostoff and Male
2. Essential Immunology. Roitt, Ivan. M.
3. Fundamental of Immunology. William Paul
4. Immunology. Goldsby, R.A., Thomas J. Kindt, Barbara, A Osborne and Kuby, Janis, W.H

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture.
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: **BIOENERGETICS AND INTERMEDIARY METABOLISM**

Type: **BCH - 303 ELECTIVE-1**

SEMESTER - III

TOTAL CREDITS: 4

TOTAL HOURS: 42L+18T+0P

Course Objectives

This course is very pivotal to Biochemistry. It is a course that describes all reactions concerned with the storage and generation of metabolic energy required for the biosynthesis of low-molecular weight compounds and energy storage compounds. The course is essentially theoretical. Hence upon successful completion of the course, the students will be able to explain some of the molecular events that occur during normal and abnormal biomolecular activities

Course Learning Outcomes

Upon successful completion of this course student should be able to:

- Learning and understanding the concepts of General features of metabolism, degradation of carbohydrates- Glycolysis, the Tricarboxylic Acid Cycle (TCA), the Pentose Phosphate pathway, Gluconeogenesis and glycogenolysis, Disorders of carbohydrate metabolism; Amino acids as building blocks of proteins.
- Oxidative phosphorylation, Fatty acids oxidation, amino acids metabolism.
- Metabolism of nucleic acids (DNA &RNA)
- Role of various vitamins in the overall metabolic processes.

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	General features of metabolism, Concept of free energy, standard free energy, High energy phosphate compounds- introduction, phosphate group transfer, free energy of hydrolysis of ATP, and bioenergetics	4L+2T
2.	2.	Metabolism of carbohydrate: glycolytic pathway, fermentation, tricarboxylic acid cycle, glyoxylate and Gamma aminobutyrate shunt pathways, pentose phosphate pathway, anaplerotic reactions, coupling reactions, gluconeogenesis, biosynthesis of disaccharides and polysaccharides, glycogenesis and glycogenolysis, glycogen storage disease, Cori cycle, Entner-Doudoroff pathway, control of carbohydrate metabolism	5L+2T
	3.	Oxidative phosphorylation: Complexes and carriers of Electron	4L+2T

		transport chain, hypothesis of mitochondrial oxidative phosphorylation, inhibitors and uncouplers	
4	4.	Fatty acids oxidation (alpha, beta, omega), oxidation of unsaturated and odd chain fatty acids, biosynthesis of fatty acids, triacylglycerol and phospholipids. Cholesterol metabolism, Regulation of fatty acids and triacylglycerol metabolism, metabolism of ketone bodies, control of lipid metabolism	6L+2T
5	5.	Metabolism and regulation of glycolipids, sphingolipids, lipoprotein, prostaglandins, and steroids in normal and diseased conditions	5L+2T
6	6.	Sources of the atoms in the purine and pyrimidine molecules, Metabolism of nucleotides and its regulation, diseases involved in the abnormal functioning	4L+2T
7	7.	General reaction of amino acids metabolism: transamination, oxidative deamination and decarboxylation, glycogenic and ketogenic amino acids, Biosynthesis and degradation of aromatic amino acids and their regulation, conversion of amino acids into specialized products, diseases involved in abnormal metabolic processes. Biosynthesis of urea and its regulation	6L+2T
8	8.	Role of myoglobin and hemoglobin in oxygen transport with special emphasis on allostery. Molecular mechanism of sickle cell anemia	4L+2T
9.	9.	Role of various vitamins in the overall metabolic processes: Discovery, structure and function	4L+2T

Lst of Reference Books

1. Principles of Biochemistry: Lehninger
2. Biochemistry: Lubert Stryer
3. Biochemistry: Voet and Voet
- 4 Biochemistry: Harper

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PHYSICO-CHEMICAL ASPECTS OF BIOLOGY

Type: BCH - 304 ELECTIVE-2

SEMESTER - III

TOTAL CREDITS: 4

TOTAL HOURS: 48L+12T+0P

Course Objectives

- To understand the living things on chemical level

Course Learning Outcomes

- To understand the chemical nature of living molecule

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Atoms and Chemical bonds: Electron theory of valence. Hybridization of chemical bonds. Hybrid orbitals and hybrid molecules. Hydrophobic interactions and Van der waals interaction. Covalent bond, coordinate bond, coordinate bond formation in transition metals. Crystal field theory, ligand field theory, valence bond theory. Structure, bonding and special properties of water. Bonding of iron in hemoglobin and cytochromes, cobalt in Vit B12, magnesium in chlorophyll. Chelates: Types of ligands and complexes	8L+2T
2.	2.	Stereochemistry: Isomerism, types of isomers. Importance of stereochemistry, position and order of groups around carbon. Geometric and optical isomerism, absolute and relative configuration. Symmetry view of chirality, relation between chirality and optical activity, representation of chiral structures by Fischer. Structure and stereochemistry of glucose; anomer, epimer, enantiomer, stereoisomer, D and L, + and -, R and S notation and stereochemistry of amino acids	8L+2T
	3.	Mechanism of organic reactions: Characteristic aspects of ionic, radical and concerted reactions. Classification of rearrangement reactions. Energy profiles of reactions, transition state theory. Mechanisms and stereochemistry of substitution (electrophilic and nucleophilic- SN1 and SN2 reactions), addition, elimination and rearrangement reactions. Mechanisms of ester hydrolysis, property of aromaticity and resonance	8L+2T
4.	4.	Heterocyclic systems: Occurrence in biological systems, structure and properties of Furan, Pyrrole. Indole, Thiazole, Imidazole, Pyridine, Pyrimidine, Purine, Quinine, Pteridine and Isoalloxazine. Chemistry of	8L+2T

		porphyrins and heme	
5.	5.	Secondary metabolites: Structure, properties and importance of phytochemicals; Terpenes, Polyphenols, Procyanidins, Flavonoids, Xanthones, Alkaloids and Pigments. Free Radicals: Introduction to free radicals. Generation and reaction of free radicals with biological materials and their adverse effects	8L+2T
6.	6.	Thermodynamics: Basic concepts of entropy, free energy changes, standard free energy change and its relation to equilibrium constant, oxidation-reduction reactions, oxidation reactions in biological systems	8L+2T

Lst of Reference Books

- 1) Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).
- 2) Bioinorganic Chemistry; Ei-Ichiro Ochiai, Elsevier (2008).
- 3) Physical Biochemistry. Kansal Edward Van Halde. Prentice Hall.
- 4) Physical Biochemistry. David Frifielder. 2nd Edn. W.G. Freeman and Co
- 5) Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
- 6) Introduction to Biophysical Chemistry, Bruce Martin

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. .Assignment and Presentatiom/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-Voce
3. Main Semester Examination

Title of Paper: MEDICAL BIOCHEMISTRY

Type: BCH - 305 ELECTIVE-3

SEMESTER - III

TOTAL CREDITS: 4

TOTAL HOURS: 50L+10T+0P

Course Objectives

- Medical biotechnology and its application in various disease
- Understanding about drugs and their application

Course Learning Outcomes

- To develop the understanding of drugs , types of drugs and their application
- Metabolic disorders and how pathological conditions affect it

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Drugs- Introduction, characteristics, definition, classification, absorption, route of administration and metabolism	10L+2T
2.	2.	Types of Drugs: a. Antibiotics- Discovery, mechanism of action of penicillin, streptomycin, tetracycline, erythromycin and quinolone, multi drug resistant in bacteria (MDR). b. Anesthetics- General properties, classification and mode of action (CHCl ₃ , and Thiopental) c. Narcotics- General properties and classification with reference to Morphine and Cocaine. d. Analgesics - General properties and classification with reference to Aspirin and Ibuprofen. e. Sulpha Drugs- General properties of Sulphanamides.	15L+3T
	3.	Metabolic disorders and their pathological conditions a. Carbohydrate metabolism- Diabetes Mellitus, galactosuria, fructosuria, Hunter's syndrome and Glucose tolerance test b. Lipid metabolism- Gaucher's disease and Tay -Sach's disease. c. Protein metabolism-Albinism, phenyl ketonuria, Alkaptonuria, Maple-Syrup disease, Cystinuria and Homocystinuria. d. Nucleic acid metabolism- Lesch- Nyhan syndrome, Van-Gierker's disease and Gout.	15L+3T
4	4.	Porphyria diseases and diagnosis	10L+2T

Lst of Reference Books

1. Medical biochemistry : Harper
2. Textbook of Medical biochemistry- Chaterjee and Shinde
3. Biochemistry- AC Dev

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture.
4. .Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PRACTICAL - V

Type: BCH - 306 CORE

SEMESTER - III

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+ 0 Hrs+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Preparation and maintaing of stock cultures, checking cultures for contamination.	60 hours
2) Enumeration of soil microbes by using serial dilation techniques.	
3) Isolation of bacteria from curd/milk and its Gram's staining	
4) Isolation of bacteria exposure plate technique and bacterial population counts.	
5) Pure culture techniques : Streak plate method, spread plate method, pour plate method	

List of Reference Books

1. Practical Textbook of
BIOCHEMISTRY
DM Vasudevan,
Subir Kumar Das
2. Introduction to Practical Biochemistry
György Hegyi
József Kardos
Mihály Kovács
András Málnási-Csizmadia
László Nyitray
Gábor Pál
László Radnai
Attila Reményi
István Venekei
3. Biochemistry Practical Manual
Soundravally Rajendiran, Pooja Dhiman

Title of Paper: Practical – VI

Type: BCH - 307 CORE

SEMESTER - III

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+ 0 Hrs+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Determination of Polysaccharides	60 hours
2) Determination of Dietary fibre	
3) Qualitative test for lipids.	
4) Qualitative test for amino acids	
5) To explore the site map of NCBI and PUBMED and to study the resources available on NCBI and PUBMED.	
6) To retrieve a nucleotide sequence of interest from Genbank entry with Specific accession number	

List of Reference Books

1. Practical Textbook of
BIOCHEMISTRY
DM Vasudevan,
Subir Kumar Das
2. Introduction to Practical Biochemistry
György Hegyi
József Kardos
Mihály Kovács
András Málnási-Csizmadia
László Nyitrai
Gábor Pál
László Radnai
Attila Reményi
István Venekei
3. Biochemistry Practical Manual
Soundravally Rajendiran, Pooja Dhiman

Title of Paper: ENZYMOLOGY

Type: BCH - 401 CORE

SEMESTER - IV

TOTAL CREDITS: 4

TOTAL HOURS: 48 L+12T+0P

Course Objectives

To understand the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell

Course Learning Outcomes

Define enzyme structure

- Define differences between enzymes and normal catalytic substances
- Explain cofactor and coenzymes chemical structure
- Express Important coenzymes and the groups they transfer
- Define factors that effect enzyme activity
- Define enzyme kinetics

Sr. No.	Unit No.	Syllabus Content	Hours (L+T+P)
1.	1.	ENZYME CLASSIFICATION Introduction of enzyme, enzyme classification and nomenclature, concept of enzyme-substrate complex; active site, specificity; factors affecting the rate of enzyme-catalyzed reactions; mechanism of enzymes action; enzyme units	4L+1T
2.	2.	Enzyme kinetics and their inhibition Microbial sources of enzymes. kinetics of enzyme activity, Michaelis-Menten equation and its derivation; different plots for the determination of Km and Vmax and their physiological significance, two substrate reactions; enzyme inhibition: types of inhibition	12L+3T
3.	3.	Regulatory enzymes Microbial enzyme production, submerged and solid state fermentation, important parameters in enzyme production. enzyme purification techniques - precipitation, chromatographic separation. gel filtration, anion and cation exchange, zymography	8L+2T
4	4.	Enzyme technology and its applications Methods for large-scale production of enzymes; immobilized enzymes and their comparison with soluble enzymes; methods for immobilization of enzymes; applications of immobilized and soluble enzymes in health and industry; applications to fundamental studies of biotechnology	12L+3T

5.	5.	Molecular Biology Enzymes Thermal stability and catalytic efficiency of enzyme; site directed mutagenesis and enzyme engineering; modification of active site of an enzyme.	12L+3T
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Lst of Reference Books

1. Voet, D and Voet, J. 1995. Biochemistry, 2nd ed. John. Wiley and Sons.
2. Nelson, D.L. and Cox., MM 2002. Lehninger Principles of Biochemistry, 4th ed. WH Freeman and Company, New York.
3. Rodwell, VW, Bender, DA, Botham, KM, Kennelly, PJ and Weil, PA 2015. Harper's illustrated Biochemistry, 30th ed. McGraw Hill Education.
- 4 Stryer, L. 2006. Biochemistry, 6th ed. WH Freeman

Teaching Methodology

1. Power-point Presentations
- 2 Online Class/E-content
3. Class Lecture
4. .Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-Voce
3. Main Semester Examination

Title of Paper: INDUSTRIAL BIOPROCESS TECHNOLOGY

Type: BCH - 402 CORE

SEMESTER - IV

TOTAL CREDITS: 4

TOTAL HOURS: 48 L+12T+0P

Course Objectives

- The purpose of this course is to teach students about applying biotechnology to industrial process
- To teach the basic principles of processing of bioproducts
- To expose students to relevant advancement in industrial Bioprocess technology

Course Learning Outcomes

- Student can appreciate the relevance of microorganisms and have a better understanding to industrial context
- Student will learn the design and operations of various bioreactors and downstream processing
- Student will be able to apply gene manipulation technique to industrially important microorganisms

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Scope and history of industrial microbiology. Isolation, Maintenance and Preservation of industrial strains. Screening and Methods of strain improvement (mutagenesis, strain protoplast fusion etc) of industrial important strains.	8L+2T
2.	2.	Composition of typical Fermentation media. Inoculum Preparation. Medium sterilization, design of a batch and continuous sterilization processes, holding time, Scale up of sterilization	8L+2T
3.	3.	Fermenter design body construction Basic concepts of fermenter-batch,continuous, fed batch, packed bed, bubble column, trickle, plug flow reactors. Fermentations-Submerged and solid state, fluidized bed	8L+2T
4	4.	Downstream Processing: Cell disintegration: Physical, chemical and Enzymatic Methods. Removal of microbial cells and other solid matter, foam separation, precipitation, filtration, centrifugation, Liquid- liquid extraction, drying and crystallization	8L+2T
5	5.	Industrial production of Penicillin and Streptomycin. Production of Amylase and Protease enzyme.	8L+2T

		Industrial production of Lysine, Glutamic acid and Single Cell Protein (SCP)	
6	6.	Industrial production of Vitamin B12 and Riboflavin. Industrial production of organic acids: Lactic acid and Citric acid. Industrial production of Vinegar, alcohol and alcoholic beverages (Beer and Wine)	8L+2T

Lst of Reference Books

1. Principles of fermentation Technology by Stanbury PF, Whitaker A and Hall SJ. (2006).
2. Industrial Microbiology by Casida LE. (1991). 1st edition. Wiley Eastern Limited.
3. Biotechnology - A text book of Industrial Microbiology WulfCrueger&AnnelieseCrueger.
4. Prescott and Dunn's Industrial Microbiology by Reed, G, CBS Publishers & Distributors.
5. Industrial Microbiology: An introduction by Waites, MJ, Morgan, NL, Rockey, JS,Higton, G, Edition .1st, Wiley-Blackwell

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. .Assignment and Presentatiom/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PROTEOMICS

Type: BCH - 403 CORE

SEMESTER - IV

TOTAL CREDITS: 4

TOTAL HOURS: 48L+12T+0P

Course Objectives

To determine the protein parts that are present in such samples and to define their concentrations, molecular states, structures, functions or connections.

Course Learning Outcomes

The proteome is the entire set of proteins produced or modified by an organism or system. Proteomics enables the identification of numbers of proteins.

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Protein, classification of protein, Analysis of proteomes - Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, Reduction, Resolution	8L+2T
2.	2.	Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, DEDetecting proteins in polyacrylamide gels, Image analysis of 2-DE gels	12L+2T
	3.	Mass spectrometry based methods for protein identification 2-DE gel electrophoresis coupled with mass spectrometry	8L+2T
4	4.	Micro array techniques- Types of micorarrays, Designing a microarray experiment, Microarray Technology in Treating Disease	8L+2T
5	5.	Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications, Proteomics in drug Discovery in human, Proteomics in plant genetics and breeding	12L+2T

Lst of Reference Books

1. Biochemistry – Wilson walker
2. Biochemistry - Lehninger

Teaching Methodology

1. Power-point Presentations

2. Online Class/E-content
3. Class Lecture
4. .Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: MEDICINAL AND PHARMACEUTICAL BIOCHEMISTRY

Type: BCH - 404 CORE

SEMESTER - IV

TOTAL CREDITS: 4

TOTAL HOURS: 52L+8T+0P

Course Objectives

- To studied the Carotenoids, Glycosides, Membrane transport, Alkaloids, lignans and quassanoids.

Course Learning Outcomes

- The student will have an understanding of the application of Carotenoids, Glycosides, Membrane transport, Alkaloids, lignans and quassanoids.
- Develop the understanding of chromatographic Techniques on various pigment such as alkaloids, lignans etc
- Learning this subject content will develop the ideas with the fundamental of analytical chemistry among the pupil.

Sr. No.	Unit No.	Syllabus Content	No. of Hours (L+T+P)
1.	1.	Study of the biological sources, cultivation, collection, Commercial varieties, chemical constituents, substitutes, adulterants, uses	5L+1T
2.	2.	Role of medicinal and aromatic plants in national economy. Biological sources, preparation, identification tests and uses of the following enzymes: Diastase, papain, pepsin, trypsin, pancreatin	6L+1T
	3.	Chemical and spectral approaches to simple molecules of natural origin Concept of stereoisomerism taking examples of natural products. Chemistry, biogenesis and pharmacological activity of medicinally important monoterpenes, sesquiterpenes, diterpenes, and triterpenoids	7L+1T
4	4.	Carotenoids α - carotenoids, β - carotenes, vitamin A, Xanthophylls of medicinal importance	6L+1T
5	5.	Glycosides	7L+1T

		Chemistry and biosynthesis of digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin	
6	6.	Alkaloids Chemistry, biogenesis and pharmacological activity of atropine and related Compounds; quinine, reserpine, morphine, papaverine, ephedrine, ergot and vinca alkaloids	7L+1T
7.	7.	Chemistry and biogenesis of medicinally important lignans and quassanoids, flavonoids	7L+1T
8	8.	Introduction, classification and study of different chromatographic methods and their application in evaluation of herbal drugs	7L+1T

List of Reference Books

1. Kokate C.K. "Practical Pharmacognosy" Vallabh Prakashan, New Delhi.
2. Wallis T.E. "Analytical Microscopy" J&A Churchill Ltd; London.
3. Treatse, G.E., & Evans, W.C., Evans W.C., "Pharmacognosy" Bailliere Tindall east Baorne, U.K.
4. Tyler V.E., et al: "Pharmacognosy" Lea & Febiger, Philadelphia.
5. Walli.T.E. "Text Book of Pharmacognosy" Churchill Ltd. London.
6. Kokate C.K. et al. "Pharmacognosy" Nirali Prakashan, Pune.
7. Medicinal plants of India I&II, Indian council of Medical Reasearch, New Delhi
8. Nadkarni A.K. Indian Materia Medica 1-2, Popular Prakashan (P) Ltd. Bombay
9. Atal C.K. & Kapur BM. "Cultivation & utilization of Medicinal plants, RRL, Jammu.
10. Indian Herbal Pharmacopoeia, vol. I &II, ICMR & RRL, Jammu.
11. The wealth of India, Raw Materials (All volumes) Council of Scientific & Industrial Research, New Delhi
12. Compendium of Indian Medicinal Plants I-IV, Rastogi & Malhotra.
13. Indian Ayurvedic Pharmacopoeia, Govt. of India.
14. Kokate CK, Gokhale AS , Gokhale SB, Cultivation of Medicinal Plants, Nirali Prakashan.
15. Atal CK and Kanpur B M, Cultivation and utilization of Medicinal plants, RRL, Jammu .
16. Chadha K L and Gupta R Advances in Horticulture- Vol II- Medicinal and Aromatic Plants, Malhotra Publishing House, New Delhi
17. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London

18. Harborne JB, Phytochemical Methods, Chapman, and Hall. Hall, International Edition, London.
19. Henry TA, The Plant Alkaloids, McGraw Hill, New York
20. Robinson, T., The Biochemistry of Alkaloids, Springer-Verlag, New York. Ross M S E, and 21. Brain K.R., Introduction to Phytopharmacy, Pitman medical. Kent.
22. Swain T, Comparative Phytochemistry, Academic Press, London

Teaching Methodology

1. Power-point Presentations
2. Online Class/E-content
3. Class Lecture
4. .Assignment and Presentation/Viva-voce

Evaluation Criteria

1. Internal Sessional Examination
2. Assignment Presentation/Viva-voce
3. Main Semester Examination

Title of Paper: PRACTICAL - VII

Type: BCH - 405 CORE

SEMESTER - IV

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hr+0 Hrs+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Identification of solubility of lipid in different solutions.	60 hours
2) Determination of Reducing Sugar by picric acid method	
3) Determination of Reducing Sugar by Fehling method	
4) Determination of Pentose Sugar by Bial's method	
5) Estimation of Reducing sugar by Titration method	

List of Reference Books

1. Practical Textbook of
BIOCHEMISTRY

DM Vasudevan,
Subir Kumar Das

2. Introduction to Practical Biochemistry

György Hegyi

József Kardos

Mihály Kovács

András Málnási-Csizmadia

László Nyitray

Gábor Pál

László Radnai

Attila Reményi

István Venekei

3. Biochemistry Practical Manual

Soundravally Rajendiran, Pooja Dhiman

Title of Paper: PRACTICAL - VIII

Type: BCH - 406 CORE

SEMESTER - IV

TOTAL CREDITS: 2

TOTAL HOURS (Hrs): L+T+P (0 Hrs+0 Hrs+60 Hrs)

Practicals

List of Practicals	No. of Hours (L+T+P)
1) Isolation of genomic DNA	60 hours
2) Isolation of plasmid DNA	
3) DNA detection by gel – electrophoresis	
4) Quantitative estimation of DNA by spectrophotometric method	
5) Analysis of protein by gel electrophoresis under denaturing conditions (SDS-PAGE)	

List of Reference Books

1. Practical Textbook of
BIOCHEMISTRY

DM Vasudevan,
Subir Kumar Das

2. Introduction to Practical Biochemistry

György Hegyi
József Kardos
Mihály Kovács
András Málnási-Csizmadia
László Nyitray
Gábor Pál
László Radnai
Attila Reményi
István Venekei

3. Biochemistry Practical Manual

Soundravally Rajendiran, Pooja Dhiman