GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

KUMBAKONAM 612 002

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

DEPARTMENT OF BIO-CHEMISTRY

(Effective for those admitted from 2020-2021 onwards)

SYLLABI

M.Sc., BIO-CHEMISTRY

MSc. Biochemistry

Program outcomes

After completion of Biochemistry program students will able

To get strong theoretical and practical background in fundamental concepts.

To get insights of multiple important technical areas of Biochemistry.

To apply contextual knowledge and modern tools of biochemical research for solving problems.

To acquire the solvation skills for the entrepreneurs approaches.

To develop the modern and noval concepts of research and development.

Program Specific outcomes

Program Specific outcomes will able

To acquire the knowledge in Clinical practices.

To develop the Skills in research to contribute towards the health and practices.

Its aim is to understand the fundamental chemical principles that govern complex biological systems.

To educate the structure, composition, and chemical reactions of substances in living systems.

To understand the biological molecular mechanisms and it’s applications in medicine.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli – 620 024)

KUMBAKONAM – 612 002

TAMILNADU

Syllabus for

M.Sc. BIOCHEMISTRY

Choice Based Credit System (CBCS)

(With effect from **2020 - 2021 onwards)**

Department of Biochemistry

Government Arts College (Autonomous)

(Affiliated to Bharathidasan University, Tiruchirappalli – 620 024)

Kumbakonam – 612 002

Tamilnadu

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM – 612 002

SYLLABUS FOR M.Sc. BIOCHEMISTRY (2020 - 2021 ONWARDS)								
SCHEME OF STUDY AND EXAMINATION								
SEMESTER	**Course Code**	**Title of the Paper**	**Hrs**	**Credits**	**Exam hours**	**Marks**		**Total**
						Int.	**Ext.**	
I	20P1B1	CC1 – Biomolecules	6	4	3	25	75	100
	20P1B2	CC2 - Biophysical and Analytical Chemistry	6	4	3	25	75	100
	20P1B3	CC3 - Cell and Molecular Biology	6	4	3	25	75	100
	20P1B4EC	EC1 - Biostatistics, Bioinformatics and Computer Applications	6	4	3	25	75	100
	20P1BP1	CP1 - Lab Course – I	6	4	6	40	60	100
	Total		**30**	**20**	**-**	**-**	**-**	**500**
II	20P2B5	CC4 – Enzymology	6	5	3	25	75	100
	20P2B6	CC5 - Bioenergetics and Metabolism	6	5	3	25	75	100
	20P2B7	CC6 - Immunology and Immunotechnology	6	5	3	25	75	100
	20P2B8EC	EC2 - Pharmacology	6	5	3	25	75	100
	20P2BP2	CP2 - Lab Course – II	6	4	6	40	60	100
	Total		**30**	**24**	**-**	**-**	**-**	**500**
III	20P3B9	CC7 - Human Physiology	6	5	3	25	75	100
	20P3B10	CC8 - Advanced Clinical Biochemistry	6	5	3	25	75	100
	20P3B11	CC9 - Endocrinology and Neurochemistry	6	5	3	25	75	100
	20P3B12EC	EC3 - Biotechnology and Genetic Engineering	6	5	3	25	75	100
	20P3BP3	CP3 - Lab Course – III	6	4	6	40	60	100
	Total		**30**	**24**	-	-	**-**	**500**
IV	20P4B13	CC10 - Microbial and Plant Biochemistry	6	5	3	25	75	100
	20P4B14EC	EC4 - Industrial Biochemistry and Nanotechnology	6	5	3	25	75	100
	20P4B15EC	EC5 - Food and Nutritional Biochemistry	6	4	3	25	75	100
	20P4BP4	CP4 - Lab Course – IV	6	4	6	40	60	100
	20P4PW	PW - Project Work	6	4	-	-	-	100
	Total		**30**	**22**	-	-	**-**	**500**
Grand Total			**120**	**90**	-	-	-	**2000**

M.Sc - Biochemistry Course Structure

Course	Nos.	Credits	Marks
Core Course (Theory)	10	47	1000
Core Course (Practical)	4	16	400
Elective Course	5	23	500
Project Work	1	4	100
Total	**20**	**90**	**2000**

Question paper pattern for semester theory examination

SL. NO.	SECTION	MARKS	NUMBER OF QUESTIONS	MARKS	TOTAL MARKS
1	**Section A**	**2 marks**	Two questions from each unit	10 x 2 = 20	**20**
2	**Section B**	**5 marks**	One SET from each unit – Either Or type	5 x 5 = 25	**25**
3	**Section C**	**10 marks**	One question from each unit – Answer any **THREE** questions	3 x 10 = 30	**30**
TOTAL					**75**
INTERNAL ASSESSMENT					**25**
GRAND TOTAL					**100**

Question Paper Pattern

Question paper pattern for semester practical examination

Internal Maximum: 40

External Maximum: 60

Project Evaluation

Maximum Marks: 100

SL.NO	Report Max. 80	Viva Voce Maximum: 20
1	To be evaluated for overall objective and quality of work presented in the report.	Performance of the candidate

Subject Code: 20P1B1	CC1 - BIOMOLECULES	Credits: 4

Learning Objectives

- To learn about the basis of chemical molecules in biology.
- To learn about the structural and functional aspects of biomolecules like carbohydrates, proteins, lipids, nucleic acids and vitamins.

Course Outcomes

At the end of the course, the student will be able to

- Obtain adequate knowledge about the hierarchical organisation of various biomolecules.
- Understand the structure, classification, properties and biological importance of biomolecules.
- Analyse the realtionship between the structure and biological role of biomolecules.
- Acquire knowledge on the building blocks of carbohydrates, proteins, lipids and nucleic acids.
- Understand the biologically important molecules and their biomedical significance.

Unit I

Carbohydrates – Definition, classification, stereo isomeric forms, structure, functions and reactions of biologically important carbohydrates. Monosaccharide - glucose, fructose, mannose, galactose, arabinose. Disaccharides- lactose, maltose, sucrose and cellobiose. Storage and structural polysaccharides - starch, glycogen, inulin, cellulose, chytin and pectin. Glycosaminoglycans – structure and biological functions of hyaluronic acid, chondroitin sulphate and heparin. Glycoproteins. Bacterial cell wall polysaccharides.

Unit II

Amino acids, peptides and proteins – Definitions. Amino acids - classification, properties and reactions. Peptides - peptide bond, chemical synthesis of peptides and biological importance of peptides. Proteins - functions and classification based on their functions, chemical nature, solubility and nutritional importance. Structure of proteins - primary, secondary, tertiary and quaternary structures. Structure and functions of collagen, hemoglobin, myoglobin. Ramachandran plot and its significance. Bonds stabilizing the protein structure. Protein sequencing.

Unit III

Fatty acids and Lipids - Definitions. Fatty acids - nomenclature, classification and properties. Lipids –physiological significance and classification. Structure and biological functions of triacylglycerol, phospholipids and glycolipids. Sstructure and functions of cholesterol, bile acids and sex hormones. Structure and functions of polyamines, prostaglandins, thromboxanes, leucotrienes. Lipoproteins. Types and functions of porphyrins.

Unit IV

Nucleic acids – Definition and types. Building blocks of nucleic acids- purines and pyrimidines, nucleosides, nucleotides. Synthesis of oligonucleotides. Watson and Crick DNA double helix model. Chargaff's rule. DNA organization. Types of DNA – A, B and Z form, Double stranded linear DNA. Circular DNA and Extra chromosomal DNA. Properties of DNA. Denaturation of nucleic acids and melting temperature. Different types of RNA and their biological functions. DNA sequencing.

Unit V

Vitamins - Definition and classification. Water soluble vitamins - Structure and functions of vitamin C, thiamine, riboflavin, niacin, pyridoxine, biotin, pantothenic acid, folic acid and cobalamin. Fat soluble vitamins - Structure and functions of vitamins A, D, E and K.

References

1. Lehninger - Principles of Biochemistry by Nelson D. Cox Michael M - 6th Edition
2. Biochemistry by L. Stryer - 4 th Edition.
3. Biochemistry by V.Voet and J.G.Voet - 4th Edition.
4. Harpers Illustrated Biochemistry by Victor W. Rodwell, David Bender, Kathleen M. Botham - 30th Edition.
5. Outline of Biochemistry by E. E, Conn and P. K. Stumpf - 5th edition, John Wiley & Sons.
6. Text Book of Biochemistry by E.S. West and W.R. Todd. - 4th edition, Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.

Subject Code: 20P1B2	CC2 - BIOPHYSICAL AND ANALYTICAL CHEMISTRY	Credits: 4

Learning Objectives

- To study the fundamental mechanism, principle and applications of modern analytical instruments.
- To practice the methodology and interpretation in the current research.

Course Outcomes

At the end of the course, the student will be able to

- Obtain necessary knowledge to perform techniques to biochemistry
- Explain the instrument components, principles of operation and applications of spectroscopy, radioisotope technique and microscopy.
- Exhibit a knowledge base in handling different chromatographic techniques and to make an appropriate choice based on nature of the sample.
- Differentiate the principles of paper, ion exchange, gel and affinity chromatography.
- Apply practically the knowledge acquired on centrifugation for separation of biological samples and isolation of cell organelles.
- Gain knowledge on principles of electrophoresis and learn the procedure for electrophoresis, blotting and hybridisation techniques.

Unit I

Acids, bases and buffer systems in living body. Henderson-Hasselbalch equation. pH-Effect of pH on biological – biological buffer systems, methods of pH determination and types of electrode – Glass and Calomel electrode and its applications. Surface tension and viscosity of blood. Colloids – types of charge, precipitation, emulsification, dialysis and Donnan equilibrium.

Unit II

Electrophoresis, electrophoretic support media, factors affecting electrophoresis, types of electrophoretic techniques – Zonal and disc electrophoresis. High and low voltage electrophoresis. PAGE, Isoelectrofocussing, Isotachophoresis, Capillary and Immunoelectrophoresis. Electrophoresis of nucleic acids.

Unit III

Radio isotope Techniques: Nature and units of radioactivity, detection and measurement of radioactivity. Geiger-Muller counter, Solid and liquid scintillation counting, Quenching, scintillation cock tail's, Autoradiography. Application of isotopes in biology, Hazards and prevention of radioisotopes.

Unit IV

Chromatography techniques. Paper, Thin layer, Column, Ion-exchange, Exclusion chromatography. Chromato focusing, affinity chromatography, GLC and HPLC and their applications. Centrifugation: Principles, Differential and Analytical centrifugation, Density gradient centrifugation; Analysis of subcellular fractions, Ultracentrifuge and its Application.

Unit V

Spectroscopy : Basic law of light absorption, optical rotatory dispersion, circular dichorism, X-ray diffraction, UV- Visible spectrometry, Spectro flurimetry, Atomic absorption spectro photometer, Flame photometry, IR, Mass spectrometry, Electron Spin Resonance, Nuclear Magnetic Resonance – principles, instrumentation and applications.

References

1. Keith Wilson John Walker, 2004, Practical Biochemistry – Principles and Techniques, 5th edition, Cambridge University Press.
2. David T Plummer, 2004, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Publishing Co, Ltd.
3. John G. Webster, 2004, Bioinstrumentation, John Wiley & Sons. Inc.
4. Upadhyay, Upadhyay and Nath, 2001, Biophysical Chemistry - Principles and Techniques, Himalaya Publishing House.
5. Veerakumari.L, 2004, Analytical Biochemistry, MJP Publishers.
6. Rodney Boyer, 2004, Modern Experimental Biochemistry, 3rd edition, Pearson Educational International.
7. Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).
8. Introduction to Biophysical Chemistry, Bruce Martin.
9. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
10. Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
11. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, (2018).
12. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
13. Biochemical Techniques 87th Edn., John F. Roby,& Bernard J White Waveland Press Inc. (1987).
14. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).

Subject Code: 20P1B3	CC3 - CELL AND MOLECULAR BIOLOGY	Credits: 4

Learning Objectives

- To learn the molecular level of both prokaryotic and eukaryotic cell and its functions.
- To understand the special aspects of genetic code, nucleosomes, replication, transcription, translation and plasma membrane

Course Outcomes

At the end of the course, the student will be able to

- Compare the genome structure of prokaryotes and eukaryotes and appreciate the complexity of eukaryotic genome.
- Discuss the mechanisms of DNA replication, repair and recombination.
- Explain the enzymes and processes involved in RNA biosynthesis, protein biosynthesis and degradation.
- Gain knowledge on the regulation of gene expression at transcriptional and translational levels.

Unit I

Molecular organization of prokaryotic and eukaryotic cells. Structure and function of mitochondria, Endoplasmic reticulum, Golgi complex, Lysosomes and peroxisomes. The cytoskeleton – microtubules, microfilaments and intermediate filaments. The nucleus, nucleolus and chromosomes.

Unit II

Plasma Membrane: Structure, function and models of membrane. Inter cellular communication. Membrane transport – Active (Na K ATPase) and Passive transport, group translocation, porins. Programmed cell death-Carcinogenesis. Cell cycle- phases, regulation by cyclin and cyclin dependent kinases.

Unit III

Nucleosomes – Organization of Histone octomer. Replication – Semi conservative, rolling circle, cairn's model. Mechanism of DNA Replication, enzymes involved in replication synthesis of Okazaki fragments, events in the replication fork. Gene mutation – mutagenic agents and repair mechanism, outlines of Transposans and Retroposons.

Unit IV

Genetic code – Features, Wobble base hypothesis. Transcription – prokaryotic and eukaryotic Transcription. Initiation, open promoter complex, closed promoter complex and termination, anti termination, post transcriptional modifications, RNA processing and splicing.

Unit V

Prokaryotic and Eukaryotic translation. Ribosomes, role of tRNA – Initiation, elongation and termination, post translational modifications, Inhibitors and regulation of translation. Regulation of gene expression in prokaryotes *Lac* operon and Tryptophan operon. Regulation of eukaryotic gene expression.

References

1. Benjamin Lewin, 2004, Genes VIII, Pearson Educational International.
2. Lodish et. al., 2004, Molecular and Cell Biology, 5th edition, W.H. Freeman Co, New York.
3. Watson, J.D et. al. 2004, Molecular Biology of the Gene, 5th edition, Pearson Education International.
4. Philip Sheeler Donald E. Binanchi, 1987, Cell and Molecular Biology, 3rd edition, John Wiley & Sons Inc.
5. Cooper, G.M Hausman, R.E, 2004, The Cell - A Molecular Approach, 3rd edition, ASM Press, Washington.
6. Wayne M. Becker Lewis J. Klein Smith, 2004, The Word of the Cell, 5th edition, Pearson Education.
7. David Freifelder, 2007, Molecular Biology, 2nd edition, Jones Bartiett Publication.
8. Biochemistry; David Rawn, Panima Publishers (2012).
9. LEWINS Gene XII; Krebs, Jocelyn E.Burlington, MA : Jones & Bartlett Learning, (2018).
10. Molecular Biology of the Cell, Alberts et al., Garland Publications, (2012).
11. Molecular Biology 5th Edn., Robert F. Weaver, McGraw Hill (2018).
12. Microbial Genetics; Maloy et al., Jones and Bartlett Publishers, (1994).
13. Principles of Developmental Genetics; S.A. Moody, Academic Press (2007).
14. Molecular Biology of Gene; Watson, J.D. et al.,7th Edn. Pearson Education; (2004).
15. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott Oxford University Press (2014).

Subject Code: 20P1B4EC	EC1 - BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATIONS	Credits: 4

Learning Objectives

- To practice the statistics, computer and its application in bioinformatics.
- To apply the statistical methods in research and projects.

Course Outcomes

At the end of the course, the student will be able to

- Know the scope, definition, statistical methods, functions and limitations of statistics.
- Understand the correlation, rank correlation, chi square test, students 't' test, F test and ANOVA.
- Explain the bioinformatics, information network, database – DNA, RNA, FASTA, BLAST, and Gene prediction software.
- Acquire knowledge about the genomics, proteomics, human genome project, microbial genome project, phylogenetic trees, discovery of drugs and pharmacogenomics.
- Gain knowledge on the operating system, MS – word, excel, power point, PDF, journal impact factor and index.

Unit I

Introduction, scope and definition, Statistical methods, functions and limitations of statistics. Collection, organization and representation of data. Measures of central tendency – mean, median and mode. Measures of dispersion – range, quartile deviation, mean deviation, standard deviation and coefficient of variation, standard error.

Unit II

Skewness and Kurtosis, Types of skewness, Measures of skewness, Karl – Pearson's co-efficient of skewness, Bowley's measure of skewness, Measure of skewness based on moment, Types of kurtosis, correlation analysis – types and methods, Karl pearson's Co-efficient of Correlation, rank correlation, regression analysis – regression line and regression equation, Chi square test, Students 't' test, F test and ANOVA

Unit III

Introduction to Bioinformatics, Information network, Database – nucleic acid, genome, protein sequence databases. DNA, RNA, Protein sequence searches, sequence alignment, algorithms. FASTA, BLAST, Gene prediction software.

Unit IV

Genomics, proteomics, Human genome project, Microbial genome project, Phylogenetic relationship, Phylogenetic trees, Discovery of drugs, Pharmacogenomics, Application of JAVA and UNIX programme in bioinformatics, Basic information on biojava & bioinformatics projects.

Unit V

Introduction to Windows Operating system, MS – Word, Excel, Power point, PDF, Journal-Impact Factor and Index. Application of computer packages in Biostatistics-SPSS, MINITAB.

References

1. Orpita Bosu, 2007, Bioinformatics-Experiments, Tools, Databases, Algorithms, Oxford University Press.
2. Brian Francis, Murray Aitkin, John Hinde, Ross Darnell, 2009, Statistical Modeling in R, 1st edition, Oxford University Press.
3. Bryan Bergeron, 2002, Bioinformatics and Computing, 1st edition, Prentice Hall.
4. Arthur M. Lesk, 2002, Introduction to Bioinformatics, 1st edition, Oxford University Press.
5. Christopher W. Sensen, 2002, Essentials of Genomics and Bioinformatics**,** 1st edition, Wiley, John & Sons.
6. Practical Biostatistics; Mendel Suchmacher and Mauro Geller, Academic Press (2012).
7. Choosing and Using Statistics; A Biologist Guide, Clavin Dythan, Blackwell Scientific (1999).

Subject Code: 20P1BP1	CP1: LAB COURSE – I	Credits: 4

Hours: 6 **Marks: Internal 40** **External: 60**

Learning Objectives

- To learn the skills in qualitative and quantitative analysis of biomolecules.
- To ascertain the knowledge of analytical techniques.

Course Outcomes

At the end of the course, the student will be able to

- Independently undertake qualitative and quantitative analysis of biomolecules.
- Analyse the different biomolecules.
- Acquire the skills in vitamin and amino acid estimation.
- Handle the paper chromatography and electrophoretic techniques.

Qualitative Analysis

1) Carbohydrate
2) Amino Acids
3) Lipids

Quantitative Analysis

1) Estimation of Sugar
2) Estimation of Protein
3) Estimation of Nucleic Acid
4) Acid Number of oil
5) Iodine number of oil
6) Saponification of oil
7) Ascorbic Acid
8) Estimation of Amino Acid by Formal Titration

Demonstration

1) Paper Chromatography
2) Electrophoresis

References

1. Modern Experimental Biochemistry R.F.Boyer [Ed.] (1986) Addition Wesley.
2. Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack, Oxford University (1995).
3. Analytical Biochemistry; D.J. Holme and H. Pick Longman (1983).
4. Biochemical Techniques 87th Edn., John F. Roby,& Bernard J White, Waveland Press Inc. (1987).
5. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, (2018).
6. Bioanalytics, Friedrich Lottspeich, Wiley-VCH (2018).

Subject Code: 20P2B5	CC4 - ENZYMOLOGY	Credits: 5

Learning Objectives

- To understand the concepts and classification and Mechanism of action of enzymes.
- To study about enzyme kinetics and applications of enzymes in industry, medicine and clinical laboratory.

Course Outcomes

At the end of the course, the student will be able to

- Understand the characteristics, classification, isolation and assay of enzymes.
- Analyse the factors that influence enzyme kinetics.
- Evaluate the mechanisms and regulation by enzyme modulation.
- Translate the basic concepts of enzymology to industrial and medical applications.

Unit I

Historical aspects of enzymology. Nomenclature and classification of enzymes according to IUB. Intracellular localization of enzymes, homogenization techniques, isolation and fractionation of enzymes - classical methods of purification and crystallization - separation based on molecular size, electric charge, solubility difference and selective adsorption, criteria of purity, units of enzyme activity. Turn over number, specific activity. Methods of Enzyme assay Active site definition, organization and determination of active site residues.

Unit II

Thermodynamic terms and basic concepts - types of thermodynamic systems. Enthalpy and Entropy biochemical reactions, biological thermodynamic standard state, activation energy and free energy. Coenzymes - Structure and function of Thiamine, Pyrophosphate, Nicotinamide, Flavin nucleotides, Biotin, Pyridoxal phosphate, Coenzyme A, Tetrahyrofolate and Vitamin B12.

Unit III

Kinetics of catalyzed reaction: Single substrate reactions, Concept and derivation of Michaelis – Menten equation, Limitations of Michaelis-Menten Kinetics. Line - weaver burk plot, Briggs Haldane relationship. Eadie -Hofstee plot, Hanes plot, Eisenthal -Cornish Bowden plot. Determination and significance of kinetic constant. Bisubstrate reactions - Sequential, Non - sequential reactions, King and Altman equation, Monad Wyman and Changeux. Inhibition kinetics - competitive, non-competitive and uncompetitive. Allosteric inhibition, Cooperative, cumulative and feedback inhibition.

Unit IV

Criteria of chemical reactions - Collision & transition state theories, specificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, covalent and electrostatic catalysis -nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis., Mechanism of enzymes action: mechanism of action of lysozyme and chymotrypsin. Multienzymes system - Mechanism of action of pyruvate dehydrogenase and fatty acid synthase complex .Isoenzymes- LDH.

Unit V

Applications of enzymes in Industry. Immobilization and Immobilized enzymes. Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Applications of immobilized enzymes. Biosensors – glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and Ribozymes. Enzymes of clinical importance - diagnostic significance and therapeutic effects. Enzyme Engineering- Introduction and Applications only.

References

1. Enzymes (Longman, London) - Dixon, M. and Webb, J.F., 1979.
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry Kindle Edition-T Palmer, 2007.
3. Biochemistry- Stryer, I, (W.H. Freeman Company, New York), 1988.
4. Biochemistry - Voet, D. and Voet, J.G, (John Wiley & Sons Inc., New York).
5. Fundamentals of Enzymology- Price and Stevens: (Oxford University Press).
6. Fundamentals of Enzymology - Nicholas C., Oxford Science Publications, 2nd Edition.
7. Fundamentals of Ezymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).
8. Enzyme Kinetics and Mechanism. P. F. Cook and W. W. Cleland, Garland Science (2007).
9. Enzymes; Trevor Palmer, East – West Press Pvt. Ltd., Delhi (2004).
10. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland , Wiley-VCH Publishers (2000).
11. Methods in Enzymology; Colowick S.P. et al., Vol. 152, Academic Press, (1987).
12. Enzyme Kinetics; Roberts, D.V. Cambridge University Press (1977).
13. Enzyme Kinetics; Irwin H. Segel (1976) Interscience-Wiley.
14. Enzyme Kinetics; the Steady state approach; Engel, P.C. 2nd Edn. Champman and Hall (1981).
15. Introduction to Enzyme and Co-enzyme Chemistry. Ed. T. Bugg, Blackwell Science (2000).
16. An Introduction to Enzyme and Coenzyme Chemistry; Timothy B. Bugg, (1997) Jones.

Subject Code: 20P2B6	CC5 - BIOENERGETICS AND METABOLISM	Credits: 5

Learning Objectives

- To study the importance of organization of living systems.
- To learn the biochemical reactions and energy formation through metabolic pathways with their regulatory mechanisms.

Course Outcomes

At the end of the course, the student will be able to

- Understand the basic principles of bioenergetics and mitochondrial mechanisms in energy production.
- Understand the reaction pathways by which carbohydrates and lipids are synthesised and degraded and energy production.
- Learn the metabolic fates of amino acids and the features of protein catabolism.
- Know the biochemistry of porphyrins, purines and pyrimidines and the integral relationship of metabolic pathways.
- Acquire knowledge the clinical conditions arising from metabolic dysfunction.

Unit I

Bioenergetics: Free energy and Entropy. Enzymes and coenzymes involved in biological oxidation reduction reactions. High energy compounds. Electron transport chain - organization and role in electron capture and inhibitors of electron transport. Oxidative phosphorylation and its regulation. F_0/F_1 ATPase structure and mechanism of action. Chemiosmotic theory. Inhibitors, ionophores and uncouplers of oxidative phosphorylation. Substrate level phosphorylation. Mitochondrial transport systems - ATP/ADP exchange and Malate/Glycerophosphate shuttle.

Unit II

Carbohydrates metabolism: Introduction, Glycolysis, Pyruvate dehydrogenase complex. Citric acid cycle and its regulation. Glyoxylate cycle. Pentose phosphate pathway and its significance. Gluconeogenesis and its regulation, Lactic acid cycle, Metabolism of fructose, galactose and lactose. Glycogen metabolism and its regulation. Metabolic adaptation in Starvation and Diabetes mellitus.

Unit III

Lipid metabolism: Introduction. Alpha, beeta and omega oxidation of fatty acids, Oxidation of unsaturated fatty acids. Biosynthesis of saturated fatty acids. Desaturase and elongase. Fatty acid synthase multienzyme complex. Metabolism of triacylglycerols, phospholipids and cholesterol. Formation of ketone bodies and their oxidation. Regulation of fatty acid and Cholesterol biosynthesis.

Unit IV

Amino acids and protein metabolism: General reactions of protein metabolism, General reactions of amino acid metabolism - transamination, decarboxylation, oxidative and non-oxidative deamination of amino acids. Urea cycle and its regulation. Essential and Nonessential amino acids. Biosynthesis of glutamine, serine, glycine, proline and tyrosine. Degradation of valine, proline, cysteine, phenylalanine and methionine. Inborn errors of protein metabolism.

Unit V

Nucleic acid metabolism: Degradation of nucleic acids. Deoxyribonucleases and ribonucleases. Biosynthesis and degradation of purine nucleotides. Biosynthesis and degradation of pyrimidine nucleotides. Regulation of purine and pyrimidine nucleotide metabolism. Metabolism of porphyrins. Inherited disorders of purine and pyrimidine metabolism.

References

1. Biochemistry by L. Stryer - 4th Edition.
2. Text Book of Biochemistry by Thomas M. Devlin, John Weily & Sons.
3. Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).
4. Principles of Biochemistry; Smith et al., McGraw Hill (1986).
5. Biochemistry- R. Garret, Charles M Grisham, Belmont (2013)
6. Biochemistry; Geoffrey Zubey, WCB Publishers, (1998).
7. Biochemistry; David Rawn, Panima Publishers, (1989).
8. Fundamentals of Biochemistry Donald Voet John Wiley & Sons (2016).
9. Text Book of Biochemistry with Clinical correlations; 6th Edn. Thomas M. Devlin Wiley-Liss (2012).
10. Lehninger- Principles of Biochemistry; D. L. Nelson and M.M. Cox 7th Edn. Macmillan Publications (2017).
11. Bioenergetics; A Practical Approach, G.C. Brown and C.E. Cooper (1995) IRL- Oxford University Press.
12. Harper;s Illustrated Biochemistry, 31st Edn.Victor W Rodwell et al., (2018).
13. Bioenergetics; David Nicholls and Stuart Ferguson, Elsevier (2013).

Subject Code: 20P2B7	CC6 – IMMUNOLOGY AND IMMUNOTECHNOLOGY	Credits: 5

Learning Objectives

- To understand the basic and advanced immunological reactions in the human system.
- To know how to diagnose the diseases through immunological techniques.

Course Outcomes

At the end of the course, the student will be able to

- Describe the components of immune system and the role of cells and organs in immune response.
- Learn the latest developments in vaccine production and mechanisms.
- Understand the abnormal immunologic manifestation in transplantation, hypersensitivity and antibody diversity.
- Gain knowledge in view of immunological mechanisms with a focus on management of diseases like cancer, AIDS and autoimmune disorders.
- Comprehend the principle and application of various techniques like immune diffusion, ELISA, RIA and EMIT.

Unit I

Immunity - innate and acquired immunity. cells and organs of the immune system; cells and Bone marrow, thymus and bursa of fabricus. Lymph node, spleen and mucosal associated lymphoid tissue. Antigens- Definition, antigenicity, antigenic determinants, haptens and epitopes. Antibodies- Structure, classification and functions.

Unit II

Immune response- Primary and secondary response. Humoral and Cell mediated immunity. . Complements system- components, nomenclature, and activation of complement, classical and alternate pathway. Antibody biosynthesis- theories of antibody formation- side chain, Clonal selection and class switching theory.

Unit III

Lymphokines and cytokines. Antigen processing and presentation. MHC complex- gene organization. HLA genes- class I and class II antigens, structure and function. Histocompatibility testing- lymphocytotoxicity test – cross matching. Transplantation- types, genetics of transplantation.

Unit IV

Hypersensitivity: types – I, II, III, IV, V. Immunotolerance, Autoimmunity- the spectrum of autoimmune diseases. HIV life cycle, diagnosis and treatment. Classification of tumor antigen.

Unit V

Active and passive immunization. Toxoids, Killed and attenuated Vaccines. Recombinant vaccines, Anti-idiotypic Vaccines and subunit vaccines. Immunological techniques- Principles and Production of antisera, precipitation, agglutination, complement fixation test, Immunodiffusion, immuno electrophoresis and immuno fluorescence. Hybridoma technique- Production and application, merits and demerits. Radio-Immuno Assay. Enzyme immunoassay-ELISA and EMIT.

References

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2. Nandhini Shetty, 1996, Immunology, New age international publication.
3. Gregory J. Bancrt, 2004, Infection and Immunity, 2nd edition, Oxford University Press.
4. Antibodies– A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press (2014).
5. Primer to the Immune Response, Tak Mak Mary Saunders Bradley Jett, Elsevier (2014).
6. Autophagy: Cancer, Other Pathologies, Inflammation, Immunity, Infection, and Aging; M. Hayat (Ed.) Elsevier (2014).
7. Cellular and Molecular Immunology (8th Edn.), A. Abbas, A. Lichtman, S. Pillai, Saunders, Elsevier, USA (2014).
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9. Immunology: Roitt et al., Mosby (2001),
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11. Immunology at a Glance: J.H.L. Playfare [ed.] Blackwell Science, (1987).
12. Immunology; Jan Klein [Ed.], Blackwell Science (1990).
13. Understanding Immunology (Cell and Molecular Biology in Action); Peterwood, Pearson Education Ltd. (2006).

Subject Code: 20P2B8EC	EC2 - PHARMACOLOGY	Credits: 5

Learning Objectives

- To study the drug discovery and development process.
- To learn the different types of drugs and their mode of action.

Course Outcomes

At the end of the course, the student will be able to

- Learn the drug metabolic pathway, drug discovery and development process.
- Acquire knowledge in the anti-inflammatory drugs.
- Understand the pharmacotherapy, vitamins, vaccines and hypoglycemic drugs.
- Understand the anticancer drugs, antibiotics, antiviral and antimalarial substances.
- Acquire knowledge on drug resistance and drug addiction.

Unit I

Drug: Classification of drugs, route of drug administration, drug absorption and distribution. Drug metabolic pathway - phase I - oxidative reactions- Epoxidation, hydroxylation, C - N system, C - O system and C -S system. phase II - reductive reactions - hydrolytic reaction. conjugation- Amino acids, sulphates, acetic acid, glutathione, mercapturic acid, methyl conjugation and transformation. Hard drugs - definition, biophosphanates and pyrophospahte. Soft drugs - definition and examples. Drug receptor and drug action, forces involved in the drug receptor complex. Drug discovery and development process.

Unit II

Anti-inflammatory drugs: steroid Anti inflammatory drugs and Non steroidal Anti-inflammatory drugs, Examples, pathways, mechanism of action and therapeutic uses. Pharmacokinetics: Definition, Importance, Toxicity, Distribution, Factors involved and Elimination. Drug adverse effects: Classification, Detection and prevention.

Unit III

Pharmacotherapy of gout and rheumatoid arthritis, therapeutic gases-oxygen and carbon dioxide, enzyme therapy, mechanism of enzyme catalysis, types of catalysis and inhibition (chymotrypsin, aspartic proteases), vitamins, vaccines and hypoglycemic drugs. Organic pharmaceuticals and their role as preservatives and food additives.

Unit IV

Chemotherapy: Anticancer drugs: Introduction, types of neoplasm, metastasis, causes of cancer and its treatment (chemotherapy only). Antibiotics - classification, structure, activity and uses of penicillin, cephalosporin, streptomycin and chloromphenicol, tetracycline. Action of alkaloids, antiviral and antimalarial substances.

Unit V

Biochemical mechanism of drug resistance, Multiple drug resistance (MDR), Common multidrug-resistant organisms (MDROs), Antifungal resistance, Antiparasitic resistance, Antibiotic resistance and Modes of Antibiotic action. Drug tolerance: Definition and types - Pharmacodynamic tolerance, Pharmacokinetic (metabolic) tolerance and Behavioral tolerance. Drug addiction: Definition, Risk factors, Mechanism, Diagnosis and treatment. Drug abusers: Definition, Classification and sign and its symptoms.

References

1. W.C.Bowman, M.J.R and G.B.West.1968. Text Book of pharmacology, Black well scientific Inc.Oxford,
2. Jayashree Gosh, 1996, Text Book of Pharmaceutical chemistry edition, S.Chand & Co.New Delhi.
3. Mehta, S.C.Kar, Ashutossh,2009, pharmaceutical pharmacology, 1st edition, New age International.
4. Kar, Asutosh,2010, Medicinal chemistry, 5th Edition, New age International.
5. Dr. S.P. Maity and R.N.Chatterjee, Pharmacology, 2012, Books and Allied Pvt. Ltd.
6. Biopharmaceuticals Biochemistry and Biotechnology 2nd Edn. Gary Walsh, John Wiley & Sons, Ltd, England (2003).

Subject Code: 20P2BP2	CP2: LAB COURSE - II	Credits: 4

Hours: 6 **Marks: Internal 40** **External: 60**

Learning Objectives

- To learn the preparation of various buffers with their experimental usage.
- To study the activity of amylase, acid phosphatase, alkaline phosphatase and urease.
- To investigate the factors like pH, temperature and substrate concentration influence the activities of amylase, acid phosphatase, alkaline phosphatase and urease reactions.

Course Outcomes

At the end of the course, the student will be able to

- Get practical knowledge for the preparation of various pH buffer solutions.
- Understand the enzyme activity by experiments.
- Acquire practical knowledge on the factors pH, temperature and substrate concentration influence the activity of amylase, acid phosphatase, alkaline phosphatase and urease.

Demonstration

1. Preparation of various pH buffer solutions using pH meter

Amylase

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of Km by Line Weaver – Burk Plot

Acid phosphatase

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

Alkaline phosphatase

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

Urease

1. Determination of activity
2. Effect of pH
3. Effect of Temperature
4. Determination of specific activity
5. Determination of Km by Line Weaver – Burk Plot

References

1) Biochemical Calculations, Irwin H.Segel (1976) 2nd Ed. Jhon Wiley and Sons.
2) Methods in Enzymology; Colowick , S.P. et al., [Eds.] (1987) Vol. 152, Academic Press.
3) Modern Experimental Biochemistry R.F.Boyer [Ed.] (1986) Addition Wesley.
4) Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
5) Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack, Oxford University (1995).

6) Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland , Wiley-VCH Publishers (2000).
7) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry: Trevor Palmer, Horwood, (2001).
8) Enzyme Kinetics: A Modern Approach: Alejandro G. Marangoni, John Wiley & Sons (2002).
9) Enzyme Kinetics: Principles and Methods: Hans Bisswanger, Wiley–VCH (2002).
10) Fundamentals of Enzyme Kinetics: 4th edn. Athel Cornish-Bowden, Wiley-Blackwell (2012).
11) Fundamentals of Enzyme Kinetics: Athel Cornish-Bowden, Portland Press (2004).
12) Contemporary Enzyme Kinetics and Mechanism, D. L. Purich 3rd Edn., AP (2009).
13) Practical Enzymology, Second Revised Edtion [StormRG]: Hans Bisswanger, Wiley – Blackwell; 2 edition (2011).

Subject Code: 20P3B9	CC7 - HUMAN PHYSIOLOGY	Credits: 5

Learning Objectives

- To study the structure, composition and disorders of all organs
- To learn the functions of all organs

Course Outcomes

At the end of the course, the student will be able to

- Understand the fundamental components and functions of nervous, digestive, urinary and muscular system.
- State the normal and abnormal composition, functions and clinical significance of investigating body fluids.
- Understand the basic concepts of acid-base and water-electrolyte homeostasis and pathophysiological mechanisms of diseases arising due to imbalance.
- Acquire knowledge about the basic mechanism of organs and fitness regarding human beings.

Unit I: Body Fluid and Blood

Body fluid: Body fluid compartments, composition, capillary structure and filtration across capillary wall. Blood: Composition, functions of plasma, RBC, WBC and platelets. Blood coagulation mechanism. Blood groups and Blood Buffers (Hemoglobin and Bicarbonate). Lymph: composition and function. Circulatory system: Elementary principles of circulation, vasomotor circulation, blood pressure and structure of heart.

Unit II: Nerve and Muscle

Organization of nervous system: central and peripheral nervous system, structure of brain and neuron, excitability, action potential, conduction of nerve impulses, nerve fiber type and neurotransmitters. Muscle: Skeletal muscle, Smooth muscle and Heart muscle - structure, contraction and relaxation. Cardiac cycle. Electrocardiogram.

Unit III: Renal Physiology

Structure of kidney and Nephron. Glomerular filtration, tubular reabsorption and secretion. Renal role in acid base balance, mechanism and regulation of miturition and renal failure. normal and abnormal constituents in urine.

Unit IV: Gastro Intestinal Physiology

Digestive system - Composition and functions of digestive secretions, saliva, gastric juice, bile, pancreatic and intestinal secretions. Absorption and transport of carbohydrates, proteins and lipids. Role of dietary fiber. Gastrointestinal hormones. Body temperature: Heat production and lose, Regulation and abnormality of body temperature.

Unit V: Special Senses and Sports Physiology

Special senses: Structure and functions of eye, ear and taste and olfaction.

Sports physiology: Muscle, respiration, cardiovascular system and body fluids and salts in exercise. Drugs and athletes.

References

1. Concise Medical Physiology: SK Chaudhuri, New Central Book Agency, Chintamoni Daslane, Calcutta.
2. BDS Text book of Physiology and Biochemistry: G.H. Bell, D. Emsile - Smith, C.R, Peterson Churchill Livingstone.
3. Text book of Biochemistry Human Physiology: Talwar. G.P, Srinivastava. I, M Mondgil. K.D, 1989, Prentice Hall India.
4. Text book of Medical physiology: Guyton Hall, 2006, Blackwell Publishing House.
5. Comparative Developmental Physiology, Stephen J. Warburton, 2006, Oxford University Press.
6. The Cell, Copper, Geoffery, M., Oxford University Press, (2001)
7. Principles of Human Physiology; 4th Edn. Cindy L. Stanfield Pearson, (2010).
8. Cellular Physiology & Neurophysiology 2nd Edn., Mordecai, P. Blaustein, Elsevier Sceince,(2012).
9. Human Biochemistry, Orten and Neuhans , 10th Edn. Mosbey International, (1983).
10. The Neuron,; Cell and Molecular Biology, Irwin B Lavitan, Leonard K Kaczmarck, Oxford University press (2015).
11. Human Physiology: The mechanisms of Body functions. A.J. Vander, et. Al., McGraw-Hill, (1985).
12. Molecular Biology of the Cell, Bruce Alberts, Alexander D Johnson, Julian Levis, David Morgan, Martin Raff, Garland Science (2014).
13. Cellular Physiology of Nerve and Muscle. Gary G Mathew (1998) Balckwell Scientific Inc.

Subject Code: 20P3B10	CC8 - ADVANCED CLINICAL BIOCHEMISTRY	Credits: 5

Learning Objectives

- To know the fundamental principle, Mechanism and diagnosis of different diseases in modern clinical field.
- To study the etiology, diagnosis and therapy of many diseases.

Course Outcomes

At the end of the course, the student will be able to

- Understand the collection, preservation and different clinical samples.
- Learn the different organ functional tests to assess the liver and kidney functions.
- Describe the molecular basis of genetic and acquired disorders.
- Understand the etiology, findings and management of diabetes, atherosclerosis and cancer.
- Describe and explain the diseases of the major organs and systems and organ functional tests for diagnosis and management.
- Acquire knowledge on the principles of recent advancements in diagnosis and therapy.

Unit I

Specimen collection and processing-Collection of blood - Vein puncture, Skin puncture, arterial puncture, anticoagulants. Collection of urine, urine preservatives, test for urinary components, Clinical significance of urinary components with reference to sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF – Collection, composition, chemical examination and clinical investigation in meningitis and Encephalitis. Amniotic fluid- Origin, collection, composition and analysis of amniotic fluid. Automated instruments in analysis.

Unit II

Serology- C Reactive Protein test, immunology test for pregnancy. Rheumatoid arthritis (RA) test. Hematology- ESR, Screening for sickle cell anemia, coagulation test and prothrombin time. Hemoglobin- Haemoglobinopathies, thalassemia and related disorders, normal and abnormal hemoglobin, haemoglobinaemia, Haemoglobinuria. Myoglobin related disorders. Porphyrins and disorders-porphyria.

Unit III

Blood sugars – Its maintenance, hyper and hypoglycemia. Regulation of blood glucose concentration – Diabetes mellitus – Complications, secondary degenerative diseases. Laboratory diagnosis of early and latent diabetes. Glucose tolerance test. Glycogen storage diseases, galactosemia and fructosuria. Disorders of purine and pyrimidine metabolism-Leisch Nyhan syndrome, hyperuricemia, Gout, hypouricemia and orotic aciduria. Disorders of lipid metabolism – lipoprotenemia, lipid storage disease, Gaucher's disease, Taysach's disease, Niemann pick's disease, fatty liver and atherosclerosis.

Unit IV

Clinical enzymology – Principles of diagnostic enzymology- factors affecting enzymes level in blood. Principles of assay and clinical significance of transaminases, creatine kinase, lactate dehydrogenase, glucose 6 phosphate dehydrogenase and ceruloplasmin. Enzyme pattern in diseases-Myocardial infarction, Hepatobiliary diseases and nephritic syndrome.

Unit V

Liver function test and related disorders- Cirrhosis, Jaundice, Hepatitis, Fatty liver and Cholestasis. Renal function test and related disorders- Acute renal failure, glomerulonephritis. Analysis of urinary calculi. Oncology- Oncogenes, tumor suppressor genes, alfa fetoprotein, carcinoembryonic antigens, leukemia. Free radicals in disease- introduction, oxygen toxicity, free radicals and free radicals induced lipid peroxidation. Free radical scavengers- super oxide dismutase, catalase and peroxidase.

References

1. Philip D. Mayne, 1994, Clinical Chemistry in Diagnosis and Treatment, 6th edition, ELBS Publication.
2. Karperetl, D.L, 2005, Harrison's Principles of Internal Medicines, 16th edition, Vol. I and Vol. II, Mc-Graw Hill publication, New York.
3. Bishop. Lipincot, 2000, Clinical Chemistry, Principles and Procedure, Correlations press.
4. Christopher Haslett et al., 2002, Davidson's Principles and Practice of Medicine, 19th edition, Elsevier Science.
5. John F. Zilva, 1988, Clinical Chemistry in Diagnosis and Treatment, Medical Publishers, Chicago.
6. Teitz Fundamentals of Clinical Chemistry, Burtis,C. and Bruns, D. 2007 3rd Edition, W.B. Saunders Company.
7. Clinical Chemistry, Principles, Techniques, Correlations with Access, 8th Edn. Michael Bishop, Edward Fody, & Larry Schoeff, Lippincott William & Wilikns (2018).
8. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc.(2010).

Subject Code: 20P3B11	CC9 - ENDOCRINOLOGY AND NEUROCHEMISTRY	Credits: 5

Learning Objectives

- To know the secretions, composition and functions of hormones.
- To study the organization, function, chemistry and conduction of nerve impulse and transmission.

Course Outcomes

At the end of the course, the student will be able to

- Understand the hormones, intracellular second messengers and functions.
- Get knowledge on the thyroid, parathyroid, hypothalamus and pituitary hormones.
- Get knowledge on the pancreatic, adrenal and gonadal hormones.
- Learn the organization and functions of brain and nervous system.
- Acquire knowledge on the prostaglandins.

Unit I

Neuro endocrine system-Definition, classification of hormones, molecular basis of hormonal action, steroid hormone action, Intracellular second messengers-cAMP, protein kinases, tyrosine kinases, adenylate cyclase system, ANP, guanyl cyclase, calcium. Control of hormone release, regulation by releasing factors, prohormones and feedback control. Growth factors- Erythropoietin, Nerve growth factor, epidermal growth factor and fibroblast growth factor.

Unit II

Hypothalamus and Pituitary hormones- Vasopressin and Oxytocin. Hypothalamic releasing factors. Anterior pituitary hormones-actions and feedback regulation of synthesis. Hypo and Hyperactivity of Pituitary hormones- Gigantism, acromegaly, Dwarfism and Diabetes insipidus. Thyroid hormones- Synthesis, secretions, transport, metabolic fate and biological actions, anti-thyroid agents, hyperthyroidism and hypothyroidism. Parathyroid hormones- Biological actions, regulation of calcium and phosphorous metabolism.

Unit III

Pancreatic hormones- cell types of the islets of Langerhans. Insulin- Biosynthesis, regulation of section, biological actions and mechanism of action. Glucagon, somatostatin. Adrenal hormones-glucocorticoids, mineralocorticoids-biological effects and mechanism of action. Adrenal medulla-catecholamines - biological actions. Abnormal secretion of adrenal hormones-Addison's disease and Cushing's syndrome, Gonadal hormones-Androgen, estrogen-biological actions.

Unit IV

Brain-Chemical composition, neuro transmitters and cyclic AMP. Biochemical aspects of learning and memory: encephalins and endorphins. Nervous system-general organization, functional unit, chemistry, resting and action potential, conduction of nerve impulse, synaptic transmission and neuro muscular junction.

Unit V

Prostaglandins-chemistry and nomenclature, biosynthesis - the cyclo oxygenase pathway, metabolism. Biological actions of prostaglandins, prostacyclins and thromoboxanes. Synthetic prostaglandin analogues and their therapeutic uses. Leukotrienes-chemistry, synthesis-Lipoxygenase pathway and their role in hypersensitive reactions.

References

1. Mac E. Hadley, 2004, Endocrinology, 5th edition, Pearson Education.
2. Donald W.Pfaff, 2006, Principles of Hormone/Behaviors relations, 1st edition, Academic Press.
3. Long staff. A, 2002, Instant Notes on Neuroscience, 1st edition, Viva books Private Limited.
4. Robert K. Murray et. al. 2003, Harpers Illustrated Biochemistry, 26th edition, Lange Medical Publication.
5. Emil S.Smith, 2000, Principles of Biochemistry-Mammalian Biochemistry, McGraw-Hill publication.
6. Biochemistry of Signal Transduction and Regulation, Gerhard Krauss, 5th Edn. Wiley-VCH Verlag GmbH & Co (2014).
7. Basic Neurochemistry; George Siegel et al., Wippincott, Williams and Wilkins (1999).
8. The Biochemistry of Cell signaling; Ernst J.M. Helmreich, OUP, (2001).
9. Signal transduction and human disease; Toren Finkel, and J. Silvio Gutkind, John Wiley & Sons, Inc. (2003)
10. Greenspan's Basic and Clinical Endocrinology; 9th Edn. David Gardner and Dolores Shoback Lange Clinical Medicine (2012).
11. Biochemistry of Signal Transduction and Regulation; Gerhard Krauss, Wiley-VCH (2003).
12. Elements of Molecular Neurobiology; 3rd Edn. C. U. M. Smith, John Wiley & Sons Ltd, (2002).
13. Cell Signaling; Wendell Lim, Bruce Mayer, Tony Pawson; Garland Science (2014).
14. Signal Transduction; Lewis Cantley, CSHL Press (2014).

Subject Code: 20P3B12EC	EC3 - BIOTECHNOLOGY AND GENETIC ENGINEERING	Credits: 5

Learning Objectives

- To learn the uses of technology in biological science.
- To learn the tools and various methods used in biotechnology and genetic engineering.
- To study the genetically modified organisms produced by genetic engineering.

Course Outcomes

At the end of the course, the student will be able to

- Get technical knowledge on versatile techniques in recombinant DNA technology.
- Understand the applications of genetic engineering techniques in basic and applied experimental biology.
- Apprehend the role of rDNA technology in constructing vectors, cDNA and genomic libraries.
- Know the advantages and disadvantages of transgenic plants and foods.
- Comprehend the methodology and applications of bacterial leaching and biomining.

Unit I

Principles of genetic engineering and rDNA technology. Cutting and joining of DNA molecules. Restriction enzymes and their types. DNA ligases. Alkaline phosphatase. Double linkers. Adaptors. Homopolymeric tailing. Essential features of cloning vectors. Plasmids - pBR322 and pUC, Phage vectors - λ and M13, Cosmids and High capacity cloning vectors -YAC, PAC and BAC. Shuttle vectors. Expression vectors. Gene cloning in bacteria and yeast. Selection and screening of recombinants.

Unit II

Genomic DNA library, cDNA synthesis and cloning, Chromosome walking, Gene transfer methods - Calcium phosphate precipitation, PEG stimulated, liposome mediated, electroporation, microinjection, viral vectors and particle bombardment gun (biolistic) method. PCR technology. Blotting techniques - southern, northern and western blotting.

Unit III

Agrobacterium mediated transformation. Ti plasmids - cointegrative and binary vectors, Production of transgenic plants - viral, pest and herbicide resistant plants. Plant as bioreactors. Plant tissue culture - callus culture, micropropagation and protoplast culture. Anti-sense RNA technology and its applications.

Unit IV

Transgenic animals - Production and applications. Animal cell culture – methods and applications. Gene therapy. Principles and applications of stem cell technology. Production of insulin, vaccines, antibodies, interferons and somatostatin.

Unit V

DNA fingerprinting and foot printing with its applications. Bacterial leaching and biomining. Bioreactors - Design and types of fermentors, batch and continuous bioreactors. Downstream processing. Bioethics - Ethical issues in production of genetically engineered foods and transgenic plants and animals.

References

1. Genes VIII by Benjamin Lewin, 2004, Pearson Educational international.
2. Recombinant DNA by Watson, 2001, 2nd edition, Scientific American Books.
3. Plant Biotechnology by Adrian Slater, 2003, Oxford University Press.
4. Biotechnology by John E.Smith, 1996, 3rd edition, Cambridge University Press.
5. Molecular Biology Techniques; Sue Carson, Heather Miller and D. Scott Witherow, Academic Press (2011).
6. Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn. Keith Wilson and John Walker (2012).
7. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
8. Gene Cloning and DNA analysis- An Introduction; T. A. Brown, 5th Edition, Wiley-Blackwell (2006).
9. Gene Cloning Laboratory Manual 4th Edn. Michael R. Green and Joseph Sambrook, CSHL Press (2014).
10. Current Protocols in Molecular Biology; S Gallaghar, Wiley Interscience (2008).
11. Molecular Biology and Biotechnology; 4th Edn., J.M. Walker and R. Rapley, RSC (2000).
12. Molecular Cloning; A laboratory manual; Michael R. Green, CSHL Press (2012).
13. Molecular Biology of the Cell; 7th Edn. Bruce Alberts et al., (2008), Garland Publications.
14. Gene Cloning and DNA analysis- An Introduction; T. A. Brown, 5th Edition, Wiley-Blackwell Publishing (2006).
15. Plant Biotechnology and Agriculture; Arie Altman and Paul Hasegawa Academic Press (2011).

Subject Code: 20P3BP3	CP3: LAB COURSE - III	Credits: 4

Hours: 6 **Marks: Internal 40** **External: 60**

Learning Objectives

- To practice the students in the field of clinical biochemistry experiments.
- To motivate the students with modern techniques for clinical laboratory.

Course Outcomes

At the end of the course, the student will be able to

- Describe the principles associated with the biochemical measurements performed in clinical laboratory.
- Quantitatively analyze the blood constituents and assay enzymes of diagnostic importance.
- Interpret the result patterns in relation to normal level.

I. Hematological studies

1. Estimation of hemoglobin content by Hemoglobinometer
2. Total RBC count.
3. Total WBC count.
4. Differential WBC count (DC).
5. Determination of clotting time
6. Determination of Prothrombin time
7. Determination of ESR.
8. Grouping of blood and Rh typing.

II. Biochemical analysis of blood

1. Estimation of blood glucose by Ortho toluidine method
2. Estimation of serum proteins (A: G ratio)
3. Estimation of blood urea
4. Estimation of serum uric acid
5. Estimation of serum creatinine.
6. Estimation of serum triglycerides.
7. Estimation of serum cholesterol.
8. Estimation of serum calcium.
9. Estimation of serum bilirubin.
10. Estimation of serum Iron.

III. Urine Analysis

1. Identification of normal and abnormal constituents of urine.

IV. Immunological techniques

1. Widal test – rapid slide test for typhoid
2. VDRL test – test for syphilis
3. Latex agglutination test for rheumatoid factor and Pregnancy
4. Immunoelectrophoresis
5. ELISA – demonstration.

V. Spotters

1. Sphygmomanometer
2. Hemocytometer
3. Micropipette

References

1) Practical Clinical Biochemistry, ed. Harold Varley, 4th edn. CBS Publishers (1988).
2) Practical Clinical Biochemistry: Methods and Interpretation, ed. Ranjna Chawla, Jaypee Brothers Medical Publishers (1996).
3) Practical and Clinical Biochemistry for Medical Students, ed. T.N. Pattabhiraman, Gajanna Publishers (1994).
4) Hawk's Physiological Chemistry, ed. Oser, 14th Edn.(1976), Tata-McGrawHill.
5) Biochemistry, ed. Plummer Tata-McGraw Hill, (1971).

Subject Code: 20P4B13	CC10 - MICROBIAL AND PLANT BIOCHEMISTRY	Credits: 5

Learning Objectives

- To understand the fundamental and biochemical pathways in plants and microbes
- To aware the students in the field of pathogenesis.

Course Outcomes

At the end of the course, the student will be able to

- Understand plant cell structure and functions of all compartment of plant cell.
- Learn the structure, properties and function of the secondary metabolites.
- Describe how microorganisms are used as modern system to study basic biology, genetics, metabolism and ecology.
- Understand the microorganism play an integral role in disease, treatment and prevention.
- Acquire knowledge of different bacterial and fungal pathogens.

Unit I

Structure of bacteria, fungi and algae. Viruses: morphology, structure, reproduction and mode of infection. Microbial growth : Nutritional patterns among organisms, physical and chemical requirements for growth, culture media, mixed and pure cultures, preservation of cultures, phases of growth, measurements of microbial growth- Sterilization and Staining techniques.

Unit II

Soil Microbiology: Different soil microbes. Biogeocycle- carbon, Nitrogen and sulphur cycles. Aquatic Microbiology: Fresh water microbial flora, effects of pollution, chemical pollution- test for water purity, salinity, BOD, COD, Microbial load. Water treatment- Sewage treatment- primary, secondary treatment- sludge digestion, septic tank, oxidation ponds and tertiary treatment. Water borne diseases. Food Microbiology: Microbial spoilage- Fresh food, milk and canned food. Food preservation- temperature, canning, pasteurization and sterilization methods in food industry. Mycotoxicosis: Mycotoxins of food contaminants like *A. flavus, P. rubrum, P. citrinum,* and *A. canidus* and *Stachybotraya citra.*

Unit III

Photosynthesis: Chloroplast structure and function- CO_2 fixation by C3, C4 and CAM plants. Hill's reaction, Photorespiration, Photophospharylation. Nitrogen metabolism, transport and storage of nitrogen. Trace elements in plant nutrition. Translocation of Organic and Inorganic substances. Plant pigments- isoprenoids, anthocyanina and secondary metabolites - flavanoids, alkaloids, phenolics, tannins and lectins.

Unit IV

Germination changes in composition and enzyme activities in seed, factors affecting germination. Structure and functions of plant hormones- Auxins, gibberellins and absicic acid. Plant breeding- principles of plant breeding, important conventional methods of breeding. Self and cross pollination and vegetative propagated crops. Genetic variability. Patterns of variation in morphology and life history in plants.

Unit V

Plant pathogens: common plant pathogens of interest of India, portals of entry, transmission of plant pathogen by vector. Plant diseases caused by bacteria, fungi and viruses, their effects on respiration, photosynthesis and water uptake. Defensive mechanism including resistance to infections.

References

1. Frank B. Salisbury Clean W.Ross, 2004, Plant Physiology, 4th edition, Thomson Wordsworth.
2. Arvind Kumar S.S Purohit, 2005, Plant Physiology Fundamental and Applications, 2nd edition, Agrobios.
3. Ananthanarayan. R CK Jayaram Paniker. 2005, Text Book of Microbiology, Orient Longman.
4. Michael J. Pelczar et. al. 2004, Microbiology, Tata Mc-Graw Hill.
5. Microbiology; Prescott, Harley and Klein, McGraw-Hill (2003).
6. Microbial physiology, 4th Edn. Albert G. Moat, John W. Foster and Michael P. Spector, Wiley-Liss (2002).
7. Modern Food Microbiology; James M Jay CBS Publishers (1996).
8. A Modern Introduction to Food Microbiology; Board, R.G. (Ed.) (1983) Blackwell Scientific Publications.
9. Microbiology; Lansing M. Prescot, Hartley and Klein, 5th Edn. McGraw Hill (2002).
10. Applied Microbial Physiology: A practical approach Rhodes and Stanbury (1997) IRL Press.
11. Basic and Practical Microbiology, Ronald L. Atlas (1986) McMillan Publication Co.
12. Microbiology, Pelczer, Reid and Kreig Tata McGraw Hill (1996).
13. Biology of Microorganisms, Brock Prentice Hall (1996).

Subject Code: 20P4B14EC	EC4 - INDUSTRIAL BIOCHEMISTRY AND NANOTECHNOLOGY	Credits: 5

Learning Objectives

- To learn the methods of industrial production of different kinds of food, organic compounds, vitamins, antibiotics, vaccines and enzymes.
- To study the applications of enzymes in medicine and industry.
- To develop the basic knowledge in nanotechnology.

Course Outcomes

At the end of the course, the student will be able to

- Understand the applications of biochemistry in industrial purposes.
- Understand the food, microorganisms and fermented food products.
- Get wide knowledge on industrial production and applications of organic compounds, foods, vitamins, alcohol, antibiotics, vaccines and enzymes.
- Comprehend the nanotechnology and its application in biosciences.
- Get adequate knowledge to serve in pharmaceutical and food industries.

Unit I

Food and microorganisms - microorganisms in food industry, contamination and spoilage of different kinds of food: milk and milk products, sugar and sugar products, vegetables and fruits, cereals and cereal products, meat, fish, eggs and poultry, sea food and canned food. Food borne illnesses due to bacterial food poisoning, disease investigation, material and equipments, laboratory testing, field analysis and preventive measures; food hygiene and hazard analysis critical control points (HACCP). Fermentation processes in dairy and other food products. Biotechnology of food and feed: fermented food products– toffu, kaffir, cheese, buttermilk, yogurt and sour cream.

Unit II

Fermentation of antibiotics - organisms, cultures, procedures of fermentation, penicillins, β - lactams, cyclosporine and their derivatives, streptomycin, erythromycin, gentamycin, tetracyclines. Disease prevention through vaccines, conventional vaccines, purified antigen vaccines. Vaccine biotechnology - vaccine production through recombinant DNA - various approaches for novel vaccine production. Recombinant polypeptide vaccines, DNA vaccines and edible vaccines.

Unit III

Alcohol and alcoholic beverages - microbes and biotechnology of alcoholic fermentation. Fermentation of organic acids - acetic acid, lactic acid, gluconic acid and citric acid. Fermentation of amino acids - glutamic acid, tryptophan, phenylalanine. Vitamin production - B12, riboflavin and L-carotene: occurrence, economic significance, biosynthesis, production process. Feed production - SCP, fats, amino acid and food additives.

Unit IV

Biotechnological advance in production of cellulase, amylases, lipases and proteases. Bacterial and fungal cellulases, amylases, lipases, proteases, lysozyme, β – lactamases. Industrial applications of proteases, carbohydrases (amylases and cellulases) and lipases. Enzymes as diagnostic, analytical and therapeutic agents. Marketed enzymes. Baking and food enzymes. Textile enzymes. Digestive enzymes. Biological importance of Nucleotidase and Glucose 6 phosphate dehydrogenase.

Unit V

Nanotechnology and its applications in biosciences (basics only): Biosystems at the Nanoscale, interaction of nanoparticles with biomolecules, dendrimers, quantum dots, nanotubes, nanoshells. Concepts of property. Types of IPRs. Patent - Criteria of patentability, Non patentable invention, Patent specification. TRIPs.

References

1. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan, Mc Graw Hill, New York.
2. Biochemical Engineering, S. Aiba, A.E. Humphrey, Nancy F. Mills, University of Tokyo Press.
3. Principles of Fermentation Technology, P.F. Stanbury, A Whitaker, S.J. Hall.
4. Enzymes by Dixon and Webb, Academic Press.
5. The essential, understanding nanosciences and nanotechnology - T. Pradeep, Tata McGraw- Hill Publishing Company Limited.
6. Law Relating to Intellectual Property by B.L. Wadhera.
7. IPR Handbook for Pharma Students and Researchers by P. Bansal.

Subject Code: 20P4B15EC	EC5 - FOOD AND NUTRITIONAL BIOCHEMISTRY	Credits: 4

Learning Objectives

- To learn the food groups, classification and Nutritional requirements for normal and / different categories of human beings.
- To understand the role of micro and macro nutrients and vitamins in our health.

Course Outcomes

- Understand the basic knowledge of food, preservation and food groups to provide nutritive requirement for normal health.
- Learn the food energy, minerals and food safety.
- Describe the different diets in different life style.
- Be aware of energy requirements for humans, malnutrition disorders in children and role of vitamins and minerals in maintaining health.

Unit I

Food - Sources, composition, properties and storage of common foods. Functions of food in relation to health - Classification of foods based on nutrients. Food preservation - reasons for preserving foods, principles, methods of preservation. Food addictive in processed food and their effects. Food groups to provide nutritive requirement for normal health- body building foods, energy foods and protective foods.

Unit II

Basics for computing nutrient requirements: Latest concepts in dietary recommendations, RDA – ICMR and WHO: Uses and limitations. Definition of unit of energy – Cal, RQ, SDA and NPU. Energy metabolism: Basal and resting metabolism – influencing factors, Methods to determine energy requirements and expenditure. Sources and functions of essential nutrients – Proteins (high biological and low biological value), Carbohydrates and fats. Sources and functions of dietary fibre, Pro and Prebiotics.

Unit III

Micro and macro mineral nutrients: Distribution sources, metabolic functions and deficiency manifestations – Calcium, Phosphorus, Sodium, Potassium, Iron, Copper, Selenium and Zinc.
Fat and water soluble vitamins – Occurrence, properties and functions – Hyper and Hypovitaminosis. Role of Vitamin as Antioxidant.

Unit IV

Nutrition through life cycle. Special needs of Infants, children, adolescents, pregnant and lactating women, convalescents and old persons.
Food technology- Preparation of infant's Food, Food safety and Food Hygiene.

Unit V

Principles of diet therapy, Diet during stressed conditions- laborers. Patients- therapeutic diets for anemia - Iron deficiency anemia, Pernicious anaemia, Megaloblastic anaemia. Malnutrition - Kwashiorkor, Marasmus and Marasmic Kwashiorkor. Obesity, Diabetes mellitus - IDDM, Non - IDDM, Cancer, Cardiovascular diseases and allergy.

References

1. Krause's Food and Nutrition Therapy, Kathleen Mahan L, Sylvia Escott-Stump MA, 12th edition, International edition, Saunders Elsevier Publications.
2. Principles of Nutrition and Dietetics, Swaminathan M, Second Edition, The Bangalore Printing and Publishing Co., Ltd.
3. Food Science, Srilakshmi B, Fourth Edition, New Age International (P) Limited Publishers.
4. Advanced Nutrition and Human Metabolism 7th Edn. Sareen S Gropper, Jack L Smith, & Timothy P Carr, Cenage Learning (2018).
5. Introduction to Human Nutrition, 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
6. Modern Nutrition in Health and Disease, 10 Ed. Shills et al;, Lippincott Williams & Wilkins (2006).
7. Nutrition: Everyday Choices, 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley (2006).
8. Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease; Watson Elseveir (2012).
9. Nutrition and Metabolism, 2nd Edn., Lanham S, Mac Donald I and Roche H. The Nutrition Society, London, UK, (2012).
10. Introduction to Human Nutrition, 2nd Edn., Gibney M, Lanham S, Cassidy A and Vorster H. The Nutrition Society, London, UK, (2012).

Subject Code: 20P4BP4	CP4: LAB COURSE - IV	Credits: 4

Hours: 6 **Marks: Internal 40** **External: 60**

Learning Objectives

- To apply the technical approaches in the research.
- To educate the students in the awareness of food and its analysis.

Course Outcomes

- Understand the food analysis by both qualitative and quantitative methods.
- Describe the analysis of RNA, DNA, protein and sugar.
- Acquire knowledge on the sterilization techniques, media preparation and isolation of bacteria.

Experiment: Semi quantitative Analysis

1. Isolation of casein from milk
2. Isolation of lactose from bovine milk
3. Isolation of glutamic acid from gluten
4. Isolation of Starch from potato.

Experiment: Quantitative Analysis

1. Estimation of reducing sugar in milk – Benedicts or Anthrone Method
2. Estimation of iron content in apple juice
3. Estimation of albumin from the egg white
4. Estimation of polyphenols by folin- denis method
5. Determination of rancidity in edible oil: Kries test

Tissue Analysis

1. Estimation of RNA, DNA, Protein and Sugar.

Qualitative Analysis of some Common Food Adulterants

1. Edible oil
2. Milk and milk products
3. Beverages, spices and condiments

Microbial Techniques

Sterilization Technique
Preparation of Media
Isolation of Bacteria (Staining)

References

1) Beedu Sashidhar Rao, Viay Deshpande. Experimental Biochemistry. I.K International Pvt Ltd.
2) Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011).
3) Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
4) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, 8th Edn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, (2018).
5) Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993).
6) Biochemical Techniques 87th Edn., John F. Roby,& Bernard J White Waveland Press Inc. (1987).

Subject Code: 20P4BPW	PW: PROJECT WORK	Credits: 4 Maximum Marks: 100

List of Department Elective (DE) Courses - Optional

Course	Course Title	Hrs.	Exam hours	Marks		Total
				Int.	Ext.	
Elective Course - Optional	Biostatistics, Bioinformatics and Computer Applications	6	3	25	75	100
	Pharmacology	6	3	25	75	100
	Biotechnology and Genetic Engineering	6	3	25	75	100
	Industrial Biochemistry and Nanotechnology	6	3	25	75	100
	Food and Nutritional Biochemistry	6	3	25	75	100
	Developmental Biology	6	3	25	75	100
	Genomics, Proteomics and Bioinformatics	6	3	25	75	100
	Environmental and Medical Biology	6	3	25	75	100
	Medical Laboratory Technology	6	3	25	75	100
	Drug Discovery and Development	6	3	25	75	100

Department Electives Course – Optional

EC - BIOSTATISTICS, BIOINFORMATICS AND COMPUTER APPLICATIONS

Learning Objectives

- To practice the statistics, computer and its application in bioinformatics.
- To apply the statistical methods in research and projects.

Course Outcomes

At the end of the course, the student will be able to

- Know the scope, definition, statistical methods, functions and limitations of statistics.
- Understand the correlation, rank correlation, chi square test, students 't' test, F test and ANOVA.
- Explain the bioinformatics, information network, database – DNA, RNA, FASTA, BLAST, and Gene prediction software.
- Acquire knowledge about the genomics, proteomics, human genome project, microbial genome project, phylogenetic trees, discovery of drugs and pharmacogenomics.
- Gain knowledge on the operating system, MS – word, excel, power point, PDF, journal impact factor and index.

Unit I

Introduction, scope and definition, Statistical methods, functions and limitations of statistics. Collection, organization and representation of data. Measures of central tendency – mean, median and mode. Measures of dispersion – range, quartile deviation, mean deviation, standard deviation and coefficient of variation, standard error.

Unit II

Skewness and Kurtosis, Types of skewness, Measures of skewness, Karl – Pearson's co-efficient of skewness, Bowley's measure of skewness, Measure of skewness based on moment, Types of kurtosis, correlation analysis – types and methods, Karl pearson's Co-efficient of Correlation, rank correlation, regression analysis – regression line and regression equation, Chi square test, Students 't' test, F test and ANOVA

Unit III

Introduction to Bioinformatics, Information network, Database – nucleic acid, genome, protein sequence databases. DNA, RNA, Protein sequence searches, sequence alignment, algorithms. FASTA, BLAST, Gene prediction software.

Unit IV

Genomics, proteomics, Human genome project, Microbial genome project, Phylogenetic relationship, Phylogenetic trees, Discovery of drugs, Pharmacogenomics, Application of JAVA and UNIX programme in bioinformatics, Basic information on biojava & bioinformatics projects.

Unit V

Introduction to Windows Operating system, MS – Word, Excel, Power point, PDF, Journal-Impact Factor and Index. Application of computer packages in Biostatistics-SPSS, MINITAB.

References

1. Orpita Bosu, 2007, Bioinformatics-Experiments, Tools, Databases, Algorithms, Oxford University Press.
2. Brian Francis, Murray Aitkin, John Hinde, Ross Darnell, 2009, Statistical Modeling in R, 1st edition, Oxford University Press.
3. Bryan Bergeron, 2002, Bioinformatics and Computing, 1st edition, Prentice Hall.
4. Arthur M. Lesk, 2002, Introduction to Bioinformatics, 1st edition, Oxford University Press.
5. Christopher W. Sensen, 2002, Essentials of Genomics and Bioinformatics**,** 1st edition, Wiley, John & Sons.

Department Electives Course – Optional

EC - PHARMACOLOGY

Learning Objectives

- To study the drug discovery and development process.
- To learn the different types of drugs and their mode of action.

Course Outcomes

At the end of the course, the student will be able to

- Learn the drug metabolic pathway, drug discovery and development process.
- Acquire knowledge in the anti-inflammatory drugs.
- Understand the pharmacotherapy, vitamins, vaccines and hypoglycemic drugs.
- Understand the anticancer drugs, antibiotics, antiviral and antimalarial substances.
- Acquire knowledge on drug resistance and drug addiction.

Unit I

Drug: Classification of drugs, route of drug administration, drug absorption and distribution. Drug metabolic pathway - phase I - oxidative reactions- Epoxidation, hydroxylation, C - N system, C - O system and C -S system. phase II - reductive reactions - hydrolytic reaction. conjugation- Amino acids, sulphates, acetic acid, glutathione, mercapturic acid, methyl conjugation and transformation. Hard drugs - definition, biophosphanates and pyrophospahte. Soft drugs - definition and examples. Drug receptor and drug action, forces involved in the drug receptor complex. Drug discovery and development process.

Unit II

Anti-inflammatory drugs: steroid Anti inflammatory drugs and Non steroidal Anti-inflammatory drugs, Examples, pathways, mechanism of action and therapeutic uses. Pharmacokinetics: Definition, Importance, Toxicity, Distribution, Factors involved and Elimination. Drug adverse effects: Classification, Detection and prevention.

Unit III

Pharmacotherapy of gout and rheumatoid arthritis, therapeutic gases-oxygen and carbon dioxide, enzyme therapy, mechanism of enzyme catalysis, types of catalysis and inhibition (chymotrypsin, aspartic proteases), vitamins, vaccines and hypoglycemic drugs. Organic pharmaceuticals and their role as preservatives and food additives.

Unit IV

Chemotherapy: Anticancer drugs: Introduction, types of neoplasm, metastasis, causes of cancer and its treatment (chemotherapy only). Antibiotics - classification, structure, activity and uses of penicillin, cephalosporin, streptomycin and chloromphenicol, tetracycline. Action of alkaloids, antiviral and antimalarial substances.

Unit V

Biochemical mechanism of drug resistance, Multiple drug resistance (MDR), Common multidrug-resistant organisms (MDROs), Antifungal resistance, Antiparasitic resistance, Antibiotic resistance and Modes of Antibiotic action. Drug tolerance: Definition and types - Pharmacodynamic tolerance, Pharmacokinetic (metabolic) tolerance and Behavioral tolerance. Drug addiction: Definition, Risk factors, Mechanism, Diagnosis and treatment. Drug abusers: Definition, Classification and sign and its symptoms.

References

1. W.C.Bowman, M.J.R and G.B.West.1968. Text Book of pharmacology, Black well scientific Inc.Oxford,
2. Jayashree Gosh, 1996, Text Book of Pharmaceutical chemistry edition, S.Chand & Co.New Delhi.
3. Mehta, S.C.Kar, Ashutossh,2009, pharmaceutical pharmacology, 1st edition, New age International
4. Kar, Asutosh,2010, Medicinal chemistry,5th Edition, New age International
5. Dr. S.P. Maity and R.N.Chatterjee, Pharmacology, 2012, Books and Allied Pvt. Ltd.

SYLLABUS FOR M.Sc. BIOCHEMISTRY (2020 - 21 ONWARDS)

Department Electives Course – Optional

EC - BIOTECHNOLOGY AND GENETIC ENGINEERING

Learning Objectives

- To learn the uses of technology in biological science.
- To learn the tools and various methods used in biotechnology and genetic engineering.
- To study the genetically modified organisms produced by genetic engineering.

Course Outcomes

At the end of the course, the student will be able to

- Get technical knowledge on versatile techniques in recombinant DNA technology.
- Understand the applications of genetic engineering techniques in basic and applied experimental biology.
- Apprehend the role of rDNA technology in constructing vectors, cDNA and genomic libraries.
- Know the advantages and disadvantages of transgenic plants and foods.
- Comprehend the methodology and applications of bacterial leaching and biomining.

Unit I

Principles of genetic engineering and rDNA technology. Cutting and joining of DNA molecules. Restriction enzymes and their types. DNA ligases. Alkaline phosphatase. Double linkers. Adaptors. Homopolymeric tailing. Essential features of cloning vectors. Plasmids - pBR322 and pUC, Phage vectors - λ and M13, Cosmids and High capacity cloning vectors -YAC, PAC and BAC. Shuttle vectors. Expression vectors. Gene cloning in bacteria and yeast. Selection and screening of recombinants.

Unit II

Genomic DNA library, cDNA synthesis and cloning, Chromosome walking, Gene transfer methods - Calcium phosphate precipitation, PEG stimulated, liposome mediated, electroporation, microinjection, viral vectors and particle bombardment gun (biolistic) method. PCR technology. Blotting techniques - southern, northern and western blotting.

Unit III

Agrobacterium mediated transformation. Ti plasmids - cointegrative and binary vectors, Production of transgenic plants - viral, pest and herbicide resistant plants. Plant as bioreactors. Plant tissue culture - callus culture, micropropagation and protoplast culture. Anti-sense RNA technology and its applications.

Unit IV

Transgenic animals - Production and applications. Animal cell culture – methods and applications. Gene therapy. Principles and applications of stem cell technology. Production of insulin, vaccines, antibodies, interferons and somatostatin.

Unit V

DNA fingerprinting and foot printing with its applications. Bacterial leaching and biomining. Bioreactors - Design and types of fermentors, batch and continuous bioreactors. Downstream processing. Bioethics - Ethical issues in production of genetically engineered foods and transgenic plants and animals.

References

1. Genes VIII by Benjamin Lewin, 2004, Pearson Educational international.
2. Gene Cloning- An introduction by Brown T.A, 2003, 3rd edition, Chapman Hall.
3. Principles of gene manipulation by Old Primrose, 2001, 6th edition, Black Well Science.
4. Recombinant DNA by Watson, 2001, 2nd edition, Scientific American Books.
5. Plant Biotechnology by Adrian Slater, 2003, Oxford University Press.
6. Biotechnology by John E.Smith, 1996, 3rd edition, Cambridge University Press.

Department Electives Course – Optional

EC - INDUSTRIAL BIOCHEMISTRY AND NANOTECHNOLOGY

Learning Objectives

- To learn the methods of industrial production of different kinds of food, organic compounds, vitamins, antibiotics, vaccines and enzymes.
- To study the applications of enzymes in medicine and industry.
- To develop the basic knowledge in nanotechnology.

Course Outcomes

At the end of the course, the student will be able to

- Understand the applications of biochemistry in industrial purposes.
- Understand the food, microorganisms and fermented food products.
- Get wide knowledge on industrial production and applications of organic compounds, foods, vitamins, alcohol, antibiotics, vaccines and enzymes.
- Comprehend the nanotechnology and its application in biosciences.
- Get adequate knowledge to serve in pharmaceutical and food industries.

Unit I

Food and microorganisms - microorganisms in food industry, contamination and spoilage of different kinds of food: milk and milk products, sugar and sugar products, vegetables and fruits, cereals and cereal products, meat, fish, eggs and poultry, sea food and canned food. Food borne illnesses due to bacterial food poisoning, disease investigation, material and equipments, laboratory testing, field analysis and preventive measures; food hygiene and hazard analysis critical control points (HACCP). Fermentation processes in dairy and other food products. Biotechnology of food and feed: fermented food products– toffu, kaffir, cheese, buttermilk, yogurt and sour cream.

Unit II

Fermentation of antibiotics - organisms, cultures, procedures of fermentation, penicillins, β - lactams, cyclosporine and their derivatives, streptomycin, erythromycin, gentamycin, tetracyclines. Disease prevention through vaccines, conventional vaccines, purified antigen vaccines. Vaccine biotechnology - vaccine production through recombinant DNA - various approaches for novel vaccine production. Recombinant polypeptide vaccines, DNA vaccines and edible vaccines.

Unit III

Alcohol and alcoholic beverages - microbes and biotechnology of alcoholic fermentation. Fermentation of organic acids - acetic acid, lactic acid, gluconic acid and citric acid. Fermentation of amino acids - glutamic acid, tryptophan, phenylalanine. Vitamin production - B12, riboflavin and L-carotene: occurrence, economic significance, biosynthesis, production process. Feed production - SCP, fats, amino acid and food additives.

Unit IV

Biotechnological advance in production of cellulase, amylases, lipases and proteases. Bacterial and fungal cellulases, amylases, lipases, proteases, lysozyme, β – lactamases. Industrial applications of proteases, carbohydrases (amylases and cellulases) and lipases. Enzymes as diagnostic, analytical and therapeutic agents. Marketed enzymes. Baking and food enzymes. Textile enzymes. Digestive enzymes. Biological importance of Nucleotidase and Glucose 6 phosphate dehydrogenase.

Unit V

Nanotechnology and its applications in biosciences (basics only): Biosystems at the Nanoscale, interaction of nanoparticles with biomolecules, dendrimers, quantum dots, nanotubes, nanoshells. Concepts of property. Types of IPRs. Patent - Criteria of patentability, Non patentable invention, Patent specification. TRIPs.

References

1. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan, Mc Graw Hill, New York.
2. Biochemical Engineering, S. Aiba, A.E. Humphrey, Nancy F. Mills, University of Tokyo Press.
3. Principles of Fermentation Technology, P.F. Stanbury, A Whitaker, S.J. Hall.
4. Enzymes by Dixon and Webb, Academic Press.
5. The essential, understanding nanosciences and nanotechnology - T. Pradeep, Tata McGraw- Hill Publishing Company Limited.

SYLLABUS FOR M.Sc. BIOCHEMISTRY (2020 - 21 ONWARDS)

Department Electives Course – Optional

EC - FOOD AND NUTRITIONAL BIOCHEMISTRY

Learning Objectives

- To learn the food groups, classification and Nutritional requirements for normal and different categories of human beings.
- To understand the role of micro and macro nutrients and vitamins in our health.

Course Outcomes

- Understand the basic knowledge of food, preservation and food groups to provide nutritive requirement for normal health.
- Learn the food energy, minerals and food safety.
- Describe the different diets in different life style.
- Be aware of energy requirements for humans, malnutrition disorders in children and role of vitamins and minerals in maintaining health.

Unit I

Food - Sources, composition, properties and storage of common foods. Functions of food in relation to health - Classification of foods based on nutrients. Food preservation - reasons for preserving foods, principles, methods of preservation. Food addictive in processed food and their effects. Food groups to provide nutritive requirement for normal health- body building foods, energy foods and protective foods.

Unit II

Basics for computing nutrient requirements: Latest concepts in dietary recommendations, RDA – ICMR and WHO: Uses and limitations. Definition of unit of energy – Cal, RQ, SDA and NPU. Energy metabolism: Basal and resting metabolism – influencing factors, Methods to determine energy requirements and expenditure. Sources and functions of essential nutrients – Proteins (high biological and low biological value), Carbohydrates and fats. Sources and functions of dietary fibre, Pro and Prebiotics.

Unit III

Micro and macro mineral nutrients: Distribution sources, metabolic functions and deficiency manifestations – Calcium, Phosphorus, Sodium, Potassium, Iron, Copper, Selenium and Zinc.
Fat and water soluble vitamins – Occurrence, properties and functions – Hyper and Hypovitaminosis. Role of Vitamin as Antioxidant.

Unit IV

Nutrition through life cycle. Special needs of Infants, children, adolescents, pregnant and lactating women, convalescents and old persons.
Food technology- Preparation of infant's Food, Food safety and Food Hygiene.

Unit V

Principles of diet therapy, Diet during stressed conditions- laborers. Patients- therapeutic diets for anemia - Iron deficiency anemia, Pernicious anaemia, Megaloblastic anaemia. Malnutrition - Kwashiorkor, Marasmus and Marasmic Kwashiorkor. Obesity, Diabetes mellitus - IDDM, Non - IDDM, Cancer, Cardiovascular diseases and allergy.

References

1. Krause's Food and Nutrition Therapy, Kathleen Mahan L, Sylvia Escott-Stump MA, 12th edition, International edition, Saunders Elsevier Publications.
2. Principles of Nutrition and Dietetics, Swaminathan M, Second Edition, The Bangalore Printing and Publishing Co., Ltd.
3. Food Science, Srilakshmi B, Fourth Edition, New Age International (P) Limited Publishers.

Department Electives Course – Optional
EC - Developmental Biology

Learning Objectives

- To learn the different phases of embryo development and associated medical implications.
- To understand the general concepts of organogenesis and postembryonic development.

Course Outcomes

On Successful completion of the course, the students will be able to

- Understand the basics of embryo development in vertebrates and invertebrates.
- Learn the events in the early embryonic development.
- Understand the development of organs and developmental pattern.
- Understand the events taking place during post - embryonic development.
- Understand the medical implications of developmental biology.

Unit I: Basic Concepts of Development

History and the origin of developmental biology - cell theory, mosaic and regulative development, discovery of induction, basic concepts of developmental biology - cell division, cell differentiation, signaling, patterning; model systems: vertebrates model organism - *Xenopus laevis*, chicken, mammals, zebrafish; invertebrate model organism- *Drosophila melanogaster*, *Caenorhabditis elegans.*

Unit II: Early Embryonic Development

Early embryonic development of vertebrates and invertebrates: structure of the gametes - the sperm, the egg; cleavage and gastrulation; axes and germ layers; morphogenesis - cell adhesion, cleavage and formation of blastula, gastrulation, neural tube formation, cell migration; Axis specification in *Drosophila*; origin of anteriorposterior and dorsal - ventral patterning - role of maternal genes, patterning of early embryo by zygotic genes; segmentation genes - the gap genes, the pair - rule genes, the segment polarity genes, the homeotic selector genes - bithorax and antennapedia complex.

Unit III: Organogenesis

General concepts of organogenesis: development of chick limb- development and patterning of vertebrate limb, proximal - distal and dorso - ventral axis formation, homeobox genes in patterning, insect imaginal disc - determination of wing and leg imaginal discs, organizing center in patterning of the wing, butterfly wing development, the homeotic selector genes for segmental identity; insect compound eye - morphogenetic furrow, ommatidia, signaling, eyeless gene; kidney development - development of ureteric bud and mesenchymal tubules.

Unit IV: Postembryonic Development

Postembryonic development: growth - cell proliferation, growth hormones; ageing - genes involved in alteration in timing of senescence; regeneration - epimorphic regeneration of reptile (salamander) limb, requirement of nerves for the proliferation of blastema cells; embryonic stem cells and their applications.

Unit V: Medical Implications of Developmental Biology

Medical implications of developmental biology: genetic errors of human development - the nature of human syndromes - pleiotropy, genetic heterogeneity, phenotypic variability, mechanism of dominance; gene expression and human disease - inborn errors of nuclear RNA processing, inborn errors of translation; teratogenesis - environmental assaults on human development - teratogenic agents like alcohol, retinoic acid etc.

References

1. Jonathan Slack. Essential Developmental Biology. Wiley-Blackwell. 3rd ed. 2012.
2. Lewis Wolpert. Principles of Development. Oxford University Press.4th ed. 2012.
3. Werner A Muller. Developmental Biology. Springer. 2012.
4. Scott F. Gilbert. Developmental Biology. Sinauer Associates Inc., 10th ed. 2013.
5. Klaus Kalthoff. Analysis of Biological Development. McGraw-Hill. 2nd ed. 2000.

Department Electives Course – Optional

EC - Genomics, Proteomics and Bioinformatics

Learning Objectives

- To learn the principles of genome mapping, sequencing analysis and editing.
- To apply the informatics tools for proteome and genome analysis.

Course Outcomes

At the end of the course, the student will be able to

- Understand the types and uses of gene mapping, molecular markers for mapping and classical and new generation genome sequencing approaches.
- Comprehend genome projects, post genome analysis and ELSI.
- Apply the modern methods for separation, identification, quantitation and structural analysis of proteins.
- Apply structural bioinformatics tools to predict and elucidate protein structures and map protein - protein interactions.
- Retrieve, align, analyze and interpret sequence and structural data from databases.
- Construct the phylogenetic tree of different sequences and apply database information for molecular modeling.

Unit I: Genome Mapping and Sequencing

Definition of genome and genomics. Types of gene map-genetic, cytogenetic and physical. Molecular markers for mapping-RFLPs, microsatellites and SNPs. Physical mapping - *in situ* hybridization, STG mapping. Chromosome walking and jumping. Genome sequencing approaches: whole-genome shotgun, hierarchical shotgun.

Unit II: NGS, Genome Projects, Post Genome Analysis

Next-Generation Sequencing. Exome sequencing. Genome annotation - ORF scanning, Tilign array, Similarity searchers. Genome projects –Sequence data of *E.coli* and *D.melanogaster*. The Human Genome Project: goals, sequencing technologies, results, potential benefits, ethical, legal and social issues (ELSI).Post-genome analysis- microarrays, transcriptome, ChIPs, knock-out analysis, genome editing – CRISPR/Cas9

Unit III: Protein Separation, Identification and Quantitation

Proteomics - introduction. Protein separation - general principles. 2D-gel electrophoresis, liquid-liquid chromatography. Protein identification by antibodies, Edman degradation, mass spectrometry-basic principle and instrumentation, ESI, MALDI-TOF, SELDI-TOF, tandem MS. Peptide mass fingerprinting (elementary details).

Unit IV: Structural and Functional Proteomics and Applications

Structural proteomics: X-ray and NMR for protein structure analysis. Comparative and homology modeling, secondary structure prediction, fold recognition and *ab initio* prediction. SCOP. Protein sequence analysis: substitution score matrices, pairwise similarity search, pattern recognition.
Protein function determination: database search for homology. Protein-protein interactions: yeast 2-hybrid system, protein arrays and chips (concept and applications). Applications of proteomics- protein mining, protein expression profiling and mapping protein-network, co-immunoprecipitation, pull down assay, drug diagnostics, and drug discovery.

Unit V: Bioinformatics

Useful search engines. File formats. PubMed. Bioinformatics workstation, Unix. Biological databases (primary, secondary, organism - specific, miscellaneous). Data submission and retrieval. Sequence alignment: substitution scores and gap penalties. Database similarity searching: BLAST, FASTA. Multiple sequence alignments: CLUSTAL. Gene discovery and prediction. Molecular phylogenetics: phylogenetic tree construction and analysis. Identification of orthologs and paralogs. Protein structure database-protein structure visualization, comparison and classification. Protein motifs and domain prediction. NGS data analysis.

References

1. Lesk A. Introduction to Bioinformatics. OUP. 4th ed. 2014.
2. Primrose. Principles of Genome Analysis. Wiley. 3rd ed. 2002.
3. T.A. Brown. Genomes. Garland Science. 4th ed. 2007.
4. Hartwell etal. Genetics: From Genes to Genomes. 5th ed. 2014.
5. Twyman. Principles of Proteomics. 2nd ed. 2013
6. Gibas and Per Jambeck. Developing Bioinformatics Computer Skills. O'Reilly Associates. 2nd ed. 2013.
7. Baxevanis, Ouellette. Bioinformatics. A Practical Guide to the Analysis of Genes and Proteins. Wiley Interscience. 3rd ed. 2004.

Department Electives Course – Optional

EC - Environmental and Medical Biology

Learning Objectives

- To learn the biotechnological approaches to environmental management.
- To study the molecular aspects of diseases, diagnosis and therapy.

Course Outcomes

On Successful completion of the course, the students will be able to

- Apprehend the harmful effects of pollution and biotechnological measures for pollution control.
- Apply biotechnological process in waste management, cleanup of environment and agricultural improvement.
- Comprehend the fundamentals of biodegradation, biotransformation and bioremediation and apply biotechnological innovation in conservation.
- Recognize the importance of renewable energy sources and green technology.
- Use diagnostic kits for screening diseases and understand recent molecular diagnostic methods.
- Know the various new therapeutic approaches like nanotherapy, gene therapy and stem cell therapy.

Unit I: Pollution and Control

Environmental pollution - types, methods for measurement, biosensors to detect environmental pollutants, hazards from wastes and pollutants. Air pollution and its control through biotechnology. Water pollution and control. Wastewater treatment - physical, chemical and biological. Activated sludge - oxidation ditches and ponds, trickling filter, towers, rotating discs and drums. Anaerobic processes: anaerobic digestion and filters. Effluent treatment, B.O.D and C.O.D

Unit II: Soil and Agricultural Biotechnology

Soil microbiota. Growth, ecological adaptations, interactions among soil microorganisms, biogeochemical role of soil microorganisms. Microorganisms and soil fertility. Microbial degradation of xenobiotics in the environment. Oil spill clean up. Bioremediation of contaminated soil and waste land. Biofertilisers - Definition - types and application methods. Biopesticides in integrated pest management- *Bacillus* and baculoviruses as biocontrol agents.

Unit III: Alternative Energy Sources and Green Technology

Renewable sources of energy (solar, wind, biogas); Biogas production-hydrogen production using hydrogenase and nitrogenase. Bioleaching- use of microorganisms in mining of gold and uranium. Global environmental problems; Ozone depletion, greenhouse effect, impact and management. Mass production of blue green algae. Reforestation through micropropagation - use of *Casuarina*, and mycorrhizae. Biodiversity - Alpha and beta diversity. Extinction and endangered species. Conservation of biodiversity. *In situ* and *ex situ* - gene banks.

Unit IV: Molecular Diagnostics

Diagnostic kits- AIDS. Tumor markers - oncofetal proteins, hormones, enzymes, tumor-associated antigens. Prenatal & neonatal screening for genetic disorders. DNA diagnostic systems - probes. RFLP & PCR in disease diagnosis. Histocompatibility testing: cross matching. Viral diagnostics: immunodiagnosis, molecular diagnosis. SNP-based diagnosis.

Unit V: Molecular Therapeutics

Mabs, growth factors and interferons as therapeutic agents. Therapeutic agents from nonrecombinant and recombinant organisms. Antivirals and antiretrovirals. Drug delivery and targeting. Gene therapy: gene delivery systems, *ex vivo* and *in vivo* strategies, gene therapy for single-gene disorders, cancer and AIDS. Antisense and siRNA therapy. Nanotherapy. Stem cell therapy. Ethical issues in human gene therapy.

References

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2. Ahmed N. Industrial and environmental Biotechnology. Horizon Scientific Press 2001.
3. Glick and Pasternak. Molecular Biotechnology. 4th ed. ASM Press 2009.
4. Singh BD. Biotechnology. Kalyani Publishers.
5. Maulik and Patel Molecular Biotechnology Wiley-Liss.

Department Electives Course – Optional
EC - Medical Laboratory Technology

Learning Objectives

- To understand the basic concepts of medical laboratory technology.
- To learn the techniques essential for clinical laboratory.

Course Outcomes

On Successful completion of the course, the students will be able to

- Perform the basic haematology techniques and undertake biochemical analysis of clinical samples.
- Understand the tests performed in clinical microbiology laboratory.
- Undertake histological analysis of samples.
- Comprehend the basic techniques performed in clinical immunology laboratory.
- Know about quality control, laboratory accredition and automation.

Unit I: Basic Haematology and Biochemistry

Specimen collection and handling, transportation of specimens, disposal of specimen after laboratory use. Composition of blood. Methods of estimation of Haemoglobin, PCV, total and differential count of WBC, platelet count, clotting, bleeding and prothrombin time. Blood Group - methods of grouping and Rh factor. Determination of proteins in serum and plasma. Determination of glucose, glycated hemoglobin, triglycerides, cholesterol, lipoproteins. Examination of body fluids - ascitic fluid, pleural fluid, synovial fluid, pericardial fluid, CSF and amniotic fluid. Urine analysis, abnormal constituents. Faecal specimen - Macroscopic and microscopic examinations - detection of occult blood, Semen analysis.

Unit II: Microbiology

Microscopic examination, Gram staining, Acid-fast staining, Laboratory Culture - culture media, preparation of culture media, pH adjustment of culture media, Making of culture plates, techniques of aseptic transfer, blood and urine culture. Antibiotic sensitivity tests. Laboratory analysis of throat swab, sputum specimens, purulent exudates - Tuberculosis, Vibrio infections and Cholera, Gonorrhea, Leprosy.

Unit III: Histopathology

Tissue reception, labeling, fixation and section cutting, Preparation of paraffin blocks (Dehydration, clearing, embedding, blocking). Handling and care of microtome, types of microtome, sharpening of knives, and section cutting. Frozen section techniques - CO_2 freezing, cryostat. Preparation of common stains. H & E, Congo red, methyl violet, Leishman stain, Giesma and staining techniques. Mounting of specimens, record keeping, indexing of slides. Molecular analysis of chromosomal aberrations in leukemias and lymphomas. Molecular diagnosis of genetic diseases.

Unit IV: Laboratory Immunology

Agglutination tests, Haemagglutination tests, Precipitation tests and Flocculation tests, Tests for RA factor, CRP, ASO, VDRL, Widal, TORCH, Auto-Antibodies, Hepatitis, HIV testing and EBV. Complement titration, hemolysin titration, Aldehyde test ELISA test, serum electrophoresis. Preparation of slides of LE cell phenomenon and identification. Immuno - histochemical staining methods for auto-antibodies and tumour markers. Cutaneous sensitivity test.

Unit V: Laboratory Automation and Quality Control

Functional components of clinical laboratories. Basic requirements of clinical laboratory technician. Maintenance of glassware and equipments. Quality assurance in clinical laboratory. External QC and internal QC–Assessment-Corrective and preventive actions. Clinical validation and accreditation. Equipment calibration. Automation - advantages over manual methods. Automated analyzers. Lab informatics and scientific data management system - record keeping, coding and indexing.

References

1. Praful. B. Godkar, Darshan. P. Godkar, Text book of Medical Laboratory Technology. Bhalani Publishing House. 2014.
2. F.J.Baker, R.E.Silverton, Butterworth-Heinemann. Introduction to Medical Laboratory Technology. Butterworth- Heinemann. 2014.
3. Mayne. Clinical Chemistry in Diagnosis and Treatment. ELBS. 6th ed. 1994.
4. Harold Varley. Practical clinical biochemistry. CBS Publisher. 6th ed. 2002.
5. Todd & Stanford. Clinical Diagnosis and Management by Laboratory Methods. 16th ed. 2016.

Department Elective Course – Optional
EC - Drug Discovery and Development

Learning Objectives

- To study the herbal medicine and bioactive compounds from plants.
- To learn the drug metabolism and new drug discovery process.

Course Outcomes

On Successful completion of the course, the students will be able to

- Perform the extraction and purification of bioactive compounds from plants.
- Understand the origin of drugs from plants and animals.
- Understand the Drug metabolism.
- Undertake testing drugs *in vitro* and *in vivo*.
- Perform the biomedical research on human subjects.

Unit I

Extraction and purification of bioactive compounds from plants - cold and hot extract extraction, Soxhlet extraction and crude extracts purification by various solvents. Isolation of bioactive compounds: Chromatographic techniques - thin layer chromatography, liquid chromatography, HPLC and UPLC. Structural analysis of bioactive compounds: IR spectroscopy, Mass spectroscopy - NMR spectroscopy.

Unit II

Herbal medicine: History of herbal medicine, Different types of herbal medicine - Ayurveda, Siddha and Unani. Source and nature of drugs, Classification and nomenclature. Basic principles of drug action, Pharmacokinetics: absorption, distribution and elimination of drugs, routes of drug administration. Drug – protein interactions. Pharmacogenetics: dose response curve - ED50 and LD50. Origin of drug from plants and animals.

Unit III

Drug metabolism: Elimination pathway – Entero – hepatic cycling of drugs. Drug biotransformation pathway – phase I – Hepatic cytochrome P450 enzyme system; Cytochrome P450 cycle – induction and inhibition;– Oxidation catalyzed by cytochrome P450 isoforms – All types of hydroxylation, Deamination, Dealkylation, Dehalogenation. Oxidations: Microsomal and Non-microsomal oxidations.

Unit IV

Biological testing and bioassays: Testing drugs *in vitro* and *in vivo*. Molecular libraries and discovery strategies, Lipinski's rule of five, lead–like libraries, Congreves's rule of three and fragment based drug discovery, drug discovery, Ligand efficiency, important chemical indices of ligands, diverse libraries, focused, targeted structure libraries, Bioisosteres and scaffold hopping, drug repurposing. Probe compounds, assembling molecular library - Corporate collection, vendor and outsources libraries, natural products, Pan-assay interference compounds (PAIN), compound management. Screening strategies in hit discovery; *in-silico based,* Structure-based, and Biomolecular methods. Active to hit phase, hit-to- lead phase, ADMET. Lead optimization.

Unit V

New drug discovery process - purpose, main steps involved in new drug discovery process, timelines of each steps, advantages and purposes of each steps, ethics in clinical research, unethical trials, thalidomide tragedy, Various phases of clinical trials. Safety monitoring in clinical trials. Various regulatory requirements in clinical trials. Schedule Y, ICMR guidelines etc. Documents in clinical study. Indian GCP guidelines (CDCSO guidelines). ICMR Guidelines - Ethical Guidelines for Biomedical Research on Human Subjects Schedule.

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2. Modern Pharmacology with Clinical Correlations, Charles R. Creig, and Robert E. Stitzel, Lippincott Williams & Wilkins.
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5. Applied Biopharmaceutics and Pharmacokinetics, Shar Gel,L. et al ., 2012. 6th Edn., McGraw-Hill Medical.
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