B.Sc. BIOCHEMISTRY
COURSE STRUCTURE

Year	Semester	Course	Title	No. Hrs./ Week	No. of Credits
I	I	1	Introduction to Classical Biology	5	4
		2	Introduction to Applied Biology	5	4
	II	3	Biomolecules - (T)	3	3
			Biomolecules - (P)	2	1
		4	Cell Biology - (T)	3	3
			Cell Biology- (P)	2	1
II	III	5	Analytical techniques- (T)	3	3
			Analytical techniques- (P)	2	1
		6	Basic Microbiology- (T)	3	3
			Basic Microbiology- (P)	2	1
		7	General Physiology- (T)	3	3
			General Physiology- (P)	2	1
		8	Genetics - (T)	3	3
			Genetics - (P)	2	1
	IV	9	Bioenergetics and Metabolism of Carbohydrates and Lipids- (T)	3	3
			Bioenergetics and Metabolism of Carbohydrates and Lipids- (P)	2	1
		10	Clinical Biochemistry- (T)	3	3
			Clinical Biochemistry- (P)	2	1
		11	Immunology - (T)	3	3
			Immunology - (P)	2	1
III	V	12	Nutritional Biochemistry - (T)	3	3
			Nutritional Biochemistry - (P)	2	1
		13	Enzymology- (T)	3	3
			Enzymology- (P)	2	1
		14	Molecular biology - (T)	3	3
			Molecular biology - (P)	2	1
		15	Metabolism of Nitrogen compounds - (T)	3	3
			Metabolism of Nitrogen compounds - (P)	2	1
	VI		Long term Internship/ Apprenticeship		
IV	VII	16	Recombinant DNA technology - (T)	3	3
			Recombinant DNA technology - (P)	2	1
		17	Endocrinology - (T)	3	3
			Endocrinology - (P)	2	1
		18	Biomedical Correlation of Diseases - (T)	3	3
			Biomedical Correlation of Diseases - (P)	2	1
	VIII	19	Applied Biochemistry - (T)	3	3

			Applied Biochemistry - (P)	2	1
		20	Fundamentals of Biostatistics & Bioinformatics - (T)	3	3
			Fundamentals of Biostatistics & Bioinformatics - (P)	2	1
		21	Plant and Environmental Biochemistry - (T)	3	3
			Plant and Environmental Biochemistry - (P)	2	1

VII & VIII Semesters **Skill Enhanced Courses** syllabus will be available due course of time.

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc. Biochemistry (w.e.f:2023-24A.B)

SEMESTER-I

COURSE 1: INTRODUCTION TO CLASSICAL BIOLOGY

Theory | Credits: 4 | 5 hrs/week

Learning objectives

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

Learning Outcomes

1. Learn the principles of classification and preservation of biodiversity
2. Understand the plant anatomical, physiological and reproductive processes.
3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

Unit 1: Introduction to systematics, taxonomy and ecology.

1.1. Systematics – Definition and concept, Taxonomy – Definition and hierarchy.

1.2. Nomenclature – ICBN and ICZN, Binomial and trinomial nomenclature.

1.3. Ecology – Concept of ecosystem, Biodiversity and conservation.

1.4. Pollution and climate change.

Unit 2: Essentials of Botany.

2.1. The classification of plant kingdom.

2.2. Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones).

2.3. Structure of flower – Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos.

2.4 Mushroom cultivation, floriculture and landscaping.

Unit 3: Essentials of Zoology

3.1. The classification of Kingdom Animalia and Chordata.

3.2 Animal Physiology – Basics of Organ Systems & their functions, Hormones and Disorders

3.3 Developmental Biology – Basic process of development (Gametogenesis, Fertilization, Cleavage and Organogenesis)

3.4 Economic Zoology – Sericulture, Apiculture, Aquaculture

Unit 4: Cell biology, Genetics and Evolution

4.1. Cell theory, Ultrastructure of prokaryotic and eukaryotic cell, cell cycle.

4.2. Chromosomes and heredity – Structure of chromosomes, concept of gene.

4.3. Central Dogma of Molecular Biology.

4.4. Origin of life

Unit 5: Essentials of chemistry

5.1. Definition and scope of chemistry, applications of chemistry in daily life.

5.2. Branches of chemistry

5.3. Chemical bonds – ionic, covalent, noncovalent – Vander Waals, hydrophobic, hydrogen bonds.

5.4. Green chemistry

References

1. Sharma O.P., 1993. Plant taxonomy. 2nd Edition. McGraw Hill publishers.

2. Pandey B.P., 2001. The textbook of botany Angiosperms. 4th edition. S. Chand publishers, New Delhi, India.

3. Jordan E.L., Verma P.S., 2018. Chordate Zoology. S. Chand publishers, New Delhi, India.

4. Rastogi, S.C., 2019. Essentials of animal physiology. 4th Edition. New Age International Publishers.

5. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.

6. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.

7. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.

8. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5th Edition. Pearson publishers.

9. Subrata Sen Gupta, 2014. Organic chemistry. 1st Edition. Oxford publishers.

ACTIVITIES:

1. Make a display chart of life cycle of nonflowering plants.
2. Make a display chart of life cycle of flowering plants.
3. Study of stomata
4. Activity to prove that chlorophyll is essential for photosynthesis
5. Study of pollen grains.
6. Observation of pollen germination.
7. Ikebana.
8. Differentiate between edible and poisonous mushrooms.
9. Visit a nearby mushroom cultivation unit and know the economics of mushroom cultivation.
10. Draw the Ultrastructure of Prokaryotic and Eukaryotic Cell
11. Visit to Zoology Lab and observe different types of preservation of specimens
12. Hands-on experience of various equipment – Microscopes, Centrifuge, pH Meter, Electronic Weighing Balance, Laminar Air Flow
13. Visit to Zoo / Sericulture / Apiculture / Aquaculture unit
14. List out different hormonal, genetic and physiological disorders from the society

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SEMESTER-I

COURSE 2: INTRODUCTION TO APPLIED BIOLOGY

Theory | Credits: 4 | 5 hrs/week

Learning objectives

The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bioinformatics.

Learning Outcomes

1. Learn the history, ultrastructure, diversity and importance of microorganisms.
2. Understand the structure and functions of macromolecules.
3. Knowledge on biotechnology principles and its applications in food and medicine.
4. Outline the techniques, tools and their uses in diagnosis and therapy.
5. Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

Unit 1: Essentials of Microbiology and Immunology

1.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.

1.2. Groups of Microorganisms – Structure and characteristics of Bacteria, Fungi, Archaea and Virus.

1.3. Applications of microorganisms in – Food, Agriculture, Environment, and Industry.

1.4. Immune system – Immunity, types of immunity, cells and organs of immune system.

Unit 2: Essentials of Biochemistry

2.1. Biomolecules I – Carbohydrates, Lipids.

2.2. Biomolecules II – Amino acids & Proteins.

2.3. Biomolecules III – Nucleic acids -DNA and RNA.

2.4. Basics of Metabolism – Anabolism and catabolism.

Unit 3: Essentials of Biotechnology

3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.

3.2. Environmental Biotechnology – Bioremediation and Biofuels, Bio fertilizers and Bio pesticides.

3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.

3.4. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, abiotic stress – salt tolerance). Transgenic animals – Animal and disease models.

Unit 4: Analytical Tools and techniques in biology – Applications

4.1. Applications in forensics – PCR and DNA fingerprinting

4.2. Immunological techniques – Immunoblotting and ELISA.

4.3. Monoclonal antibodies – Applications in diagnosis and therapy.

4.4. Eugenics and Gene therapy

Unit 5: Biostatistics and Bioinformatics

5.1. Data collection and sampling. Measures of central tendency – Mean, Median, Mode.

5.2. Measures of dispersion – range, standard deviation and variance. Probability and tests of significance.

5.3. Introduction, Genomics, Proteomics, types of Biological data, biological databases- NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment

5.4. Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

REFERENCES

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11th Edition. Pearson publications, London, England.

2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5th Edition. McGraw Education, New York, USA.

3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.

4. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.

5. R.C. Dubey, 2014. Advanced Biotechnology. S. Chand Publishers, New Delhi, India.

6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3rd Edition. Cambridge Publishers.

7. U. Sathyanarayana, 2005. Biotechnology. 1st Edition. Books and Allied Publishers pvt. ltd., Kolkata.

8. Upadhyay, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.

9. Arthur M. Lesk. Introduction to Bioinformatics. 5th Edition. Oxford publishers.

10. AP Kulkarni, 2020. Basics of Biostatistics. 2nd Edition. CBS publishers.

ACTIVITIES

1. Identification of given organism as harmful or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding microorganism from pond water.

4. Visit to a microbiology industry or biotech company.
5. Visit to a waste water treatment plant.
6. Retrieving a DNA or protein sequence of a gene'
7. Performing a BLAST analysis for DNA and protein.
8. Problems on biostatistics.
9. Field trip and awareness programs on environmental pollution by different types of wastes andhazardous materials.
10. Demonstration on basic biotechnology lab equipment.
11. Preparation of 3D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[**NOTE**: In the colleges where there is availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty]

Course – I & II Model Paper (70 Marks)

SECTION A (Multiple Choice Questions) ***30 x 1 = 30 M***

30 Multiple Choice Questions (Each Unit 6 Questions)

SECTION B (Fill in the blanks) ***10 x 1 = 10 M***

10 Fill in the Blanks (Each Unit 2 Questions)

SECTION C (Very short answer questions) ***10 x 1 = 10 M***

10 Very short answer questions (Each Unit 2 Questions)

SECTION D (Matching) (From 5 Units) ***2 x 5 = 10 M***

1 A
B
C
D
E

2 A
B
C
D
E

SECTION E (True or False) ***10 x 1 = 10 M***

10 True or False (Each Unit 2 Questions)

II SEMESTER
BIO MOLECULES
Credits 3

COURSE OBJECTIVES

1. Provides information about classification, physico-chemical properties of amino acids and structural organization of proteins.
2. To understand the structure, properties and biological importance of carbohydrates and lipids.
3. Explore the composition and structure of nucleic acids.

UNIT-I

Fundamentals of Biochemistry: History, scope and avenues of Biochemistry. Water as a biological solvent. Measurement of PH, Buffers, Biological relevance of Buffers. Outlines of surface tension, adsorption and osmosis and their biological relevance.

UNIT-II

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation. Reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone. Amino sugars, Glycosides. Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose). Structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen). Glycosaminoglycans.

UNIT – III

Lipids Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils (acid, saponification and iodine values, rancidity). General properties and structures of phospholipids. Prostaglandins- structure, types and biological role. Lipoproteins- types and functions.

UNIT-IV

Amino Acids and Proteins Classification, structure, stereochemistry, chemical reactions of amino acids due to carbonyl and amino groups. 2. Titration curve of glycine and pK values. Essential and nonessential amino acids, non-protein amino acids. 3. Peptide bond - nature and conformation. Naturally occurring peptides - glutathione, enkephalin. 4. Proteins: Classification based on solubility, shape, and function. Determination of amino acid composition of proteins. 5. General properties of proteins, denaturation, and renaturation of proteins. 6. Structural organization of proteins- primary, secondary, tertiary, and quaternary structures (Eg. Hemoglobin and Myoglobin).

UNIT-V

Nucleic acids and porphyrins, Types of RNA and DNA. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. 2. Effect of acids, alkali and nucleases on DNA and RNA. 3. Structure of Nucleic acids- Watson-Crick DNA double helix structure, denaturation and renaturation of nucleic acids, Tm-values and their significance, cot curves and their significance. 4. Structure and properties of porphyrins: Heme, cytochromes and chlorophylls.

COURSE OUTCOMES

After successful completion of the practical course student should be able to

1. prepare buffers and apply the knowledge to calculate the pH values of charged biomolecules.
2. Identify various carbohydrates, amino acids and lipids present in the nature by performingqualitative analysis.

II SEMESTER

Course No-3 BIO MOLECULES

Credits -1

1. Preparation of buffers (acidic, neutral, and alkaline) and determination of pH.
2. Qualitative identification of carbohydrates- glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
3. Qualitative identification of amino acids- histidine, tyrosine, tryptophan, cysteine, arginine.
4. Qualitative identification of lipids- solubility, saponification, acrolein test, Salkowski test, Lieberman-Burchardtest.
5. Preparation of Osazones and their identification
6. Estimation of proteins in biological samples:
   a. Biuret method.
   b. Folin-Lowry method.
   c. UV method.
   d. Bradford's dye binding method
7. Estimation of amino acid by Ninhydrin method.
8. Estimation of tyrosine by Million's –reaction

Recommended Books

1. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
2. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Lt
3. Nelson.D.L. and Cox.M..M -Lehninger's Principles of Biochemistry- Freeman & Co.- 7 th Edition

II SEMESTER

Course No- 4 CELL BIOLOGY
Credits -3

COURSE OBJECTIVES

1. To study the cell organelles in prokaryotic and eukaryotic cells.
2. Detailed information on Cell division, Cell cycle regulation with cdk and cyclins, MPK, MPF.
3. To know the cell communication, molecules, proteins in cell adhesion and desmosomes, hemidesmosomes, gap junctions, extracellular matrix, integrins.
4. Knowledge on ER mediated Protein Sorting and Targeting
5. Knowledge on Composition of plasma membrane and various transport mechanisms.

UNIT-I

Prokaryotic and Eukaryotic cells: Cell organelles Structure, Composition and functions of nucleus, mitochondria plastids, endoplasmic reticulum, Golgi, lysosomes, vacuole, micro bodies, ribosomes, cytoskeleton.

UNIT-II

Cell division: mitosis**,** meiosis**,** cell cycle and its regulation, different phases of cell cycle. Apoptosis, Regulation of cell cycle, Cyclins, MPF, Cyclin dependent kinases, Growth factors, Nuclear Laminins, inhibition of cell cycle progression, MPF and progression to Metaphase, Proteolysis and MPF, Regulation of MPF activity. Check points in cell cycle regulation.

UNIT-III

Cell communication: general principles of cell communication, cell adhesion and roles of different adhesion molecules, cell junction/gap junctions, extracellular matrix, integrins. Signal transduction: Cell surface receptor, G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two component systems, bacterial chemotaxis, and quorum sensing.

UNIT-IV

Protein Sorting and Targeting: Overall pathway of synthesis of nuclear coded, secretory, lysosomal and membrane proteins. Import across ER – Signal hypothesis, post translational modifications of secretory/membrane proteins in ER, sorting of lysosomal proteins, Mannose - 6 - Phosphate receptors, synthesis, trafficking, and localization of mitochondrial proteins. Protein traffic into and out of nucleus.

UNIT-V

Bio membranes: Chemical composition of Membranes, Composition of plasma and organelle membranes of animal and plant cells. Lipids, proteins, and Carbohydrates of membranes

Distribution of membrane lipids. Assembly of membrane components. Molecular structure of membranes: Miscelle, and liposomes, biological membrane; Symmetry of the membrane; Membrane fluidity; fluid mosaic model of biological membranes. Nanomaterials and their applications.

Membrane Transport: Donnan membrane equilibrium, Diffusion across cellular membranes Mediated transport; Energetics of transport systems; Passive transport anion exchange proteins; Active transport; Active transport of Na^+ K^+ (Sodium potassium ATPase) Ca^{2+} (Ca^{2+}-ATPase). Active transport of sugars coupled to Phosphorylation; group translocation (Y-Glutamyl cycle). Proton motive force in bacterial transport processes. Ionophores Gap junctions; Endocytosis, Exocytosis. Nature of receptors.

Course Outcomes

Students will be able to:

1: Isolate the cells and count them

2: Analyse the viability and examine the division mechanisms of cells

3: Resolve the biological materials by electrophoresis

4: Do cell culture works

IISEMESTER

Course No- 4 CELL BIOLOGY
Credits -1

Practical Syllabus

1. Estimation of Chlorophyl
2. Isolation of chloroplast
3. Isolation of mitochondria from the liver
4. Mitosis experiment
5. Meiosis experiment
6. Nuclei staining by DAPI / PI
7. Apoptosis- DNA Ladder Pattern, Annexin V staining
8. low cytometric analysis

Recommended Books

1. Goldman, Emanuel, and Lorrence H. Green, eds. Practical handbook of microbiology. CRC Press, 2015.
2. Dubey, R. C., and D. K. Maheshwari. Practical microbiology. S. Chand, 2002.
3. Microbiology: A laboratory manual by Cappuccino and Sherman, Pearson Education, 6th Ed.

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BLUE PRINT OF MODEL QUESTION PAPER (Sem-End. Examinations)

COURSE NAME

MODEL QUESTION PAPER - THEORY
Semester: …
Paper: ….., Title of the paper

Time: 3 Hours. Max Marks: 70

SECTION – A

Answer any 5 questions. Each question carries 4 marks (5 X 4 = 20M)
(Total 8 questions, questions 1-5 from Units 1-5 & questions 6-8 from any of the units)

1. Unit -I
2. Unit-II
3. Unit-III
4. Unit-IV
5. Unit-V
6. From any Unit
7. From any Unit
8. From any Unit

SECTION – B

Answer all the questions. Each question carries 10 marks. (5 X 10 = 50M)
(Each question (both 'A' or 'B') from each Unit.

9. from Unit I
(OR)
from Unit I

10. from Unit II
(OR)
from Unit II

11. from Unit III
(OR)
from Unit III

12. from Unit IV
(OR)
from Unit IV

13. from Unit V
(OR)
from Unit V

III SEMESTER
Course No-5: ANALYTICAL TECHNIQUES
Credits -3

COURSE OBJETIVES

1. To understand the basic concepts of analytical techniques.
2. To gain knowledge about the latest advances in analytical techniques.
3. To apply these techniques in research.

UNIT-I

Methods of tissue homogenization. Salt and organic solvent extraction and fractionation. Dialysis, Reverse dialysis, ultra filtration, lyophilization.

Chromatography: principle, procedure and application of partition chromatography, adsorption chromatography, ion exchange chromatography, gel chromatography, affinity chromatography, GLC and HPLC.

UNIT-II

Electrophoresis: Principle, procedure and application of free flow, zone electrophoresis (Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE and Disc PAGE). Isoelectric focusing, High voltage electrophoresis, Pulse field electrophoresis, Immunoelectrophoretic.

UNIT-III

Centrifugation: Principle of sedimentation technique. Different types of centrifuge and rotors. Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultra centrifugation, rate zonal centrifugation, isopycnic centrifugation.

UNIT-IV

Colorimetry and spectrophotometry: Laws of light absorption -Beer - Lambert's law. UV and visible absorption spectra, molar extinction coefficient and quantitation. Principle and instrumentation of colorimetry and spectrophotometry. Principle of nephelometry, fluoromentry, Atomic absoption and emission spectrophotometer

UNIT-V

Important stable radioisotopes used in biochemical research. P 32, I 125,I131, Co 60. C 14 etc. Radiation hazards and precautions taken while handling radioisotopes. Principle and application of RIA. Measurement of radioactivity by GM counter and Scintillation counter.

III SEMESTER
Course No-5: ANALYTICAL TECHNIQUES

Credits -1

1. Estimation of ascorbic acid
2. Separation and estimation of total carotenoids and β-carotene
3. Extraction and estimation of vitamin A, vitamin E, niacin and free amino
4. Estimation of phosphorus by Fiske and Subbarow method Characterization of fats – estimation of saponification number, iodine number, acid number and R.M.Number
5. Extraction of Phytoconstitutents by Soxhlet and quantification

COURSE OUTCOMES

1. After completing this course, the student will
2. Understand the basic concepts and principles of biochemical techniques namely Spectrophotometry, Fluorimetry, Chromatography and Centrifugation.
3. Analyse biochemical compounds such as Carotenoids, Vitamins, Alkaloids and Flavonoids.
4. Identify the compounds by various biochemical techniques and interpret the results
5. Apply the laboratory skills and concepts in carrying out experiments using sophisticated instruments.

Reference Books

1. Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company 1. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge Univerity Press.
2. The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication.
3. Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K and Nath N., Himalaya publishing house.
4. Experimental Biochemistry. Cark Jr J. M. and Switzer R.L, W.H. Freeman and Company.
5. Research Methodology for Biological Sciences: Gurumani.N. M.J.P. Publishers., Chennai, India.
6. Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S., Himalaya Publishing House, Mumbai, India.
7. A Biologist's Guide to Principles and Techniques of Practical Biochemistry: Williams. B.L. and Wilson. K. (ed.) Edward Arnold Ltd. London
8. Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd.
9. Sadasivam, S. and Manickam, A. (2005). Biochemical Methods, Second edition, New Age International (P) Ltd.

III SEMESTER
Course No-06: BASIC MICROBIOLOGY

Credits -3

COURSE OBJECTIVES

1. The objective of the course is learning and understanding the fundamentals of Microbiology like important characteristics and biology of bacteria, fungi, mycoplasma, viruses etc. and to learn basic knowledge about control methods of microorganisms and industrial application of microbes for water and sewage treatment.
2. Designed to learn nutritional requirements in microorganisms and virus classification, morphology and Methods of culturing of viruses, Isolation, purification and characterization.
3. The objectives of the course are to learn and understand the genetic material, chromosome and gene and understand the gene arrangement in prokaryotes.
4. To know the various microbial diseases and their prevention and treatment.

UNIT-I

Morphology and classification of bacteria – phenotype, numerical and phylogenetic tree - rRNA, DNA and Proteins, Microbial diversity, Major characteristics used in taxonomy – morphological, physiological and metabolic, ecological, genetic analysis and molecular characterizations- (protein, nucleic acid composition), Isolation and cultivation of bacteria, bacterial growth curves. Culture media and methods, staining techniques, differences between Gram-positive and Gram-negative bacteria. Methods of sterilization and Pasteurization.

UNIT-II

Molds – characteristics, classification and reproduction. Yeasts – morphology, characteristics, and reproduction. General characteristics of Actinomycetes, Rickettsiae, Spirochaetes and mycoplasma. Economical and industrial uses of algae.

UNIT-III

Microbial interactions – mutualism, protocooperation, commensalism, predation, parasitism, amensalism, competition, symbiosis in complex system. Role of microorganisms in domestic and industrial sewage.

Microbiology of fermented foods, food spoilage and its control (Preservation). Food borne diseases – Botulism, Salmonellosis, E. colidiarrhoea, Shigellosis, Staphylococcal food poisoning

UNIT-IV

Microbial diseases-Pathogenesis of bacterial diseases – maintenance, transport, invasion and multiplication and regulation. Airborne diseases–Diphtheria, Meningitis, Pneumonia, Tuberculosis and Streptococcal diseases. Arthropod borne – Lyme, Plague. Direct contact – Anthrax, Gonerreah, Conjunctivitis, Gastritis, Syphilis, Tetanus, Leprosy, Staphylococcal diseases. Sepsis, Mycoses, Malaria, Amoebiasis, Candidiasis

UNIT-V

Viruses- classification, structure, and replication. Methods of assay and cultivation chicken embryo, animal inoculation and tissue culture, quantification and propagation. Maintenance of animal and plant viruses. Tumour viruses. Viral diseases – Dengue, Hepatitis, HIV, Polio, Rabies, SARS. Inactivation of viruses – photodynamic inactivation. Antiviral agents-chemical and biological agents.

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III SEMESTER

Course No-06: BASIC MICROBIOLOGY
Credits -1

PRACTICAL OBJECTIVES

1) To understand various methods involved in sterilization and preparation of media.
2) To study the methods of isolation of microbes from various sources.
3) To impart knowledge about Biochemical tests.

PRACTICAL SYLLABUS

1. Sterilization Techniques-Autoclaving, hot-air oven sterilization, Sieve filtration, membrane filtration.
2. Preparation of culture media – Nutrient Broth, Nutrient Agar, Blood agar Mac Conkey's agar, Potato dextrose agar.
3. Isolation of bacteria – Streak plate and pour plate methods
4. Identification of bacteria by staining techniques – simple, differential, Gram staining and acid-fast staining.
5. Identification of bacteria – Morphological, cultural and biochemical characteristics
6. Motility of Bacteria – "Hanging drop" technique
7. Bacteriological examination of water and milk
8. Bacterial growth curve

COURSE OUTCOMES:

After completing this course, the student will:

1. Understand the concept of basic microbiology – sterilization techniques.
2. Know about the isolation of microorganisms from various sources.
3. Discuss the staining techniques to study the morphology of microorganisms.
4. Describe the antibiotic activity 5. Infer the importance of various biochemical test.

REFERENCE BOOKS

1. Vasanthakumari.R, (2009) Practical Microbiology, BI Publishers Pvt Ltd, India
2. Dubey.R.C and Maheshwari D.K., (2002), Practical Microbiology, S.Chand& comp Ltd, NewDelhi.
3. Microbiology by Pelczar, Chan and Krieg 5th edn. 1995 Mc Grew- Hill.
4. General Microbiology: Boyd, R.F., Times Mirror/ Mosby College, 1984.
5. A Textbook of Microbiology, R.C.Dubey and D.K.Maheswari, S.Chand Co (2001).
6. Pharmaceutical Microbiology, By Hugo and Russell, Blackwell Scientific (1987).
7. An Introduction to Viruses by S.B.Biswas, Vikas Publishing house.
8. Microbiology 4th edition, Prescott, Harley, Klein (Mc grew Hill)
9. Fundamentals of Microbiology – M. Frebisher.

III SEMESTER

Course No-7: GENERAL PHYSIOLOGY

Credits -3

COURSE OBJECTIVES:

1. To impart knowledge about blood composition and function and blood clotting mechanism.
2. To study about the muscular and nervous system.
3. To appreciate about the components of Urinary system and mechanism of Urine formation
4. To understand the structure and function and different components of Digestive system.
5. To introduce the organization of endocrine system and classification of hormones

UNIT-I

Blood- composition & function. Types of blood cells, morphology & function - RBC, WBC, platelets erythropoiesis. Blood groups- A B O & Rhesus system; Coomb's test, Bombay blood group, function of plasma proteins. Composition & functions of lymph & lymphoid system, Blood clotting mechanism, anticoagulants

UNIT-II

Muscular system- types of muscle & functions. Brief outline of nervous system, structure of brain and spinal cord. Synapses- chemical and electrical synapse, nerve impulse, action potential and neurotransmitters.

UNIT-III

Urinary system – components of the urinary system, Kidney structure and organization. Structure, function and classification of nephrons. Mechanism of urine formation- functions of glomerular filtration rate and selective reabsorption and tubular secretion.

UNIT-IV

Digestive system- structure and function of different components of digestive system, Mechanism of secretion of HCL, Role of hormones and enzymes in digestive process. Digestion of carbohydrates, lipids, and proteins

UNIT-V

General organization of endocrine system- classification of hormones. Biological functions - Thyroid, Para Thyroid, Insulin, Glucagon, hormones of the adrenal glands and gonadal hormones.

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III SEMESTER

Course No- 07 GENERAL PHYSIOLOGY
Credits -1

PRACTICAL SYLLABUS

1. Microscopy
2. RBC count & WBC count
3. Differential leucocyte count by Leishman' s staining
4. Estimation of Hemoglobin by Sahli's acid haematin method
5. Determination of Packed cell volume (PCV)
6. Determination of Erythrocyte sedimentation rate (ESR)
7. Determination of Coagulation time & Bleeding time
8. Determination of blood group

COURSE OUTCOME

1. Recognize and analyse blood cells and blood groups Blood clotting mechanism
2. Outline the muscular and nervous system, Mechanism of muscle contraction and structure of brain and spinal cord
3. Utilise the knowledge about the structure kidney and nephron, to understand the mechanism of Urine formation and learn the concept of Dialysis,
4. Acquire knowledge about the components of Digestive system, Hcl formation and Digestion process
5. Compile the classification of Hormones and its biological role

REFERENCE BOOKS

1. Textbook of Medical Physiology – Guyton & Hall, 11th edition ,2006
2. Davidson's Principles and Practice of Medicine (XX Edition)- John.A.A.Hunter
3. Human Anatomy & Physiology – Elaine N.Marieb ,3rd edition ,1995
4. Essentials of Medical Physiology –Sembulingam ,1999 5. Medical Physiology – Ganong
5. Text book of Medical Biochemistry Physiology – MN.Chatterjee and , Rana Shinde,7th edition.
6. Animal physiology – Mariakuttikan and Arumugam

III SEMESTER

Course No-8: GENETICS

Credits -3

Course Objectives

1. The objectives of the course are to learn and understand the fundamentals of genetics like DNA as genetic material, chromosome and gene and understand the gene arrangement in prokaryotes and eukaryotes.
2. To learn and understand the concept of bacterial genetics and detailed information about Mutation.
3. To learn and understand the bacterial, transformation, transduction, and conjugation and Transposable genetic elements and their antibiotic resistance
4. To learn and understand the bacteriophage lifecycle and various plasmids and CRISPR- Gene editing

UNIT-I

Genetic material – Direct and Indirect evidences of DNA as genetic material, experimental proof. Evidences of RNA as genetic material – eg. Virus. Chromosome - Chromosome and genes, chromosomal replication, genetic mapping of chromosomes, structure of chromatin - nucleosomes and higher orders of organization, chromosome banding, transposition in human chromosome and chromosomal abnormalities.

UNIT-II

Gene – arrangements in prokaryotes and eukaryotes. Gene structure in eukaryotic organisms, introns, exons, pseudogenes, and gene clusters, spacers, repetitive sequences. Single and multiple copy genes in eukaryotes, eg – Histones, Alu, copia, satellite. Mapping of human genes – techniques used, assignment of important genes. Gene regulatory mechanisms and cell memory. Mechanism of recombination, extra nuclear inheritance. Non-coding explosion, cell fate determination and reprogramming. Genetic technique for Archea. New gene evolution, Tiniest genome of proteobacteria and bacteriodates.

UNIT-III

Bacterial genetics – Bacterial chromosomes, plasmids – fertility, resistance, colicinogenic and other, PBR322 and other synthetic plasmids - isolation and uses. Transposable genetic elements, transformation, transduction, and conjugation in bacteria. Linkage map of bacterial chromosome. Recombination in bacteria.

UNIT-IV

Structure of Bacteriophages and their use in the study of molecular genetics – lytic cycle-replication of T-phages, Lysogeny and its regulation. Transduction – specialized, generalized and abortive. Transfection and cosmids. Fine structure analysis of T- phages, Benzers work and concept of cistrons. Bacterial defence (CRISPR- Gene turning on).

UNIT-V

Mutation – Types of mutations, mutagens, mechanism of mutation, Mutagenesis, induction and isolation of mutants. Haploid genetic tools. Radiation effects on human heredity. Phylogenetic inheritance. Heritability and its measurements and mapping, gene duplication and self-incompatibility.

III SEMESTER

Course No-8: GENETICS

Credits -1

PRACTICAL SYLLABUS

1. Isolation of phages from sewage and quantification by plaque assay.
2. PCR amplification of insert
3. Restriction digestion of the vector and the insert
4. Ligation of restricted DNA fragments
5. Preparation of competent E.coli cells, transformation and expression of cloned gene
6. PCR and restriction diagnosis-based identification of positive clones

COURSE OUTCOMES

After the completion of this course, the student will be able to

1. The students will learn about the DNA, RNA as genetic material.
2. Learn about bacterial transformation, transduction and inputs to genetic engineering
3. Gain knowledge on mutations and isolation of mutants and types of mutagens.

RECOMMENDED BOOKS:

1. Molecular Genetics by D Friefelder
2. Cell molecular biology, Albert Bruce
3. Gene VII by Lewin
4. Molecular cloning by Maniatis and Co Vol I, II, III
5. Genetics by Gardner
6. Molecular Biology of the gene by Watson.
7. Genetics by G Zubay
8. Molecular Biology of the Cell by Albert Bruce.
9. Cell molecular Biology by Baltimore.
10. Molecular Biology by D Friefelder.
11. Genes VII Benjamin Lewin (2000). Oxford Univ. Press. London.
12. Cell and Molecular Biology 2ndEdit. (2002) By P. K. Gupta, Rastogi Publ.

III SEMESTER
BIOENERGETICS AND METABOLISM OF CARBOHYDRATES AND LIPIDS-
(Course No-9)

Credits -3

COURSE OBJECTIVES

1. To acquire knowledge related to the intermediary metabolism and the role of TCA cycle in central carbon metabolism.
2. To learn basic concepts of Bioenergetics, the importance of high energy compounds, electron transport chain, synthesis of ATP, mechanisms of oxidative phosphorylation and photophosphorylation.
3. To understand the fundamentals of cellular metabolism of carbohydrates their association with various metabolic diseases.
4. To learn biosynthesis and degradation of Lipids, fatty acids and cholesterol, Metabolism of lipoproteins and Ketone bodies.

UNIT-I

Principles of thermodynamics, free energy, enthalpy and entropy, Free energy changes in biological transformations in living systems. Redox potential, phosphate group transfer potential and ATP, High-energy compounds, oxidation and reduction reactions.

UNIT-II

Oxidative phosphorylation, Mitochondria ultrastructure, Energy harnessing cascade from nutrients, Reducing equivalents, Electron transport and its carriers-Complex I, II, III, IV; Mitchell's Hypothesis—experimental verification, Determination of P:O ratio, ATP synthesis by F1-FO ATP synthase, E. Racker's experiment. Relation of proton movement and ATP synthesis. Experimental demonstration of the movement of ATP synthase.
Oxidation and reduction enzymes, utilization of oxygen aby oxygenase's, superoxide dismutase and catalase. respiratory control, Mechanism, and theories of oxidative phosphorylation. Respiratory chain inhibitors and unvouplers of oxidative phosphorylation. Microsomal electron transport system. Bioluminescence.

UNIT-III

Approaches for studying intermediary metabolism. Glucose as fuel, glucose transporters, Glycolysis, and its regulation. Substrate cycling, TCA cycle – function and regulation, Glyoxylate cycle, Gluconeogenesis, and its regulation, HMP shunt and its significance, Uronic acid pathway, Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase, Metabolism of fructose, galactose and lactose, Biogenesis of amino sugars, peptidoglycans, glycosyl aminoglycans and glycoproteins. In born errors of carbohydrate metabolism.

UNIT-IV

Lipid metabolism – Oxidation of fatty acids, Biosynthesis of fatty acids and regulation; Metabolism of arachidonic acid; formation of prostaglandins, thromboxanes, leukotrienes,

Biosynthesis of triglycerides.

UNIT-V

Metabolism of phospholipids, sphingolipids. Biosynthesis of cholesterol and its regulation, Formation of bile acids. Role of liver and adipose tissue in lipid metabolism. In born errors of lipid metabolism

IV -SEMESTER
BIOENERGETICS AND METABOLISM OF CARBOHYDRATES AND LIPIDS-
(Course No-9)

Credits -3

COURSE OBJECTIVES

1. To acquire knowledge related to the intermediary metabolism and the role of TCA cycle in central carbon metabolism.
2. To learn basic concepts of Bioenergetics, the importance of high energy compounds, electron transport chain, synthesis of ATP, mechanisms of oxidative phosphorylation and photophosphorylation.
3. To understand the fundamentals of cellular metabolism of carbohydrates their association with various metabolic diseases.
4. To learn biosynthesis and degradation of Lipids, fatty acids and cholesterol, Metabolism of lipoproteins and Ketone bodies.

UNIT-I

Principles of thermodynamics, free energy, enthalpy and entropy, Free energy changes in biological transformations in living systems. Redox potential, phosphate group transfer potential and ATP, High-energy compounds, oxidation and reduction reactions.

UNIT-II

Oxidative phosphorylation, Mitochondria ultrastructure, Energy harnessing cascade from nutrients, Reducing equivalents, Electron transport and its carriers-Complex I, II, III, IV; Mitchell's Hypothesis—experimental verification, Determination of P:O ratio, ATP synthesis by F1-FO ATP synthase, E. Racker's experiment. Relation of proton movement and ATP synthesis. Experimental demonstration of the movement of ATP synthase.

Oxidation and reduction enzymes, utilization of oxygen aby oxygenase's, superoxide dismutase and catalase. respiratory control, Mechanism, and theories of oxidative phosphorylation. Respiratory chain inhibitors and unvouplers of oxidative phosphorylation. Microsomal electron transport system. Bioluminescence.

UNIT-III

Approaches for studying intermediary metabolism. Glucose as fuel, glucose transporters, Glycolysis, and its regulation. Substrate cycling, TCA cycle – function and regulation, Glyoxylate cycle, Gluconeogenesis, and its regulation, HMP shunt and its significance, Uronic acid pathway, Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase, Metabolism of fructose, galactose and lactose, Biogenesis of amino sugars, peptidoglycans, glycosyl aminoglycans and glycoproteins. In born errors of carbohydrate metabolism.

UNIT-IV

Lipid metabolism – Oxidation of fatty acids, Biosynthesis of fatty acids and regulation; Metabolism of arachidonic acid; formation of prostaglandins, thromboxanes, leukotrienes, Biosynthesis of triglycerides.

UNIT-V

Metabolism of phospholipids, sphingolipids. Biosynthesis of cholesterol and its regulation, Formation of bile acids. Role of liver and adipose tissue in lipid metabolism. In born errors of lipid metabolism

IV -SEMESTER
BIOENERGETICS AND METABOLISM OF CARBOHYDRATES AND LIPIDS-(Course No-9)

Credits -1

PRACTICAL SYLLABUS

1. Isolation of casein from milk
2. Preparation of lactalbumin from milk
3. Estimation of reducing sugar by DNSA (dinitrosalicylic acid) method
4. Titration of glucose by Benedict's method
5. Estimation of urea by Diacetylmonoxime method
6. Estimation of creatinine in serum
7. Estimation of cholesterol by ZAK's method

COURSE OUTCOMES

After the completion of this course, the student will be able to

1. Explain the broad outlines of intermediary metabolism and importance of carbohydrate metabolism in life.
2. Describe the importance of Electron transport and ATP production mechanism.
3. Gain in knowledge in Carbohydrate metabolism and their associated with disorders.
4. Describe the details of lipid metabolism.

RECOMMENDED BOOKS

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, LubertStryer.
5. Text of Biochemistry, West and Todd.

IV-SEMESTER

Course No-10:Clinical Biochemistry

Credits -3

COURSE OBJECTIVES

1. To understand the basic concepts of laboratory techniques.
2. To understand the basic concepts of organ functions.
3. To gain knowledge about various investigations and their interpretations.

UNIT-I

Clinical Biochemistry Laboratory and Investigation of Homeostasis. The use of biochemical tests- Specimen collection and types, Automation and Computerization Water and electrolyte homeostasis - renin angiotensin – aldosterone system Pathological variations of water and electrolytes- diagnosis and Interpretations Self Study: Acid base balance and imbalance - Mechanism of regulations, Anion gap, Acidosis and Alkalosis.

UNIT-II

Abnormal Hemoglobin and Inherited Disorders 9hrs Inborn errors of Metabolism: Patterns of inheritance - alkaptonuria, phenyl ketonuria, albinism, glycogen storage diseases and inherited disorders associated with urea cycle. Abnormal hemoglobin and' hemoglobinopathies- Sickle cell anemia and thalassemias, porphyrias and porphyrinurias. Self-study: Plasma proteins in health and diseases

UNIT-III

Investigation of Renal and Gastric Functions. Renal functions tests: Preliminary investigations, tests based on GFR, RPF and tubular function. Diseases related to kidney - nephritis, nephrosis, uremia, renal failure, renal calculi, renal hypertension, renal tubular acidosis, diabetes insipidus.. Dialysis - hemodialyis and peritoneal dialysis. Gastric function tests: Examination of resting content, Fractional gastric analysis, stimulation tests, Tubeless gastric analysis. Malabsorption syndrome, acidity, ulcers - gastric, duodenal and peptic, colon cancer, pancreatitis, gastric and pancreatic 'function tests. Self study: Gout, Leschnyhan syndrome and oroticaciduria.

UNIT-IV

Liver Function Tests and Lipid Disorder Liver function tests: Tests based on abnormalities of bile pigment metabolism, detoxification and excretory functions. Diagnosis of different types of jaundice. Pancreatic function tests. Diseases relating to liver - jaundice, cirrhosis, hepatitis, cholestasis, cholelithiasis, hepatic coma, hepatic carcinoma, inherited diseases of bilirubin metabolism Lipid: Lipoprotinemias and atherosclerosis coronary heart diseases and hypertension. Self study: Biochemical changes in cancer - detection of tumor markers

UNIT- V

Blood Glucose Regulation and Enzymes of Diagnostic Importance 9 hrs Carbohydrates: Blood glucose level - regulation and its clinical significance, Diabetes mellitus, Glycosuria and GTT. Enzymes and Isoenzymes of clinical importance - general principles of assay - Clinical significance of enzymes and isoenzymes (LDH, CK, phosphatase, 5' nucleosidase, amylase, lipase, acetyl cholinesterase, transaminase and gamma glutamyl transferase) Self study: meningitis, encephalities, epilepsy, Parkinson's, Alzheimer's, cerebral palsy.

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Course No-10: Clinical Biochemistry
Credits -1

PRACTICAL SYLLABUS

1. Blood analysis:
   Iron and Hemoglobin, Glucose, GTT. 10hrs
2. Serum and Urine analysis:
   Creatine, chloride, phosphorus, calcium. 10 hrs
3. Lipid profiles (Serum) –
   Total cholesterol, triglycerides, HDL, LDL 5 hrs
4. Liver function tests –
   Total Bilirubin, total protein, albumin, globulin, albumin/globulin ratio, AST, ALT, ALP 10 hrs
5. Kidney function tests
   Urea, creatinine, uric acid.

COURSE OUTCOMES

1. After completing this course, the student will:
2. Obtain basic knowledge about specimen collections, pathological variations of water, electrolytes
3. Interpret the results to diagnose the abnormal functions of organs.
4. Understand the antinutrient factors and its implication on other nutrients in food.Understand the, patterns of inherited disorders and disorders of hemoglobin metabolism
5. Correlate the tests used for renal and gastric functions and their interpretations
6. Impart the diagnostic tests for liver function and lipoprotein metabolic disorders
7. Evaluate the alterations in blood glucose regulation and enzymes of clinical importance

REFERENCE BOOKS

1. Gowenlock, A.H. and Donald, J(2002). Varley's practical clinical Biochemistry, sixth edition, CBS publications and Distributors, New Delhi.
2. Sembulingam, K and Sembulingam, P(2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.
3. Burtis and Ashwood (2007) Tietz Fundamentals of Clinical chemistry, 6th edition, WB Saunders Company, Oxford Science Publications USA.
4. Chatterjee and Shindae(2012). Text book of medical biochemistry, 8th edition.
5. Devlin, T.M(2010). Text Book of Biochemistry with clinical correlations, 7th edition. NewYork.
6. Gans, G and Murphy, J.M. (2008). Clinical Biochemistry, fourth edition, Churchill Livingstone, Elsevier

IV -SEMESTER

Course No-11: IMMUNOLOGY

Credits -3

COURSE OBJECTIVES

1. To have a key understanding of the components of the immune system, their functions and interactions.
2. To understand the immune mechanisms involved in disease conditions.
3. To impart knowledge on the latest techniques in immunology.

UNIT-I

Introduction Overview of defense mechanisms in plants and animals; Hematopoiesis, cells and organs of the immune system, primary and secondary lymphoid organs and tissues.

UNIT-II

Innate immunity in plants and animals Plants - Chemical and morphological defence in plants; elicitors, receptors, Basal resistance, and innate biochemical host defences Animals - Anatomical barriers, cell types of innate immunity, Pattern Recognition Receptor (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response. Complement activation by classical, and alternate pathway, biological consequences of complement activation.

UNIT-III

Adaptive Immunity in Plants and Animals Plants - Biotic- interactions with symbionts, pathogens. Biochemical host defences, Basal resistance and basic compatibility; Gene for gene concept; interaction in host-pathogen systems, receptor-elicitor model, plant gene-gene interaction. Cytological protection and induced resistance. Passive and active defences. Animals - Antigens and haptens, Factors that dictate immunogenicity, B and T cell epitopes.

UNIT-IV

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Generation of antibody Diversity. Monoclonal antibodies; Immunological methods- Antigen-antibody interactions; Histocompatibility antigens - MHC, HLA and Disease; T and B cell - Maturation, activation and effector response, Positive and Negative selection, APC and Antigen Presentation, Cytokines and Chemokines.

UNIT-V

Immune dysfunction and applications Immunological tolerance; Immunological disorders – Hypersensitivity and Autoimmune diseases. Immuno deficiencies; Transplantation Immunology; Immune response against major classes of pathogens.

IV -SEMESTER

Course No-11: IMMUNOLOGY

Credits -1

PRACTICAL SYLLABUS

1. Survey of structural plants defences: viz. cuticle, wax, lignin, bark, thorns, prickles, trichomes.
2. Immunodiffusion – SRID. Rocket IEP
3. Spleen cell isolation and counting.
4. ABO and Rh blood grouping
5. Latex agglutination assay
6. Quantitative immunoprecipitation assay

COURSE OUTCOMES

After successfully completing this course, the students will be able to:

1. To get an overview of the immune system and learn about the various cells, organs and tissues of the immune system.
2. Learn the basic defines mechanisms of the human body, learn how our body differentiate self from non self and thus successfully eliminate any danger from outside
3. Understand the cellular and molecular pathways of humoral and cell-mediated immune responses and appreciate the importance of immune system in health and disease.
4. Learn about the various preexisting structural and induced defenses in plants and how pathogens can cause disease in plants and understand the genetic basis of plant-pathogen interaction.
5. Learn how immunodeficiency makes us vulnerable and how vaccine is essential to protect us from infectious diseases.

REFERENCE BOOKS

1. Immunology, T .J. Kindt, R. A. Goldsby, and B.A. Osborne. (2007) W.H.Freeman and Co, New York.
2. Biochemistry,Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley & Sons, Inc.USA.
3. Immunology - Kuby
4. Immunology - J. Kannan, MJP Publishers, Chennai-5 Immunology - Roitt Ivan, Jonathan Brastoff, David Male, 1993.
5. Immunology - Janis Kuby, 4th edition, 2000.
6. Immunology - An introduction, Tizarrd, R. 1995.
7. Fundamentals of Immunology - LippincotPraven publications, 4th edition.
8. Essential and clinical Immunology - Halen chapel, Mansal Haney, Siraj Misbah and NialSnowdan.
9. Immunology - Geoffrey Zubay, W.M.C, Brown publishers, 4th edition 1992.
10. Immunology - The immune system in health and disease, 3rd edition.

V- SEMESTER
Course No-12:NUTRITIONAL BIOCHEMISTRY

Credits -3

Course Objectives:

1. To compile various Nutrition and balanced diet,various dietary requirements of nutrients.
2. To acquire knowledge about protein calorie malnutrition
3. To revise the facts about Fat- and Water-soluble vitamins and their importance. 5. To extract facts about Obesity and various lifestyle associated diseases

UNIT- I

Animal and vegetative foods – chemical composition. Nutrients – Essential Nutrients and their classification. Digestibility, absorption and biochemical functions of macro nutrients, Carbohydrates – dietary requirements. Proteins – Nitrogen balance studies, Determination of Biological values of proteins, Specific Dynamic Action, improvement of protein quality by supplementation and fortification. Lipids – Dietary needs of lipids, essential fatty acids. Calorific values of foods, Basal metabolic rate and its determination, factors influencing BMR.

UNIT-II

Clinical nutrition – role of diet and nutrition in prevention of atherosclerosis and obesity, role of leptin in regulation of body mass. Starvation – Protein sparing treatment during fasting, Protein calorie malnutrition – Kwashiorkar and Marasmus, Nutritional requirements for pregnant and lactating women and aged people.

UNIT-III

Biological effects of non-nutrients, dietary fibre, physiological actions. Antinutrients – Protease inhibitors, hemagglutinins, hepatotoxin, goitrogens, cyanogenic glucosides, methyl xanthines, oxalates. Toxins from mushrooms. Biological effects of food contaminants – Hexachlorobenzene, arsenic, DDT, cadmium, mercury, lead, aflatoxins, food additives - saccharin and sodium nitrite. Animal foods and seafoods. Food allergy – role of allergens, diagnosis and management of food allergy. Food processing and loss of nutrients during processing and cooking.

UNIT-IV

Vitamins – Fat soluble vitamins (A,D,E,K) and Water soluble vitamins (B complex and C) (Sources, biological functions and RDA), Disorders of vitamins A, D, E, K , Vitamin C and B-complex vitamins : Thiamin, Riboflavin, Niacin, Pantothenic acid, Lipoic acid, Pyridoxine, Biotin, folic acid and vitamin B12.Minerals- iron, calcium, iodine, selenium (Sources, biological functions and RDA). Deficiency disorders of minerals Nutritional requirements in infancy, childhood, pregnancy and lactation and old age.

UNIT- V

Obesity – Causes, Anthropometric measurements and Diet management. Dietary management in – Infection, Fever, Constipation, Diabetes mellitus, Peptic Ulcer, PCOS, Hypertension, Cardiovascular diseases, Pancreatitis, Cirrhosis and Cancer.

V- SEMESTER
Course No-12: NUTRITIONAL BIOCHEMISTRY

Credits -1

PRACTICALS

1. Determination of reduced Ascorbic acid by DCPIP method
2. Determination of total Ascorbic acid by DNPH method
3. Determination of calcium in the food
4. Isolation of casein from milk and determination of its protein by any method
5. Determination of cholesterol of edible oil
6. Determination of ash content
7. Determination of moisture content of foods/food grains/ powders
8. Determination of fructose from honey/fruit pulp
9. Determination of pyridoxine of fruits/leaves
10. Isolation of lactose from skimmed milk and the estimation of lactose
11. Determination of iodine value of edible oil by titrimetry
12. Determination of acid value by titrimetry

COURSE OUTCOME

1. Analyse the role of various nutrients, their dietary allowances and relate in day-to-day life.
2. Revise the Knowledge about the water- and fat-soluble vitamins and its significance and its functions
3. Outline the Knowledge about Obesity and obtaining better results

REFERENCE BOOKS:

1. Smith EL (1983) Principles of biochemistry: mammalian biochemistry: McGraw-Hill Companies.
2. Chatterjee CC (1951) Human physiology: Medical Allied Agency.
3. Murray R, Granner D, Mayes P, Rodwell V (2003) Harper's illustrated biochemistry (LANGE basic science): McGraw-Hill Medical.
4. Guyton Aurcher C, Hall John E (2006) Text book of Medical Physiology. Elsevier India Pvt. Ltd. New Delhi.
5. Dixon M, Webb E (1979) Enzyme inhibition and activation. Enzymes 3: 126-136.
6. Rao C (1973) University General Chemistry: An Introduction to Chemical Science: MacMillan India.
7. Price NC, Frey PA (2001) Fundamentals of enzymology. Biochemistry andMolecular Biology Education 29: 34-35.
8. Palmer T, Bonner PL (2007) Enzymes: biochemistry, biotechnology, clinical chemistry: Elsevier.

V- SEMESTER

Course No-13 : ENZYMOLOGY

Credits -3

COURSE OBJECTIVES

1. To enlighten the students about enzyme kinetics.
2. To help the students to understand the mechanism of action of enzymes.
3. To help the students to learn the applications of enzymes.

UNIT-I

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model., enzyme specificity and types. IUB system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes, Abzymes.

UNIT-II

Enzyme kinetics: Importance, order of reaction, study of the factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and Derivation of Michaelis -Menten equation and Km value determination and its significance. Definition of Vmax value of enzyme and its significance. Lineweaver- Burk plot (Only for single substrate enzyme catalyzed reaction).

UNIT-III

Methods of measurements and expression of enzyme activity. Unit of enzyme activity - definition and importance. Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive, noncompetitive and uncompetitive inhibition- explanation of double reciprocal plot with examples.

UNIT-IV

Enzyme regulation – covalently modulated enzymes with examples of adenylation and phosphorylation and allosteric regulation- example Aspartate tras carbamoylase. Isoenzymes- Lactate dehydrogenase and creatine phosphokinase. Zymogens

UNIT-V

Immobilization of enzymes, methods of immobilization. Industrial uses of enzymes: Detergent enzymes, thermo stable alpha amylase, papain, chymotrypsin

V-SEMESTER

Course No-13: ENZYMOLOGY

Credits -1

PRACTICAL SYLLABUS

1. Assay of α- amylase activity in saliva
2. Determination of optimum pH of a plant/animal or microbial enzyme.
3. Studying the effect of different temperatures during enzyme activity measurements.
4. Studying the effect of different pH during enzyme activity measurements.
5. Substrate saturation and determination of Km value from Michaelis Menten curve.

COURSE OUTCOMES

After completing this course, the student will:

1. Acquire the knowledge of structure and organization of protein
2. Identify the different classes of enzymes, the methods used for purification of enzymes and describe enzyme kinetics for bisubstrate and multisubstrate reactions.
3. Do research in a contemporary action of enzyme and enzyme inhibition.
4. Explain the enzyme regulation and multienzyme complex.
5. Explore the applications of enzymes in clinical and various industrial sectors.

REFERENCE BOOKS

1. Enzymes: M. Dixon and E. C. Webb. Longman Publication
2. Enzymology: Nicholas and Price
3. Biochemistry: D.Voet and J. G. Voet, John Wiley & sons Inc. New York ChischesterBrisbane,Toronto, singapore ISBN 0-471-58651-X
4. Biochemistry: L. Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0.
5. Enzymes: Trevor Palmer Affiliated East- West Press Pvt. Ltd, New Delhi ISBN 81-7671-04

V- SEMESTER
Course No-14: MOLECULAR BIOLOGY

Credits -3

COURSE OBJECTIVES

1. To introduce the type of DNA sequences and chromosome structure
2. To instill the knowledge of the molecular basis of DNA synthesis.
3. To understand the moleculae basis of RNA synthesis and modified into different types of RNA.
4. To discuss about the genetic code, molecular basis of protein synthesis & modification.
5. To detail the mechanism of DNA mutation and Repair system.

UNIT- I

Gene Organization - Genes, DNA sequences – Unique and repetitive sequences, coding, non-coding DNA, Satellite DNAs, Cot Curves, Chromosomes – Types, properties, Gene organization in Prokaryotes and Eukaryotes.

UNIT- II

DNA Replication - Chemistry of DNA synthesis, Modes of DNA replication, Semiconservative Replication – Meselson and Stahl experiment, Enzymes of DNA replication – DNA polymerases, Helicases, Primase, Ligases, Topoisomerases, Prokaryotic replication. Brief outline of eukaryotic replication.

UNIT- III

Transcription - Chemistry of Transcription, RNA polymerases, Role of sigma factor, Closed and open promoter complexes, Prokaryotic Transcription, Post transcriptional modifications of mRNA – capping, tailing, splicing.

UNIT- IV

Translation - Basic features and deciphering of the Genetic code, Genetic code dictionary, wobble hypothesis, Ribosomes, Protein synthesis in prokaryotes - Activation of amino acids, aminoacyl t-RNA synthetases, t-RNA as adaptor molecule, Prokaryotic translation, post translational modifications. 74

UNIT- V

Mutation and DNA Repair - Mutation – Types, Physical and chemical mutagens, DNA damages and mutations, DNA repair – Direct repair systems, Excision repair – Base and nucleotide excision repair, Mismatch repair.

COURSE OUTCOMES

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

1. Gain knowledge about the organization of genes and dynamics of DNA.
2. Gain knowledge about DNA Replication and its mechanism.
3. Gain knowledge about protein synthesis.
4. Understanding the mechanism of DNA repair and various mutations.

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V-SEMESTER
Course No-14: MOLECULAR BIOLOGY
Credits -1

PRACTICAL SYLLABUS

1. Study of semi-conservative replication of DNA through micrographs / schematic representation
2. Isolation of chromosomal DNA
3. Agarose gel electrophoresis and visualization
4. Study the effect of chemical (HNO2) and physical (UV) mutagens on cells
5. Nucleic acid leakage analysis
6. To hydrolyze DNA and separate nucleotide bases by paper chromatography

RECOMMENDED BOOKS:

1. Gene cloning & DNA analysis: Brown T. A., Blackwell publishing, Oxford, U.K., 6th Ed. 2010.
2. Biotechnology: applying the genetic revolution: Clark D. P. &Pazdernik N. J., Elsevier academic press, USA. 2009.
3. Principles of gene manipulation and genomics: Primrose S. B. & Twyman R.M., Blackwell Publishing, Oxford, U.K., 7th Ed. 2006.
4. Molecular cloning-a laboratory manual: Sambrook J. & Russell D., Cold Spring Harbor Laboratory Press, 3rd Ed. 2001. Prescott, Harley & Klein's
5. Microbiology: Wiley J. M., Sherwood L. M. & Woolverton C. J. Mcgraw Hill Higher Education. 7th Ed. 2008. Genomes-3: Brown T. A., Garland sc
6. Biochemistry - Voet Donald and VoetJudith : 2004. Wiley International Edition, 3rd Edition : John Wiley & Sons.
7. Lehninger Principles of Biochemistry – Nelson David and Cox Michael: 2004. W.H.Freeman& Co : New York
8. Molecular cell biology – Lodish, Harvey, Berk, Arnold, Zipursky, Lawrence, Matsudaira, Paul, Baltimore : 2006, 4th Edition, W.H Freeman & Co .
9. Lewin's Genes X– Krebs Jocelyn, Lewis Benjamin, Goldstein, Eliottt, Kilpatrick, Stephen: 2009. Jones and Bartlett.
10. The world of cell – Becker, Wayne,Kleinsmith, Lewis, Hardin, Jeff, BertoniGregory paul : 2009, 7th Edition, Pearson Education Inc.
11. Essentials of Molecular biology- V.Malathi, 2013 , First Edition, Pearson Publishers.
12. The Cell – molecular approach, Geoffrey M. Cooper & Robert E. Hausman, 3rd Edition,

V- SEMESTER
Course No-15: METABOLISM OF NITROGEN COMPOUNDS

Credits -3

COURSE OBJECTIVES

1. To help the students to understand the basic metabolic pathways
2. To help the students to understand the inter relationship between major foodstuffs.

UNIT-I

General reactions- transamination- definition, reactions catalysed by SGOT and SGPT, Importance of transamination; Deamination - definition, oxidative and non-oxidative, examples for oxidative deamination- L-glutamate and non-oxidative- serine, aspartic acid and glutamine.

UNIT-II

Decarboxylation - definition, decaboxylation of glutamic acid, Histidine. Urea cycle- individual reactions, importance of urea cycle, hyperammonemia, regulation of urea cycle. Interrelationship between urea cycle and TCA cycle.

UNIT-III

Biosynthesis of glycine from serine and choline. Biosynthesis of alanine from transamination reaction. Biosynthesis of cysteine from L- serine. Epinephrine and Nor-epinephrine- importance and biosynthesis from tyrosine. Histamine: biological importance and synthesis. PKU and AKU characteristic features, metabolic reasons

UNIT-III

Biosynthesis of purine and pyrimidine nucleotides- sources of nitrogen and carbon atoms of purine and pyrimidine ring. Precursors of purine and pyrimidine biosynthesis. Reactions involved in the biosynthesis.
Conversion of nucleotides to deoxynucleotides. Orotic acid uria- general features. Gout; general features.

UNIT-IV

Factors regulate metabolic homeostasis.; Importance of different organs and tissues in metabolism-With special emphasis on liver, skeletal muscle, brain, heart; brown and white adipocytes etc.; Importance of endocrine organs and hormones in metabolic regulations with special emphasis on Leptin and obesity: Interconnections between carbohydrate, protein and lipid metabolism.

UNIT-V

Redox metabolism. Glutathione S-transferases in Redox Regulation and Glutathione Dependent Catalysis; Glutaredoxin and Thioredoxin Systems; Structural Basis of Redox

Active Enzymes; Redox Activities of Antioxidants in a Cellular Context; Mitochondria, Reactive Oxygen Species and Human Disease.

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V- SEMESTER
Course No-15: METABOLISM OF NITROGEN COMPOUNDS

Credits -1

PRACTICAL SYLLABUS

1) Preparation of mitochondria from rat liver.
2) Assay of aminotransferases: (a) Aspartate (b) alanine amino transferases.
3) Assay of phenyl alanine ammonialyase.
4) Assay of nitrate and nitrite reductase.
5) Assay of Glutamine synthase.
6) Estimation of Allantoin and allantoic acid.
7) Assay of nitrogenase.

COURSE OUTCOMES

After completing this course, the student will:

1. Recognise the metabolism of proteins and metabolic profile of various tissues.
2. Correlate the metabolism of amino acids and their specialized products
3. Integrate the biosynthesis and degradative pathways of nucleic acids and their disorders

REFERENCE BOOKS:

1. Lehninger's Principles of Biochemistry, David L.Nelson, Michael M. Cox. Publisher:W.H.Freeman.
2. Biochemistry-Jeremy M Berg, John L Tymoczko,andLubertStryer. Publisher:WHFreeman
3. Biochemistry,4th Edition-Donald Voet, Judith G.Voet.–PublisherJohnWiley& Sons.
4. Biochemistry; Voet , D. and Voet, J.G. [Eds.] (1999) 3 Ed. Jhon Wiley and sons.
5. Biochemistry; David Rawn, J. (1989) Neil Patterson Publishers.
6. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGarw Hill.

VII- SEMESTER

Course No-16: RECOMBINANT DNA TECHNOLOGY

Credits -3

Course Objectives

1. To understand the principles of recombinant DNA technology.
2. To study the techniques and application of gene transfer methods.
3. To understand the applications of genetic engineering.

UNIT-I

Introduction to Gene Cloning Gene cloning – Manipulation of purified DNA, DNA manipulative enzymes – nucleases, ligases, polymerases, topoisomerases, restriction enzymes – performing restriction digests, restriction mapping, ligation – joining DNA molecules together – random labelling, nick translation and end filling – importance of gene cloning.Isolation and Purification of DNA – Total cell DNA, Plasmid DNA and Plant cell DNA.

UNIT-II

Cloning and Expression Vector 12 hrs Plasmids – pBR322, pUC vectors,bacteriophages (M13 and λ), phagemids, cosmids, yeast vectors, YAC, BAC, Ti Plasmid, Ri Plasmid, Viral vectors

UNIT-III

Gene Transfer Methods 12 hrs Biolistics, electroporation, microinjection, liposome – mediated method, calcium phosphate method, Agrobacterium mediated gene transfer, Viral mediated gene Transfer - Transgenic animals and birds

UNIT-IV

Identification and Expression of Cloned Genes 12 hrs Studying gene and genome structure, construction of libraries, blotting techniques, in situ hybridization, DNA sequencing, chromosome walking and jumping, DNA foot printing, DNA finger printing, RFLP, RAPD, HRT and HART. PCR and its applications

UNIT-V

Applications of Genetic Engineering 12 hrs Applications of genetic engineering - in medicine: pharmaceutical compounds, insulin production, recombinant vaccine, gene therapy; in agriculture: gene addition, Antisense RNA technology, insect and virus resistant plants-herbicide tolerant plants. in environmental management and industry: Gene therapy

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VII- SEMESTER
Course No-16: RECOMBINANT DNA TECHNOLOGY
Credits -1

PRACTICAL SYLLABUS

1. Isolation of plasmid DNA from E. coli.
2. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA by submarine gel electrophoresis.
3. Transformation of E. coli with ampicillin resistant plasmid.
4. Trasfection of M13 DNA into E. coliJM103.
5. Isolation of phageM13.
6. Isolation of single and double standard M13DNA.
7. Conjugation: Use of broad host range plasmid RP in demonstrating conjugation transfer of plasmid bacteria.
8. Catabolite repression: Evidence of B-Galactosidase induction in presence of lactose in E .coli lac strains.
9. Restriction digestion of DNA.
10. PCR: Primer design and amplification. RT-PCR, blotting.

COURSE OUTCOMES: After completing this course, the student will

1. Understand suitable methods for isolation and purification of DNA from Bacteria, Plants, Plasmid and Phage for cloning purposes
2. Explain the restriction enzymes, construction of vectors, principle and the mechanism of various gene transfer methods
3. Use the knowledge gained about hybridization techniques, methods of sequencing, gene amplification, polymorphism studies
4. Explore the production of rDNA products in the field of agriculture, medicine, industry and environment.

REFERENCE BOOKS:

1. Brown, T.A., (2012), Gene Cloning and DNA Analysis: An Introduction, 7th edition Wiley-Blackwell
2. Brown, T.A., (2007), Gene cloning and DNA analysis, 6th edition John Wiley & Sons, New York
3. Tamarin, R.H., (2007), Principles of Genetics, 7th Ed., TMH Publishing Company, New Delhi.
4. Russell Jones, Helen Ougham, Howard Thomas, Susan Waaland (2013), The Molecular Life of Plants, Wiley Blackwell publishers.
5. Peter J. Russell., (2013) Genetics, 5 th Edition, Pearson Benjamin Cummings, New York.
6. Holdrege, B C., Steve Talbott, S (2008), Beyond Biotechnology: The Barren Promise of Genetic Engineering, The University press of Kentucky.
7. Rajagopal, K (2012), Recombinant DNA Tech and Genetic Engg, McGraw Hill.
8. Gardner, E.J., Simmons, M.J and Snusted, D.P (2006), Principles of Genetics, Eighth Ed, John Wiley & Sons, New York.
9. Nicholl D S T (2010),Introduction to genetic engineering 3rd edition, Cambridge India

VII - SEMESTER
Course No-17: ENDOCRINOLOGY

Credits -3

COURSE OBJECTIVES:

1. To impart knowledge about various hormones and their mechanism of action
2. To understand the functions and abnormalities of thyroid and parathyroid gland
3. To inculcate the knowledge on adrenal gland. To understand the role of pancreatic and gastro intestinal tract hormones.
4. To study the disorders associated with reproductive glands.

UNIT-I

Hormones, hormone secreted by various glands, tropic hormones of hypothalamus and Pituitary (functions only), Classification of hormones (Steroid, Amino acid derivatives, Peptide / Protein hormones), Hormone receptor interaction (Over view), Mechanism of action of hormones (membrane receptor, c-AMP, IP3-DAG, nuclear chromatin).

UNIT-II

Thyroid gland, functions of thyroid hormones, hypothyroidism – Goitre, Myxedema, hyperthyroidism- Exophthalmos, Natural goitrogens. Parathroid gland, functions of parathyroid hormones, Rickets, Osteomalacia, Osteoporosis.

UNIT-III

Adrenal gland, functions of adrenal cortex hormones - corisol, aldosterone, hypo adrenalism – Addison's disease, hyper adrenalism – Cushing's disease, functions of adrenal medullary hormones – epinephrine, Nor-epinephrine.

UNIT-IV

Pancreas, functions of pancreatic hormones- Insulin, Glucagon, Somatostatin, Diabetes mellitus (Type I & II), Insulinoma. Functions of Gastro intestinal hormones – Gastrin, Cholecystokinin, Secretin, Ghrelin, Leptin, Motilin, P- substance.

UNIT-V

Gonadal glands (Ovary, Testis), functions of gonadal hormones –Testosterone, Estrogen, Progestrone, Functions of Relaxin, Hypogonadism in males, Poly Cystic Ovarian Syndrome (PCOS).

VII-SEMESTER
Course No-17: ENDOCRINOLOGY
Credits -1

PRACTICAL SYLLABUS

1. Microscopic observation of endocrine glands
2. Estimation of sugar by anthrone reagent
3. Study of scavanging activity (Indirect method)
4. Pregnancy Test (strip method)
5. Effect of iodine on metamorphosis
6. Effect of thyroid hormone on metamorphosis
7. Estimation of plasma insulin by RIA- demonstration
8. Estimation of TSH by ELISA- demonstration

COURSE OUTCOMES:

1. Apply the knowledge in integration of body system by endocrines
2. Analyse the integration of thyroid hormones with metabolism and parathyroid hormones with calcium metabolism
3. Link the relationship between adrenal hormones with, neurotransmission, mineral and energy metabolism
4. Discuss the link between pancreatic and gastro intestinal hormones with diseases
5. Create awareness on gonadal systems and measures to prevent the reproductive disorders

RECOMMENDED BOOKS

1. Text book of Medical physiology - Guyton & Hall, 11th Edition, Churchill Livingstone, 2004
2. Text book of Biochemistry with clinical correlations - Thomas M.Devlin, 6 th Edition, John Wiley & Sons Inc. Publications, 2004.
3. Text book of Medical Biochemistry – MN Chatterje& Rana Shinde, 8th Edition, Jaypee Publishers, 2013.
4. Human Anatomy & Physiology – Elaine N.Marieb, RN, 3rd Edition, The Benjamin/ Cummings Publishing Company, 1991.
5. Clinical Chemistry Concepts & Applications – Shauna C.Anderson, Susan Cockayne, 1993, W.B.Saunders Publishers, Tokya,
6. William's Text book of Endocrinology- Larsen, Kronenberg, Melmed& Polonsky, 10th Edition, Saunders Publishers, 2003.
7. Mark's Basic Medical Biochemistry- A Clinical Approach, Colleen Smith, Allan D.Marks, Michael Lieberman, 2nd Edition, Lippincott Williams &Willkins, 2005

VII-SEMESTER

Course No-18: BIOCHEMICAL CORELATIONS OF DISEASES

Credits -3

COURSE OBJECTIVES

1. The course aims to provide an advanced understanding of the biochemical mechanisms and pathophysiological processes responsible for common biochemical disorders.
2. The course provides an overview of normal and abnormal metabolic functions, the impact of disorders on metabolic processes, an overall picture about the molecular basis of diseases and novel strategies to prevent the diseases.

UNIT-I

Inborn errors of metabolism: Alkaptonuria, Phenyl Ketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Introduction to Clinical Immunology: Introduction and maintenance of clinical Immunology laboratory; hazards in clinical laboratory; units; 'normal range', reference values. Factors affecting reference values quality control in laboratory – use of external and internal standards; use of WHO standards. Collection and preservation of biological samples.

UNIT-II

Nutritional Deficiency and Life style diseases: Kwashiorkar, Marasmus, Beriberi, Scurvy Pellagra, Anaemia Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson diseases, Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II, Inflammatory Bowel Disease (IBD).

UNIT-III

Hormonal imbalances and Autoimmune diseases: Outlines of hormone action and imbalances leading to diseases – precocious puberty – Hyper and hypopituitarism. Hyper and hypothyroidism Concepts in immune recognition self and non-self-discrimination. Organ specific autoimmune diseases – Hashimotos thyroiditis, Grave's disease, Myasthenia gravis, Systemic diseases – Systemic Lupus Erythematosus, Rheumatoid arthritis, Diabetes mellitus.

UNIT-IV

Diseases caused due to mis-folded proteins:Alzheimer's disease, Huntington's disease, Kuru, Cruezfeldt-Jakob disease, Sickle-cell anaemia, Thalassemia.

UNIT-V

Infectious diseases:Viral infection (Polio, Measles, Mumps, Influenza, HIV); Bacterial infections (Tetanus, diphtheria, tuberculosis, typhoid, cholera);Protozoan diseases (*Plasmodium* and *Trypanosoma)* and parasitic infections. Vaccines against diseases, General strategies in the design and the development of vaccines.

Pathophysiology of different diseases like Jaundice, Fatty liver, atherosclerosis, and osteoporosis; Functional test of liver, kidney, thyroid, gastrointestinal and pancreas, biochemical diagnosis of diseases by enzymatic assays; Clinical tissue analysis, biopsy, liquid biopsy, circulating RNA and DNA as molecular diagnosis of different diseases.

SEMESTER-VII
Course No-18: BIOCHEMICAL CORELATIONS OF DISEASES

Credits -1

PRACTICAL SYLLABUS

a) Method of collection of blood
b) Study of blood
c) Total count of WBC
d) Total count of RBC
e) Differential count of WBC
f) Estimation of Hemoglobin percentage
g) ESR, BT & CT
h) Platelets Count
i) Glucose tolerance test
j) Lipid profile: Triglycerides and total cholesterol
k) Obesity parameters
l) Blood Pressure measurements
m) Bone density measure measurements
n) Laboratory Diagnosis of Kala-azar
o) Screening for sickle-cell anemia

COURSE OUTCOMES

1. After the completion of this course, the student will be able to
2. Describe of the blood clotting pathways and the blood clotting disorders.
3. Enumerate of the different types of anemias based on aetiology.
4. Understand the pathophysiological processes responsible for common biochemical disorders such as jaundice, Pancreatitis, Fatty liver etc.
5. Differentiate three types of jaundice and their systematic analysis. Detailed study of Jaundice, Cirrhosis, Hepatitis, Fatty liver and gall stones. Serum enzyme activities in diseases.
6. Understand Formation of urine and gain perception on the various renal function tests and renal disorders
7. Gain understanding of the need for Gastric function tests, Collection of gastric contents, their examination.

RECOMMENDED BOOKS

1. Varley's Practical clinical Biochemistry –Ed. A.W.Gowenlock (Heinemann, Lon, 1988).
2. Clinical diagnosis and management by Lab methods (J.B.Henry, W.B. Salunders Co,).
3. Clinical Biochemistry – S.Ramakrishnan and Rajiswami.
4. Chemical Biochemistry (Metabolic and clinical aspects) by W.J.Marshall&S.K.Bangert.
5. Text book of clinical Biochemistry by Tietz et al.
6. Turgons "Immunology and serology" by Mosby Latest Edition 2007
7. Immunology by Irwin Roitt Latest edition.
8. Immunology a short course: Coico, R and Sunshine, G., John and Wiley &sons.
9. Text Book of Biochemistry with Clinical correlations Devlin T.M John Wiley

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VIII -SEMSTER
Course No 19: APPLIED BIOCHEMISTRY

Credits -3

Course objectives:

1. To learn and gain knowledge on importance of microorganisms in human health and disease
2. Importance of plant tissue culture, animal cell cultures and stem cells in regenerative medicine.
3. Basics of Fermentation Technology and industrial production of chemicals.
4. To understand the importance and methods of bioremediation

UNIT-I

Microbiology in Human Health and Diseases: Beneficial Microorganism: Lactobacillus, Normal flora of human gut, Probiotics, Yeast, Nitrogen fixing bacteria (Rhizobium and Azotobacter). Harmful microorganisms: Air borne- Mycobacterium tuberculae(Tuberculosis), Corynebacterium diptheriae(Diptheria), Candida sp., Haemophilus influenzae (Influenza), morbillivirus (measles). Water borne- Shigella sp. (Dysentery), Vibrio cholerae (Cholera), Salmonella sp. (Enteric fever), Hepatitis virus. Food borne- Staphylococcus aureus, Clostridium botulinum (Botulism) Soil borne- Clostridium tetani

UNIT-II

Plant Tissue Culture: History, Introduction or definition (explants, callus, dedifferentiation, re-differentiation) concept of totipotency Culture techniques; Types of culture (Callus culture, Organ culture, protoplast culture, cell culture) Applications: secondary metabolites in plant culture, Micropropagation

Animal Cell Culture: History, Introduction to Primary cell culture, Cell lines (Finite and continuousCulture techniques used for primary cultureStem cell culture, Animal Organ Culture, Whole embryo culture Applications: hybridoma (monoclonal antibody), production of Vaccines

UNIT-III

Industrial Biochemistry: Basics of fermentation Typical Fermenter, Types of Fermenters (CSTF, Bubble cap, Airlift, Fluidized Bed reactor) Industrial production of wine, penicillin

Applications Biosensors: Features of Biosensors, classification based on transducers, applications Single Cell proteins and their applications

UNIT-IV

Immobilized Enzyme: Introduction, Methods of immobilization (entrapment, adsorption, covalent binding, microencapsulation, cross linking) Stabilization of soluble enzyme (solvent and substrate stabilization, enzyme stabilization by polymer. Salts and chemical modification)

Applications Biosensors: Features of Biosensors, classification based on transducers, applications Single Cell proteins and their applications

UNIT-V

Bioremediation: Introduction to terms – Bioremediation, Biotransformation, Xenobiotics, Recalcitrant xenobiotics, Biomagnification, Factors affecting bioremediation Types of Bioremediations (Insitu, Exsitu); Types of reactions (Aerobic, anaerobic, sequential) Applications of Biodegradation - hydrocarbons, (Oil spills) Pesticides and herbicides,Heavy metals (Uranium) contaminated soil and waste land, Ground Water; Genetically Engineered Microbes in bioremediation.

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Single Major B.Sc. Biochemistry (w.e.f:2023-24A.B)
VIII -SEMSTER

Course No-19: APPLIED BIOCHEMISTRY

Credits -1

PRACTICAL SYLLABUS

1. Demonstration of the working of an autoclave and a hot air oven.
2. Optimization of curd – a demonstration.
3. Sterility testing of air by plate exposure technique. [in sterile zone, in lab] and of tap water.
4. A study of various culture inoculation methods. (streak plate, pour plate and spread plate methods).
5. Cell count in a culture medium using optical density
6. Determination of the zone of inhibition of microorganisms using the agar well method and disc method.
7. Flow sheet diagrams of industrial preparation of: a vitamin, an antibiotic, a food item, an enzyme and an alcohol.
8. Isolation of DNA from Onions and confirmation by DPA test Determination of the Minimum Inhibitory Concentration of any one disinfectant.
9. Determination of the potability of water by conducting a coliform count. [MPN]
10. Principles of Tissue culture and media preparation.

COURSE OUTCOMES

1. At the end of the course students will be able to
2. Understand the importance of beneficial and harmful microorgnisms in human health and disease.
3. Gain knowledge and proceudres on different plant tissue culture methods, animal cell cultures and applications of stem cells.
4. Knowledge and mathodologies of fermentation Technologies and industrial production of valuable products
5. Knowledge on various agents and microbes involved in the process of bioremediation.

REFERENCE BOOKS

1. J. L. Jain, Fundamentals of Biochemistry, S. Chand & company, 2005 edition
2. A.C. Deb, Fundamentals of Biochemistry, New central book agency (P) Ltd., 8th edition
3. U. Satyanarayan, Biochemistry, Books & allied (P) Ltd., Kolkata, 3rd edition
4. Murry, R. K. & others, Harper‟s Biochemistry, Appleton & Lange, california, 21st edition.
5. Michael J. Pelczar, Jr; E.C.S. Chan; Noel R. Krieg; Microbiology Tata McGraw Hill
6. S.S purohit, Biotechnology fundamental and applications
7. U. Satyanarayan; Biotechnology
8. Jogdand, Advances in biotechnology
9. Willium Frazier, Dennis C. Westhoff; Food Microbiology; The McGraw hill Companies
10. Roger Y stanier; General Microbiology,Macmillan, 1981
11. David Freifelder, Microbial genetics
12. S.K. Verma and Mohit Verma; Plant physiology, Biochemistry and Biotechnology

VIII - SEMESTER

Course No-20: FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Credits -3

COURSE OBJECTIVES

1. To understand the statistical tools commonly used in biological research
2. To assimilate the concepts of hypothesis testing and its importance in research
3. To build a strong background and potential in bioinformatics
4. To introduce the concepts of biological databases and bioinformatics tools
5. To master the computational techniques used in biological sequence and structure analysis.

UNIT-I

Biostatistics Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation.

UNIT-II

Overview of testing of hypothesis, errors of inference and distribution types. Distribution-free test - Chi-square test, G-test. Product moment Correlation- assumptions, properties, computations and applications, Spearman's rank correlation coefficient, Point biserial r, Biserial r, contingency coefficient. Properties and computations of simple linear regression.

UNIT-III

Bioinformatics Bioinformatics spectrum: Introduction to Genomic Data and Data Organization; Information from nucleic acid/protein sequences and structures. Protein and Nucleic Acid Sequence Data Banks – NBRF-PIR, SWISSPORT, GenBank, EMBL

UNIT-IV

Protein and Nucleic Acid Sequence Data Banks – NBRF-PIR, SWISSPORT, GenBank, EMBLProtein sequence databases: Uniprot, PDB; Literature database – PubMed; Data retrieval systems – Entrez. Introduction to Sequence, Alignments, Type of Alignments and their Significance, Dot plot, Pairwise alignment –BLAST and Multiple Sequence Alignment - Clustal W algorithm. Gene prediction, Human G nome Project and its significance

UNIT-V

Structural data bank – PDB, SCOP, CATH, CSD Sequence Analysis – Analysis tools for sequence data banks, Pair–wise alignment – Needleman and wunsch algorithm, smith waterman.

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VIII -SEMESTER

Course No-20 : FUNDAMENTALS OF BIOSTATISTICS AND BIOINFORMATICS

Credits -1

PRACTICAL SYLLABUS

BIOINFORMATICS PRACTICAL:

1. Sequence Alignment (BLAST/ ClustalW/ FASTA)
2. Primer Designing (IDT tools) and sequencing data analysis
3. Accessing sequence and structure databases and information retrieval Image J
4. Phylogenetic Cluster Analysis
5. Gene Prediction
6. Prediction of protein structure
7. Viewing three dimensional Structures of Macromolecules by Rasmol
8. Protein- Protein Interactions (STRING)

BIOSTATISTICS PRACTICALS:

1. Plotting of graphs.
2. Computation of Mean, median, mode, standard deviation
3. Testing of hypothesis by z and t test. 4. Chi square analysis
4. Computation of correlation statistics
5. Computation of regression equation.

COURSE OUTCOMES

After successfully completing this course, the students will be able to:

1. Gain a comprehensive knowledge regarding statistical presentation and evaluation of multiparametric data
2. Recognize the importance of data collection and its role in determining scope of inference.
3. Learn about hypothesis testing.
4. Choose and apply appropriate statistical methods for analysing one or two variables.
5. Understand the basics of bioinformatics and develop awareness of the interdisciplinary nature of this field.
6. Learn about Biological Databases and the types of databases.
7. understand protein structure using visualization software's, learn about gene prediction program
8. Understand sequence alignments and analyse phylogeny using alignment tools.

REFERENCE BOOKS:

1. Statistical methods. S.P.Gupta
2. Fundamentals of mathematical statistics. S.C Gupta &Kapoor
3. Statistical methods in biological and Health Science. J. S. Milton &J.O.Tsokan.
4. Primrose SB. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms. 2nd Ed. 1998. Blackwell Science: Oxford. ISBN0-632-04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed. 2000. Oxford University Press.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreilles Publication.
7. Bioinformatics sequence, structure and data banks ed. By Des Higgins

VIII -SEMESTER
Course No-21: PLANT AND ENVIRONMENTAL BIOCHEMISTRY
Credits -3

COURSE OBJECTIVES

1. To gain knowledge on photosynthesis mechanisms in plants, Nitrogen fixation and function of phytohormones in plant systems.
2. To learn and understand about renewable and non-renewable resources, structure and functions of different ecosystems.
3. To learn about causes, heavy metals, effects and remedies to environmental pollution and the importance of biofertilizers and biopesticides.

UNIT-I

Photosynthesis – components and mechanisms; photophosphorylation - Cyclic and Noncyclic mechanisms; Proton gradient and ATP synthesis, CO2 fixation in C3, C4 and CAM plants; factors effecting photosynthesis, regulation of photosynthesis; Mechanism of photorespiration and its significance.

UNIT-II

Nitrogen fixation – types and mechanisms, seed germination and dormancy, Factors effecting seed germination; Secondary metabolites in plants-Nature, distribution and function;Structure, physiological function and mechanism of action of phytohormones – auxins,gibberellins, cytokinins, ethylene and abscisic acid.

UNIT-III

Renewable and non-renewable resources-Forest resources, Water resources, Mineral resources, Food resources, Energy resources; Ecosystem - Structure and function, Energyflow, Ecological succession, food chains, food webs and ecological pyramids; Forest, Desertand Aquatic ecosystems.

UNIT-IV

Environmental Pollution - Definition, cause, effects and control measures of Air pollution,Water pollution, Soil pollution; Solid waste Management - Causes, effects and controlmeasures of urban and industrial wastes; Role of Information Technology in Environmental Protection.

UNIT-V

Bio fertilizers, Biopestiscides and their effects

Biofertilizers—Biocomposting, Vermiculture, Algal Bio fertilizers. Bioethanol production. Biopestisides—types, mechanism of action. Environental consequences of pestiside toxicity. Metal toxicity; toxicology of Arsenic, mercury, lead, and cadmium. Organophosphates and carbamates, Fungicides and herbicides. Occupational hazards: Industrial effluent toxicology and environmental health.

VIII -SEMESTER
Course No-21: PLANT AND ENVIRONMENTAL BIOCHEMISTRY
Credits -1

PRACTICAL SYLLABUS

1. Estimation of total chlorophyll, chlorophyll a and chlorophyll b pigments from the leaves.
2. Estimation of starch content by Anthrone reagent.
3. Spectrophotometric estimation of Indole acetic acid in plant tissues.
4. Determination of Gibberllic acid by half seed method.
5. Determination of protein under abiotic stress.
6. Isolation of chloroplast DNA

COURSE OUTCOMES

At the end of the course students will

1. Gains knowledge on Co2 fixation, mechanisms of photosynthesis, photorespiration and Nitrogen fixation in plant systems.
2. Learns the structure and functions of various ecosystems and importance of renewable and non-renewable resources.
3. Deeper understanding on causes, consequences of environmental pollution and alleviating measures and the need of bioferrtilizers and bio pesticides.

RECOMMENDED BOOKS

1. Mukherji, S and Gosh A. K., Plant Physiology, New Central Book Agency, Kolkata.
2. Slater A, NW Scott, MR Fowler, Plant bio technology, Oxford University Press.
3. Hopkins, W. G and Huner, N. P. A. Introduction to Plant Physiology, John Wiley &Sons Inc. New York.
4. Plant Biochemistry, Hans-Walter Heldt and Birgit Piechulla
5. Plant Biochemistry by Dr.V.Arun Kumar, Dr.K.Siva Kumar, Dr. N. Senthil Kumar.
6. Environmental Biochemistry by NeelimaRajvaidya, Dilip Kumar Markandey.
7. Environmental and Ecological Biochemistry by P.W. Hochachka T.P. Mommsen.
8. Plant Metabolism: H.D. Kumar and H.N. Singh Pub. Affiliated EastWest Press Pvt. Ltd. New Delhi.
9. A Text Book of Environmental Pollution, P. PAnday, 2010.
10. A Text Book of Environmental Science, V. Thakur, 2012.
11. A Text Book of Environmental Science, Prabhat Patnaik, 2011.
12. Environmetal Chemistry {aerback-by V.K.Ahuwalia (Author), Lalita s. kumar (Author), ANE Books
13. Environmental Biology (Principles of Ecology), 4/e DR. P.S. VERMA &amp: DR.V.K. AGARWAL, S. Chand publishing