Pt. Ravishankar Shukla University Raipur

M. Sc. Biochemistry (Program code- M. Sc. 0406)

Syllabus (2023-24 to 2024-25)

First Semester (July 2023-December 2023)

Paper	Title of paper (course code)	Marks			Credit
		(External)	(Internal)*	Total	
I	Molecular cell Biology & Genetics (BC-22101)	80	20	100	4
II	Chemistry of Biomolecules (BC-22102)	80	20	100	4
III	Microbial Biochemistry And Biostatistics(BC-22103)	80	20	100	4
IV	Biophysical Chemistry and Biochemical Techniques(BC-22104)	80	20	100	4
LC-I	Lab Course I (Based on paper I & II) (BCLC-22105)	80	20	100	2
LC-II	Lab Course II (Based on paper III & IV) (BCLC-22106)	80	20	100	2
Total		**480**	**120**	**600**	**20**

Second Semester (January 2024 – June 2024)

Paper	Title of paper (course code)	Marks			Credit
		(External)	(Internal)*	Total	
I	Bioenergetics & Metabolism (BC-22201)	80	20	100	4
II	Plant Physiology and Biochemistry(BC-22202)	80	20	100	4
III	Biology of Immune System(BC-22203)	80	20	100	4
IV	Human Physiology (BC-22204)	80	20	100	4
LC-I	Lab Course I (Based on paper I & II) (BCLC-22205)	80	20	100	2
LC-II	Lab Course II (Based on paper III & IV) (BCLC-22206)	80	20	100	2
Total		**480**	**120**	**600**	**20**

Third Semester (July 2024 -December 2024)

Paper	Title of paper (course code)	Marks			Credit
		(External)	(Internal)*	Total	
I	Clinical Biochemistry (BC-22301)	80	20	100	4
II	Secondary Metabolites (BC-22302)	80	20	100	4
III	Nutritional and Environmental Biochemistry (BC-22303)	80	20	100	4
IV	Enzymology (BC-22304)	80	20	100	4
LC-I	Lab Course I (Based on paper I & II) (BCLC-22305)	80	20	100	2
LC-II	Lab Course II (Based on paper III & IV) (BCLC-22306)	80	20	100	2
Total		**480**	**120**	**600**	**20**

Fourth Semester (January 2025 -June 2025)

Paper	Title of paper (course code)	Marks			Credit
		(External)	(Internal)*	Total	
I	Genetic Engineering (BC-22401)	80	20	100	4
II	Nutraceuticals and Functional Foods (BC-22402)	80	20	100	4
III	**Special Paper-A**: Plant Biotechnology(BC-22403A) **Special Paper-B:** Infectious Diseases: Molecular basis, Control and Prevention (BC-22403B)	80	20	100	4
IV	**Special Paper-A:** Life Style Disorders: Cancer and Cardiovascular Diseases(BC-22404A) **Special Paper-B:** Bioinformatics (BC-22404B)	80	20	100	4
LC-I	Lab Course I (Based on paper I & II) (BCLC-22405)	80	20	100	2
LC-II	Lab Course I (Based on paper III & IV) (BCLC-22406)	80	20	100	2
Total		**480**	**120**	**600**	**20**

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Chairman
(B.O.S)

Program Educational Objective:

PEO1. The graduating student shall become a professional in the area of biochemistry.

PEO2. The graduating student shall become a researcher in the field of biochemistry.

PEO3. The graduating student shall become a consultant or an entrepreneur or a freelancer in the area of biochemistry.

Program Outcome:

On successful completion of this program the graduates shall have:

PO1. Ability to apply the fundamental knowledge of molecules of life, molecular techniques, toxicology in the area of biochemistry.

PO2. Ability to design experiment and interpret the results.

PO3. An ability to design a system, or process to meet desired need within realistic constraints.

PO4. Ability to function in a multidisciplinary team.

PO5. An ability to identify, formulate and solve professional problems in the area of biochemistry.

PO6. An understanding of professional and ethical responsibility in the area of biochemistry.

PO7. An ability to communicate effectively in scientific reasoning and data analysis in both written and oral forms.

PO8. The broad education necessary to understand the impact of solutions in a global, economic, environmental and societal context.

PO9. A recognition of the needed for and an ability to engage in lifelong learning in the area of biochemistry.

PO 10. A knowledge of contemporary issues related to biochemistry

PO11. Ability to think critically and apply the same to update scientific knowledge.

PO12. An ability to use the techniques, skills and modern professional tools necessary for professional practice and for research.

Program Specific Objectives:

PSO1. Students shall be able to identify, formulate and solve the problems of biological metabolisms, protein biochemistry and molecular biology.

PSO2. Students shall be able to conduct the experiments in the field of medicine, toxicology and immunology as well as to analyses and interpret the results.

PSO3. Students shall be able to use the biochemical techniques, bioinformatics tools, biostatistics, skills and modern pathological tools necessary for professional practice and for research.

Pattern of Question Paper : As per University examination guideline.

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Examination Scheme for Lab Course (for each Semester) Max. Marks 100

	Exercises	Max. Marks
1.	Major exercise based on paper I	20
2.	Minor exercise based on paper I	10
3.	Major exercise based on paper II	20
4.	Minor exercise based on paper I I	10
5.	Spotting/ Interpretation*	10
6.	Viva-voce	10
7.	Sessional [Internal]	20
	Total	**100**

* A student will be required to interpret on the displayed item/material

Continuous evaluation of Performance* (Continuous Comprehensive Evaluation (CCE))

Each student will be evaluated continuously throughout the semester. There will be a **class test based on each theory paper in I and III semester and Course based seminar/ poster presentation in II and IV semester**. Each student will be required to submit a brief write-up (not more than 15-20 pages) on his/her poster/Seminar presentation. Maximum marks for Continuous evaluation of performance will be classified as follows.

Project Work

A student of IV semester will have the choice to opt for project work in lieu of four theory papers and two lab courses provided he/she secure at least **65%** or more marks in aggregate in semester I and II. The project has to be carried out in recognized national laboratories or UGC-recognized universities. No student will be allowed to carry out project work in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. RavishankarShukla University, Raipur. The valuation of all the projects will be carried out by an external examiner and HOD of Biochemistry/Professor in charge or its nominee.

Evaluation of Project Work

		Marks					Credit
		(External)		(Internal)*		Total	
		Max.	Min	Max.	Min		
I	DESSERTATION	240	48	60	12	300	11
II	SEMINAR BASED ON PROJECTS	160	32	40	08	200	06
III	VIVA VOCE	80	16	20	04	100	03
Total						**600**	**20**

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M. Sc. Biochemistry
FIRST SEMESTER (July 2023 – December 2023)
PAPER - I: Molecular cell Biology & Genetics [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction the molecular mechanisms of life together with its advancements.

Course Outcome:

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

CO.1 –Describe the chemical and molecular foundations of cell and the role in biological systems.
CO.2 – Classify the cell cycle, its regulation and development.
CO.3- Regulation of gene expression in prokaryotes, Operon concept, post transcriptional and post translational modifications, protein as signal.
CO.4- Evaluate the gene regulatory mechanisms in prokaryotic and eukaryotic cell.

Unit-I: Cell growth, types of cell division – mitosis, meiosis, cell cycle and its regulation, cytokinesis and growth factors, cytoskeleton and its organization – Microtubules and action filaments. Protein and lipid sorting and organelle biogenesis, apoptosis.

UNIT-II: Nucleosomes and solenoid structure, structure of chromosomes, histones and chromatin. Variation in chromosome number and structure. Mechanism of DNA Replication. Mutation: Types, causes and detection.

UNIT-III: Linkage, crossing over & its cytological basis. Chromosome mapping- two factor crosses and three factor crosses. Molecular mechanism of crossing over, Recombination within gene or gene conversion. Complementation. Sex determination and sex linkage.

UNIT – IV: Gene Expression and Regulation of gene expression in prokaryotes. Induction and repression, positive and negative control. Operon concept, lac operon, Trp operon, Ara operon. Post transcriptional and post translational modifications. Protein as signal.

Lab Course

Course Outcomes (COs)

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

CO.1 – Describe the basic lab requirements and their uses.
CO.2 – Examine various cell organelles through micrograph techniques.
CO.3 – Analyse various nucleic acids through staining techniques.
CO.4 – Examine plolyploidy through onion root with various treatments.
CO.5 – Examine cancer cell by photomicrography.
CO.6 – Analyse various stages of mitosis.
CO.7 – Examine various stages of meiosis cell division.

Exercises:

1. Sub-cellular fractionation and marker enzymes
2. Identification of biomolecules in different tissues by histochemical techniques
3. Preparation of Karyotype of metaphase plate.
4. Preparation of Meiotic plate and determination of phases.
5. Isolation, purification and estimation of RNA
6. Isolation, purification and estimation of DNA
7. Determination of Tm of nucleic acid
8. Fraction of poly (A) RNA
9. Restriction Mapping
10. Restriction Digestion

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11. Ligation
12. DNA molecular size determination

Books Recommended:

Molecular Cell Biology H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, andJames Darnell.
Essential Cell Biology B. Alberts, D. Bray, K. Hopkin and A. Johnson
Molecular Biology of the Cell B. Alberts, A. Johnson, J. Lewis and M. Raff
Cell and Molecular Biology Gerald Karp : Concepts and experiments
Molecular Biology of the Gene JD Watson et al.
Molecular Biology of the Cell John Wilson, Tim Hunt
Molecular Biology of the Cell Bruce Albert's, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter
Genes VIII Benjamin Lewin

M. Sc. Biochemistry
FIRST SEMESTER (July 2023 – December 2023)
PAPER – II: Chemistry of Biomolecules [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the molecules of life.

Course Outcome:

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

CO1: H-bonding, acids and bases, reaction equilibrium, ionization behavior and its biological application. Maintenance of normal pH of the body fluids. Blood buffers
CO2: Illustrate the detailed structure and functions cellular components.
CO3: Understand the structure and biological importance of carbohydrate and lipids.
CO4: Understand the structure and synthesis of protein and nucleic acids.
CO5: Differentiate the role of cell suicide in maintaining the cellular balance.

UNIT – I: Physical Properties and structure of H_2O, H-Bonding, Ionization of water, pH scale, Handerson – Hasselbalch Equation, Buffers, Buffer solution and their action, Ionization behavior of amino acids and proteins. Colloidal Particles and their properties, Donnan membrane Equilibrium and its biological application.

UNIT – II: Carbohydrates – Structure of Monosaccharide, Isomerism of sugars, Reactions of aldehyde and ketone groups, Ring structure and anomeric forms, mutarotation, structure, occurrence and biological importance of monosaccharide, oligosaccharides and polysaccharides e.g., cellulose, chitin, agar, alginic acid, pectins, proteoglycans, sialic acids, glycogen and starch. Bacterial cell wall polysaccharides.

Lipids - Definition and classification. Fatty acid – classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acid, prostaglandins.Triacylglycerols- nomenclature, physical and chemical properties of fats- hydrolysis, saponification value, rancidity of fats, Reichert-Meissel number, reaction of glycerol. Glycerophospholipid, sphingomyelins, glycolipids. Properties and functions of phospholipids and sterols.

UNIT-III: Amino Acids and Proteins – Amino Acids – common structural features, classification and structures of standard amino acids, physical and chemical properties of amino acids. Essential Amino acids.Level of organization of protein – primary, secondary, tertiary structure of

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protein.Forces stabilizing the tertiary and quaternary structure of protein.Denaturation and renaturation of proteins. Salting in and salting out of proteins. Structure and biological function of fibrous protein, globular proteins (hemoglobin and myoglobin), lipoprotein, metalloprotein, glycoprotein and nucleoproteins.

UNIT – IV: Nucleic Acids Structure of constituents of nucleic acids, purines, pyrimidines, nucleosides and nucleotides. General structural plan of nucleic acids, features of DNA double helix. Denaturation and annealing of DNA, structure and roles of different types of RNA. Central dogma and molecular biology. Biological roles of nucleotides.

Lab Course

Course Objective: The module is designed to provide introduction to basics of reagent preparation and quantification of biomolecules.

Course Outcome:

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

CO1: Apply the knowledge to prepare buffer solution
CO2: Apply the knowledge to prepare normal and molar solution
CO3: Apply the techniques for identification of pKa value CO4: Determine the different properties of solutions
CO4: Determine the proteins content in different sample.

Experiments:

1. Specific tests for sugars, amino acids and lipids
2. Formal titration of amino acids
3. Estimation of proteins using ninhydrin and biuret method
4. Estimation of sugar by anthrone and Folin-Wu method.
5. Saponification value and iodine number of fat.
6. Estimation of ascorbic acid.
7. Achromic point determination using salivary amylase
8. Effect of ions on salivary amylase activity.
9. Enzyme assay and kinetics (ex. Amylase, Protease)

Books Recommended:

Nelson, Cox and Lehninger Principles of Biochemistry
G. Zubay Biochemistry
Stryer Biochemistry
Garrett and Grosham Biochemistry
West, Tood, Mason &Bbruglen Text book of biochemistry
White, Handler & Smith Biochemistry-clinical application
D. Voet and J C Voet Biochemistry

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M. Sc. Biochemistry
FIRST SEMESTER (July 2023 – DEC 2023)
PAPER – III: Microbial Biochemistry and Biostatistics
[Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction to the biochemistry of micro-organisms and give a general description of the basic recombinant DNA Techniques.

Course Outcome:

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

CO1: Explain the structure of bacteria and their microscopic examinations.
CO2: Analyze the types bacterial toxins and the toxicology.
CO3: Apply the use of microbes.
CO4: Explain Data, methods to test hypothesis.
CO5: Apply the scientific research etc.
CO6: Apply the knowledge of biostatistical analysis.

UNIT-I: General characteristics of fungi, classification of fungi, life cycle of selected fungal genus (Aspergillus, Pencillium, Fusarium and Mucor). Algae: Distribution, classification, reproduction, ecology and importance.
Morphology and ultra-structure of bacteria, morphological types, cell wall of archaebacteria, gram negative, gram positive eubacteria, eukaryotes. Cell membranes – structure, composition and properties.Structure and function of flagella, cilia, pili, gas vesicles.Cyanobacteria, protozoa, mycoplasma and Rickettsia.Gene transfer mechanisms, transformation, transduction, conjugation and transfection. Plasmids F: factors colicins and col factors, plasmids as a vector for gene cloning.

UNIT-II: Viruses: Structure and classification of viruses; morphology and ultra-structure; capsids and their arrangements, types of envelopes, viral genome, their types and structure, virus related agents (viroids, prions). General feature of virus reproductions, early events in virus multiplication, virus restriction and modification of host, virus mRNA. General overview of bacterial viruses, RNA and DNA bacteriophages (MS2, ϕX174, M13, T3, T4). Lysogeny and Lytic phase. General account of plant and animal viruses (TMV, HIV and other oncogenic virus, Hepatitis virus).

UNIT-III: Introduction to biostatistics. Types of biological data: data on different scales. Frequency distributions.Cumulative frequency distributions. Randomsampling.Parameters and statistics. Measures of central tendency and dispersion: Mean, Median, Mode, Range, Variance and Standard deviation. Coefficient of variation.Distribution: normal & binomial. Probability: Basic laws of probability, addition law, multiplication law. Probability and frequency.

UNIT-IV: Statistical errors in hypothesis testing. Testing goodness of fit: Chi-square goodness of fit. Heterogeneity Chi-square.The 2 x 2 contingency table. One sample hypothesis.Two-sample hypothesis.Testing for difference between two means (t-test).Testing for difference between two variances (F-test). The paired sample t-test. Multiple-sample hypothesis (ANOVA): Single factor and two factors ANOVA. Simple linear regression. Regression vs. Correlation.
Scientific Writing: Interpretation and Report Writing. Meaning of Interpretation, Techniques of interpretation, Precaution of interpretation. Significance of Report Writing. Step in Report Writing. Types of Report Writing.Component of a Research Report.

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Lab Course

Course Outcome:

On successful completion of this program the graduates shall have:

CO1: Demonstrate the techniques of pure culture of bacteria or fungi.
CO2: Interpret the motility of the microbes.
CO3: Interpret the biochemical activities of microbes by various tests
CO4: Understand about the impact of antibiotics on microbial survival
CO5: Apply the knowledge of sampling techniques.
CO6: Calculate the measures of central tendencies with the help of online software
CO7: Illustrate various data presentation styles for a good presentation
CO8: Test the significance of data

Experiments:

1. Glassware preparation and sterilization techniques- wet heat- dry heat-
filter types- laminar flow chamber types- CDC- safety levels.
2. Preparation of liquid & solid media, plating, pouring, inoculation and incubation for growth of microorganism
3. Methods of obtaining pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods
4. Microscopic examination of the microorganisms, identification and staining methods
5. Micrometery and camera lucida drawings
6. Study of bacterial growth by turbiditimetry/ spectrophotometry
7. Biomass measurement for fungi
8. Isolation and enumeration of microorganisms from soil by serial dilution agar plating method.
9. Enumeration of viruses by plaque assay technique.
10. Motility of bacteria by hanging drop technique.

Experiments:

1. Exercises for data distribution.
2. Exercises for computation of measures of central tendency.
3. Exercises for computation of measures of variability.
4. Computation of correlation coefficient, r, and regression constants.
5. Data analysis by ANOVA and multiple-range tests.
6. Hypothesis testing by t-test, F-test, and Chi-square test.
7. Review Writing.

Books Recommended:

Campbell RC Statistics for biologists
Zar JH Biostatistical Analysis
Wardlaw AC Practical Statistics for Experimental Biologists
Snedecor GW & Cochran WG Statistical Methods
Sokal RR &Rohlf FJ Introduction to Biostatistics

Books Recommended:

Microbiology L.M. Prescott, J.P. Harley and D.A. Klein
General Microbiology RY Stanier, J L Ingrahamana, ML Wheelis& P. R. Painter
Principles of Microbiology R.M. Atlas
Microbiology Peleczar, Chan & Krieg.
General Virology Luria, Darnell, Baltimore and Campell.
Introduction to Mycology CJ Alexopoulos and CW Mims

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M. Sc. Biochemistry
FIRST SEMESTER (JULY 2023 – DEC 2023)
PAPER- IV: Biophysical Chemistry and Biochemical Techniques
[Credit: 4 and Maximum Marks: 80]

Course Objectives: This module is a general introduction to different types of techniques. It includes the DNA isolation Technique, PCR, RFLP etc.

Course Outcome:
On successful completion of the course, the student shall be able to:
CO1: Apply the principle, methodology and applications of Spectroscopic techniques.
CO2: Apply the principle, methodology and applications of Centrifugation techniques.
CO3: Employ the principle, methodology and applications of Electrophoretic techniques.
CO4: Apply the principle, methodology and applications of Chromatography techniques.
CO5: Interpret the principle, methodology and applications of PCR techniques.
CO6: Outline the principle, methodology and applications of Radioisotope techniques.

UNIT-I Centrifugation: Principle, techniques. Preparative, analytical and ultracentrifuges, sedimentation coefficient and factors affecting sedimentation coefficient.Application of centrifugation.**Photometry:** Basic principles of colorimetry, UV- visible spectrophotometry & IR-spectrophotometry. Spectroflurometry Atomic absorption spectroscopy: Principle, Instrumentation and applications Electrophoresis: Paper electrophoresis, Starch gel, agarose, PAGE-type, 2D-E.

UNIT-II Microscopic techniques: light microscopy, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Microtomy: types, principle and applications *Lyophilization*: Principle, instrumentation and applications

UNIT-III Chromatography: Paper and Thin Layer Chromatography. Gel filtration, Ion exchange chromatography and Affinity chromatography. Gas-liquid chromatography and HPLC.

Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, *In situ* localization; FISH and GISH. Radioactivity: GM counter, liquid Scintillation counter, solid Scintillation counter, gamma counters

UNIT-IV Molecular techniques: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, separation methods; RNA, DNA and proteins; 1-D and 2-D, isoelectric focusing gels; Molecular cloning of DNA and RNA fragments in bacterial systems; Expression of recombinant DNA; DNA sequencing. Gene expression; mRNA, cDNA using PCR and qRT-PCR. Micro array based techniques. Molecular Markers for diversity analysis: RFLP, RAPD, AFLP, VNTR, SSR, ISSR, SNP, DArT.

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Lab Course

Course Objective: This module is a general introduction to different types of techniques involved in quantification of some biomolecules like glucose, vitamins, hemoglobin, chlorophyll and lipids.

Course Outcome:
On successful completion of the course, the student shall be able to:
CO1: Apply the estimation techniques for different blood components
CO2: Illustrate the technique of hemoglobin level determination
CO3: Analyze various enzymes related to organ disorders
CO4: Illustrate the techniques of paper chromatography
CO5: Analyze plant pigments by calorimetric method.

Exercise:

A. Verification of Beers Law
B. Determination of absorption maxima
C. Quantitative determination, Enzyme kinetics
D. Amino acid and carbohydrate separation by paper and TLC
E. Ion exchange and gel filtration chromatography
F. SDS Polyacralamide Gel Electrophoresis DNA electrophoresis
G. Isoenzymes
H. Separation of sub-cellular organelles by differential centrifugation.
I. Isolation of DNA and Agarose gel Electrophoresis
J. Isolation of RNA and Electrophoresis of RNA on denaturing gels.
K. Isolation of Protein and SDS-PAGE

Books Recommended:

K Wilson and John Walker Practical Biochemistry: Principles & Techniques
RF Boyer Biochemistry Laboratory: Modern Theory & Techniques
S Carson, H Miller and D Scott Molecular Biology Techniques: A Classroom Laboratory Manual
TC Ford and J. M. Graham An Introduction to Centrifugation
R Baserga and D Malamud Autoradiography: techniques and application
T Chard An Introduction to Radioimmunoassay and Related Techniques , Volume 6
MD Bruch NMR Spectroscopy Techniques

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M. Sc. Biochemistry

SECOND SEMESTER (JAN 2024– JUN 2024)

PAPER – I: Bioenergetics & Metabolism [Credit: 4 and Maximum Marks: 80]

Course Objective: This module is a general introduction to the metabolism of biomolecules (Carbohydrates, Lipids and the basic energetics).

Course Outcomes (COs)

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

CO.1 – Describe the fundamentals of thermodynamics in biochemical processes.

CO.2 – Acquire the knowledge of energy production in living systems by the degradation of fatty acids.

CO.3 – Explain the various pathways of fatty acid synthesis in living systems.

CO.4 – Describe the energy generated from the carbohydrate metabolism.

CO.5 – Explain the mechanism of the machinery system involved in carbohydrate metabolism.

UNIT-I: First and second laws of thermodynamics. Concept of free energy. High – energy compounds, ATP cycle, structural basis of free energy change during hydrolysis of ATP. Other high- energy biological compounds

UNIT-II: Basic concepts of intermediary metabolism. Carbohydrate metabolism: Glycolysis, Kreb's cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeogenesis, and glyoxylate pathway, inborn errors of carbohydrate metabolism. Regulation of carbohydrate metabolism

UNIT-III: Biosynthesis and degradation of Lipids. Regulation of lipid metabolism. Electron transport and oxidation phosphorylation: electron carriers, complexes I to IV, substrate level phosphorylation, mechanism of oxidative phosphorylation. Shuttle system for entry of electron.

UNIT-IV: Biosynthesis of amino acids Degradation of amino acids Regulation of amino acid metabolism Biosynthesis and degradation of purine and pyrimidine nucleotides.

Lab Course

Course Outcomes (COs)

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

CO.1 Explain biochemical parameter of biological sample.

CO.2- Explain fermentation process by microorganism.

CO.3- Explain enzyme assay of salivary enzyme.

CO.4- Apply the various techniques for isolation of lipids.

CO.5- Practice the biochemical parameters in biological system.

CO.6- Practice the estimation of plasma sugar.

CO.7- Demonstrate the cholesterol level from known sources.

Experiments:

1. Protein estimation by Lowry, Bradford and Spectrophotometric method
2. Estimation blood cholesterol
3. Estimation of sugar by Nelson- Somagy and Benedict's reagent
4. Isolation and estimation of lipid from seeds and egg.
5. Estimation of inorganic and total phosphorus by Fiske-SubbaRao method
6. Assay of phosphatases in blood and seeds
7. Urease estimation in plant tissues

Books Recommended:

Principles of Biochemistry Nelson, Cox and Lehninger

Biochemistry G. Zubay

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Biochemistry G. Zubay
Biochemistry Stryer
Biochemistry Garrett and Grosham
Text book of biochemistry West, Tood, Mason &Bbruglen
Biochemistry White,Handler& Smith
Biochemistry with clinical application D. Voet and J C Voet
Enzymes Dixon and Webb
Fundamentals of Enzymology Price and Steven
Practical biochemistry Plummer
Enzyme biotechnology G. Tripathi
Enzyme Reaction Mechanism Walsh
Enzyme catalysis and regulation Hammes

M. Sc. Biochemistry
SECOND SEMESTER (JAN 2024 – JUN 2024)
PAPER- II: Plant Physiology and Biochemistry [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the basics of plant biochemistry and latest development in plant biotechnology.
Course Outcome:
On successful completion of the course, the student shall be able to:
CO1: Differentiate between photosynthesis and respiration in a plant cell.
CO2: Acquire the knowledge about nitrogen fixation and plant hormones.
CO3: Understand the plant stress management.

UNIT- I Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Nitrogen metabolism: assimilation of nitrate,structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Biological nitrogen fixation by free living and in symbiotic association; structure and function of the enzyme nitrogenase.

UNIT-II Photosynthesis – Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, their location; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, path of carbon in photosynthesis – C3 and C4 pathway of carbon reduction and its regulation, Photorespiration.

UNIT-III Phytohormones: Structure, biosynthesis, molecular mechanisms of Auxin, Gibberellins, Cytokinin, Abscisic acid and Ethylene, Brassinosteroids.
Senescence and Programmed cell death: Senescence; Metabolism and regulation of pigment and nucleic acid, PGR regulation, SAG. PCD; Formation of TE and mobilization of cereal endosperm.

Unit- IV Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Antioxidative defense system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.

Lab Course

Course Objective: The module is designed to provide an experimental background on analysis of plant metabolites and learn the basic plant tissue culture techniques.

Course Outcome:

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

CO1: Estimate the chlorophyll contents in various leaf sources.

CO2: Analyze the various metabolites present in plant.

Exercise:

1. Spectrophotometric determination of chlorophyll-a, chlorophyll-b and total chlorophyll in young, mature and senescent leaves.
2. Kinetin estimation by cucumber cotyledons expansion bioassay.
3. Auxin bioassay using wheat coleoptiles.
4. GA bioassay by inducing *de-novo* synthesis of Amylase in de-embryonated seeds of wheat.
5. Estimation of mono, di and total phenols in the young and aged leaves.
6. Estimation of Guaiacol peroxidase activity in fresh and aged seeds.
7. Determination of Superoxide dismutase levels in the healthy and deteriorated seeds.
8. Estimation of metal toxicity induced changes in the AOS levels in leaf tissues.
9. Determination of Nitrate reductase activity in leaf tissues.
10. Separation of isozymes of SOD and GPX.

Books Recommended:

Fosket DF Plant Growth & Development
Foyer CH Photosynthesis
Bacon KE Photosynthesis: Photobiochem. &Photobiophysics
Leopold AC &Kriedemann PE Plant Growth & Development
Moore TC Biochemistry & Physiology of Hormones
L Taiz& E Zeiger Plant Physiology
BB Buchanan, W Gruissem& Biochemistry and Molecular Biology of Plants
RL Jones MB Wilkins Advanced Plant Physiology
JA Hopkins Introduction to Plant Physiology
FB Salisburry& CW Ross Plant Physiology
Hans-Walter Heldt Plant Biochemistry & Molecular Biology

M. Sc. Biochemistry

SECOND SEMESTER (JAN 2024 – JUN 2024)

PAPER – III: Biology of Immune System [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the principles of body's defense mechanism.

Course Outcome:

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

CO1: Differentiate between innate and adaptive immunity and also between humoral and cell mediated immunity.

CO2: Explain the primary and secondary responses and their relevance to immunizations.

CO3: Identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.

CO4: Apply immunochemical techniques used in pathological laboratories.

CO5: Discriminate the nature of antigens and antibodies.

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UNIT-I Innate immune mechanism and characteristics of adaptive immune response. Cells of immune system: Hematopoisis and differentiation, mononuclear cells and granulocytes. Antigen presenting cells. Primary and Secondary lymphoid organs and tissues.Ontogeny and phylogeny of lymphocytes.Lymphocyte traffic.

UNIT-II Antigens: nature of antigens, factor affecting immunogenicity, Haptens and super antigens. Antigenic determinants.Recognition of antigens by T and B cell. Antigen processing.Role of MHC molecules in antigen presentation and co-stimulatory signals .Antigen and antibody interaction.

Antigen receptor molecules: B-cell receptor complex, Immunoglobulin- structure, types and function. T-cell receptor complex.Clonal selection theory- concept of antigen specific receptor. Organization and expression of immunoglobulin genes.Generation of antibody diversity.Light and heavy chain gene recombination. Recombination Signal Sequences. Heavy chain constant region genes.Class switching.T-cell receptor diversity.

UNIT-III Cell mediated and Humoral immune response and its regulation. Cytokines and interleukins- structure and function. Hypersensitive reactions and their types.Immunodeficiency disorders.Autoimmunity. Major Histocompatibility Complex- types, structural organization, function and distribution. Transplantation and Rejection.Complements in immune function.

Unit IV Immune response to infectious diseases: viral, bacterial and protozoal. Cancer and immune system. Nutrition and Immune response. Principles of vaccination. Immunization practices. Passive immunization (immunotherapy). Role of vaccine in prevention of diseases: vaccines against important viral, bacterial, protozoan and parasitic diseases. DNA vaccines; Antiviral, antibacterial agents.

Lab Course

Course Objective: The module is designed to provide introduction & detailed information on some basic immunodiagnostic techniques and quantification of blood proteins.

Course Outcome:

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

CO1: Apply the techniques to test various clinical conditions.
CO2: Perform immunological techniques
CO3: Analyze the different blood cell counting.
CO4: Perform qualitative and quantitative test for proteins

Experiments:

1. Identification of cells of immune system
2. Separation of mononuclear cells by Ficoll-Hypaque
3. Identification of Lymphocytes and their subsets
4. Lymphoid organs and their microscopic organization
5. Isolation and purification of Antigens
6. Purification of IgG from serum
7. Estimation of Levels of gamma globulins and A/G ratio in blood
8. Antigen antibody interaction

Books Recommended:

Kuby's Immunology R.A. Goldsby, T. J Kindt and B. A. Osborne
Immunology Roitt, Brostoff and Male
Fundamentals of Immunology William Paul
Immunology Tizard
Immunology Abbas et al

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M. Sc. Biochemistry
SECOND SEMESTER (January 2024– June 2024)
PAPER- IV: Human Physiology

Course level learning outcomes:
Students will gain insights into the mechanism of signal transduction by steroid and polypeptidehormones and the role of second messengers in signal transduction. The process of gaseousexchange in tissues and lungs, respiratory adaption to high altitude and the difference betweenhemoglobin and myoglobin will be explained. Students will gain awareness on musculardystrophies, the role of steroids in muscle building and the use of hormones in cattle and poultryindustry. Role of kidneyin erythropoiesis will be explained.

Course Content:
Unit-I: Neurotransmission: Types of neurons, generalized structure of multipolar neuron. Resting membrane potential, Action potential, Transmission of nerve impulse along an axon and across a synapse. Neurotransmitters and inhibitors of neurotransmission.
Muscle:Types of muscles and their structure. Ultra structure of skeletal muscle.Contractile andregulatory proteins of muscle.Sliding filament model of skeletal muscle contraction.
Bone: Composition and structure of long bone, growth and remodelling of long bone. Factors affecting its growth.

Unit-II: Excretory system: Structure of the nephron, formation of urine – Glomerular filtration, tubularreabsorption and secretions.
Body fluids: Blood volume, composition and functions, RBC, WBC and platelets, theirstructure and functions. Mechanism of blood coagulation.Biochemical events in transport ofCO_2 and O_2 in blood.Cerebrospinal fluid, lymph and its function. Blood brain barrier.

Unit-III: Heart and lungs –Structure and function of cardiac tissue and lungs Acid-base balance: Maintenance of normal pH of the body fluids. Blood buffers. Role of lungs
and kidney in acid base balance. GIT and Liver: Structure and function of gastrointestinal tract, Structure of a lobule, functions– metabolic, storage and detoxification.

Unit-IV: Endocrine system: Endocrine organs, classification of hormones. Dynamic balance and regulation of hormone secretions. Functions of the hormones of hypothalamus, pituitary, adrenal, thyroid, pancreas and gonads. General mechanism of hormone action. Concept of messengers eg: cAMP, DAG, IP3.

Lab Course

Course level learning outcomes:
The learning outcomes include: Qualitative and quantitative analysis of biological moleculesand their estimation using multiple methods

1. Practical content
2. Preparation of blood smear and differential leucocyte count.
3. RBC and WBC counting, Calculation of blood Indices.
4. Estimation of hemoglobin
5. Colorimetric estimation of Protein by Lowry's method.
6. Estimation of Uric acid.
7. Urea by DAMO method.
8. Creatinine by Jaffe's method.
9. Phosphorous by Fiske and Subbarow's method.
10. Iron by Wong's method.
11. Qualitative analysis of urine - detection of urea, uric acid and creatinine.

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Suggested Readings:

1. Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2. Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice HallInternational Inc.
5. Textbook of medical physiology: A. C. Gyton, and J. E HallSaunders Elsevier
6. Publications, A division of Reed Elsevier India Pvt .Ltd.New Delhi ISBN 81-8147-084-2
7. Human physiology: Chatterjee, Medical Allied Agency.

M. Sc. Biochemistry
THIRD SEMESTER (JULY 2024 – DEC 2024)
PAPER - I: Clinical Biochemistry [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the basics of pathological conditions arising in body and the basic concepts of hormones and their functions.

Course Outcome:

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

Students will learn about the normal constituents of urine, blood and their significance inmaintaining good health. The mechanisms of causation of diseases of liver, kidney and of Cancerwill be explained. Students will become aware with the variations in the levels of trigycerides andlipoproteins and their relationship with various diseases. Students will get acquainted with the role
of enzymes in diagnosis of various diseases..

UNIT-I: Urine: Normal composition of urine – volume, pH, colour, specific gravity. Constituents-urea,uric acid, creatinine, pigment. Abnormal constituents – glucose, albumin, ketone bodies,variations in urea, creatinine, pigments and their clinical significance in brief.
Abnormalities in Nitrogen Metabolism – Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance.

Unit-II: Blood: Normal constituents of blood and their variation in pathological conditions - urea, uricacid, creatinine, glucose, bilirubin, total protein, albumin/globulin ratio. Lipid profile – cholesterol, triglycerides, lipoproteins - HDL and LDL.
Blood Clotting – Disturbances in blood clotting mechanisms – haemorrhagic disorders – haemophilia, von Willebrand's disease, purpura, Rendu-Osler-Werber disease, thromboticthrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombincomplex disorders, circulating anticoagulants.

Unit- III: Diagnostic Enzymes – Enzymes in health and diseases. Biochemical diagnosis of diseases byenzyme assays – SGOT, SGPT, alkaline phosphatase, CPK, cholinesterase, LDHDisorders of liver and kidney – Jaundice, fatty liver, normal and abnormal functions of liverand kidney. Inulin and urea clearance.
Electrolytes and acid-base balance – Regulation of electrolyte content of body fluids and maintenance of pH, reabsorption of electrolytes.

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Unit-IV: Biochemistry of Cancer, Cellular differentiation in cancer, carcinogens and cancer therapy

Inborn errors of metabolism: Sickle cell anaemia, phenyl ketonuria, Neimann – Pick diseaseand Gaucher's disease.

Lab Course

Course Objective: The module is designed to provide introduction & detailed information on some basic diagnostic techniques.

Course Outcomes (COs)

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

CO1: Analyze the protein content in normal and diseased samples

CO2: Analyze the sugar content in normal and diseased samples

CO3: Analyze the various metabolites present in human.

CO. 4- Demonstrate glucose tolerance test.

CO. 5- Illustrate various important ions of different samples.

CO. 6- Illustrate thyroid hormones in blood sample.

1. Assay of Alkaline and Acid Phosphates
2. Estimation of blood glucose by GOD and POD method
3. Various types of glucose tolerance tests.
4. Estimation of SGOT, SGPT, LDH and CPK, Serum Amylase enzymes
5. Estimation of HDL- cholesterol, LDL- cholesterol.
6. Estimation of uric acid and creatinine in plasma.
7. Estimation of urine and blood billurubin.
8. Histological / Histochemical / Cytological study of Endocrine gland
9. Qualitative and quantitative analysis of urine : proteins, Bence-Jones proteins, Cl- , Ca+2

10Qualitative analysis of abnormal constituents in urine - glucose, albumin, bilepigments,bile salts and ketone bodies.

11. Experiments on blood

(a) Estimation of haemoglobin by cyanmethemoglobin method

(b) Determination of A/G ratio in serum

12. Gel Electrophoresis of serum proteins

Suggested Readings:

1. Harper's Biochemistry: R.K.Murray, D.K.Granner, P.A. Mayes and V.W.Rodwell.
2. Clinical Laboratory Science Review: Robert R. Harr
3. Fundamentals of Clinical Chemistry: C.A. Burtis, E.R. AshwoodTietzvb
4. Notes on Clinical Chemistry- Principles of Internal Medicines: Whitby, Smith, Beckett, Walker, Harrison
5. Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
6. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
7. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice HallInternational Inc.
8. Textbook of medical physiology: A. C. Gyton, and J. E HallSaunders ElsevierPublications, A division of Reed Elsevier India Pvt .Ltd.New Delhi ISBN 81-8147-084-2
9. T.M. Delvin (editor), Text book of biochemistry with clinical correlation, (1982), JohnWiley & Sons Inc. USA.

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M. Sc. Biochemistry
THIRD SEMESTER (JULY 2024 – DEC 2024)
PAPER – II: Secondary Metabolites [Credit: 4 and Maximum Marks: 80]

Course Outcome:

Students will develop understanding about

- Food crops Medicinal: Plant secondary metabolites.
- Knowledge of extraction, isolation, characterization and elicitation of bioactive metabolites.
- Nutraceuticals and functional foods.
- Plant-based biofuels.

Unit-I: Introduction to secondary metabolites: Definition and systematic of secondary metabolites. Major classes of secondary metabolites i.e. alkaloids, terpenoids/ or isoprenoids, flavonoids and phenolics. Significance of secondary metabolites in plant's life. Roles in chemical defense system, taxonomical and ecological functions. Pharmacological and biological properties of secondary metabolites. Industrial and commercial significance of secondary metabolites

Unit-II: Biosynthesis and regulation of secondary metabolites: Biosynthesis of alkaloids derived from Shikimic acid pathway. Biosynthesis of isoprenoids via 3C-methyl-D-erythritol-4-phosphate (MEP) pathway. Biochemical pathways of flavonoids and polyphenol (lignin) biosynthesis. Integration of secondary metabolism with primary metabolic pathways. Regulation: Genetic, developmental, seasonal and geographical factors, roles of precursor feeding, metabolic channeling and compartmentalization. Cross-talk/exchange of intermediates between biochemical pathways. Use of specific enzyme inhibitors in regulation

Unit-III: Production of secondary metabolites: Methods of production of secondary metabolites: Tissue, organ and hairy root cultures. Roles of Endophytes in production of secondary metabolites. Production of secondary metabolites in bioreactors. Effects of precursors, co-factors and elicitors on production. Production of Taxol, Camptothecin, Berberine and rubber.

Unit-IV: Metabolic Engineering of secondary metabolic pathways: Cloning and characterization of enzymes of the Shikimate and MEP pathways. Functional genomics approaches for improvement of secondary metabolite production. Metabolic engineering of *Escherichia coli* and yeast for the production of flavonoids, terpenoids and alkaloids.

Lab Course:

1. Isolation of essential oil and determination of the oil yield.
2. Qualitative test for determination of terpenoids, alkaloids, flavonoids and saponins.
3. Quantitative test for determination of terpenoids, alkaloids, saponins and phenolics.
4. Determination of antimicrobial activity of the plant extracts.
5. Demonstration of hairy root culture for production of secondary metabolites
6. RNA extraction and gene expression of key enzymes of Biosynthesis of alkaloid; *Strictosidine Synthsae [STR1], Strictosidine glucosidase (SG), Acetylajmalan Esterase (AAE) etc.*

Recommended Books:

David S. Seigler	Plant Secondary Metabolism,
Alan Crozier	Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet
Y. M. Shukla	Plant Secondary Metabolites

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R. Verpoorte, A. W. Alfermann Metabolic Engineering of Plant Secondary Metabolism.
Herbert, R.B. The Biosynthesis of Secondary Metabolites
Fett-Neto, Arthur Germano (Ed.) Biotechnology of Plant Secondary Metabolism Methods and Protocols
Keller, Nancy P., Turner, Fungal Secondary Metabolism
Bell, E.A., Charlwood, B.V. (Eds.) Secondary Plant Products
Petroski, Richard J., McCormick, Susan P. (Eds.) Secondary-Metabolite Biosynthesis and Metabolism
Makkar, Harinder P.S., Sidhuraju, P., Becker, Klaus Plant Secondary Metabolites

M. Sc. Biochemistry
THIRD SEMESTER (July 2024 – December 2024)
PAPER- III: Nutritional and Environmental Biochemistry
[Credit: 4 and Maximum Marks: 80]

Course Objectives: 1. The module is designed to provide information on organic and inorganic content of food stuffs, food preservation techniques and some knowledge on various nutritional disorders.
2. This module will be helpful to develop understanding of Human-environment interactions and consequences of disturbance of the environment.

Course Outcome:
On successful completion of the course, the student shall be able to:
CO1: Explain the basic components of food stuff and balance diet.
CO2: Summarize the dietary component and body electrolytes.
CO3: Recognize the food vitamins and minerals with nutritional disorder.
CO4: Distinguish the effect of toxic substances on environment.
CO5: Interpret the effect of toxic chemicals on body parts and their cure.

UNIT-I Composition of balanced vegetarian and non-vegetarian diets; recommended dietary allowance (RDA) for different categories of the human beings.Food preservation standards, food adulterations and precautions, government regulations on preservation and quality of food.Food processing and loss of nutrients during processing and cooking.
Basal metabolism and methods of measuring basal metabolic rate (BMR); energy requirements during growth, pregnancy, lactation and various physical activities.

UNIT- II Nutritional aspects of the carbohydrates, lipids and protein: nutritive value, requirements, and functions.
Nutritional aspects of the vitamins and minerals: requirement and functions Malnutrition, its implications, relationship with dietary habits and prevention. Disorders related to the nutrition: Protein energy malnutrition, Starvation, Obesity.

UNIT- III
Environmental Pollution: Types, Outdoor and indoor Air pollution, sources, structure and control strategies. Water and Soil Pollution.Eco–toxicology and its environmental significance.Xenobiotic metabolism, Phase I reaction – oxidation – reduction, hydrolysis and hydration. Phase II reaction – conjugation and methylation.

UNIT- IV
Pesticide toxicity – insecticides, fungicides, herbicides and biopesticides.Toxicology of food additives.Metal toxicity – arsenic, mercury, lead and cadmium. Toxicity testing – Test control, genetic toxicity testing. Occupational toxicology: Occupational hazards and their assessment.

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Lab Course

Course Objectives: The module is designed to provide detailed techniques about estimation of vitamins and minerals in food products and also to analyze the microbial content of domestic and industrial effluents.

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

CO1: Analyze the contents of mineral and vitamin in food samples.
CO2: Analyze the chemical and microbial contents in various effluents.
CO3: Demonstrate TLC for different food components.
CO4: Analyze the adulterants present in food samples.

Exercises:

1. Separation and purification of sub-cellular organelles and assay of marker enzymes.
2. Protein fractionation - salt, solvent and isoelectric precipitation.
3. Identification and assay of certain toxicants.
4. Effect of various toxicants on serum enzymes and proteins
5. Effect of various toxicants on liver and kidney metabolism
6. Estimation of carbohydrate, protein and fat in food materials.
7. Titrimetric method of ascorbic acid estimation in fruit.
8. Separation of casein protein from milk

Books Recommended:

LG Corkerhem and BSS Shane Basic Environmental Toxicology
T Shibamato& L F Bzeidanes Introduction to Food Technology
M. Stipanuk Biochemical, Phys. & Mol. Aspects of Human Nutrition
Tom Brody Nutritional Biochemistry
DA Bender Nutritional Biochemistry of the Vitamins
R.L. Pike and M.L. Brown Nutrition: An integrated approach -
G.P. Talwar Text book of Biochemistry and Human Biology
DWS Wong Mechanism and theory in food chemistry
M.S. Banji N P. Rao& V. Reddy Text book of Human Nutrition
Linten Nutritional Biochemistry and Metabolism

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THIRD SEMESTER (July 2024 – December 2024)

PAPER - IV: Enzymology [Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction & detailed information on structure, biosynthesis and engineering of proteins.

Course Outcome:

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

CO1: Explain the enzyme classification.
CO2: Interpret the mechanisms of enzyme actions.
CO3: Acquire knowledge of allosteric enzymes and their kinetics.
CO4: Analyze the thermodynamics of enzyme substrate reactions.
CO5: Outline the knowledge of enzyme action, isolation and purification techniques.

UNIT-I Isolation and purification of enzymes. General properties and effects of pH, substrate and temperature on enzyme catalyzed reactions. Kinetics of catalyzed reaction: Single substrate reactions, bisubstrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, Concept of convergent and divergent evolution of enzyme. Methods of examining enzyme – substrate complexes

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UNIT-II Enzyme Turnover and methods employed to measure turnover of enzymes, significance of enzyme turnover.
Protein – ligand binding, including measurement, analysis of binding isotherms, cooperativity phenomenon, Hill and Scatchard plots. Multi enzyme system: occurrence , isolation & their properties , mechanism of action & regulation; Pyruvate dehydrogenase complex, fatty acid synthetase complexes. Mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymease

UNIT-III General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, symmetrical and sequential modes for action of allosteric enzymes and their significance.Water soluble enzymes and their coenzymes. Metalloenzymes. Immobilized enzymes and their industrial applications. Enzyme modeling; WHATIF, Verify3d, PROSA and DOPE score

UNIT-IV Enzymes of Industrial Importance; their source, characteristic properties, functions and uses. Enzymes used in leather, paper, and textile industries. Enzymes in baking, brewing, Alcohol products; enzymes in detergents, starch and animal feeds. Amylases, cellulases, catalase, pectinase, lipase, protease, xylanase, laccase, beta glucanase.

Lab Course

Course Objective: This module is a general introduction to different analytical techniques involved in assessment of some specific enzymes of our body.

Course Outcome:

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

CO1: Illustrate the kinetics of a specific enzyme involved in a metabolic activity of human body
CO2: Identify the optimum pH and temperature of an enzyme
CO3: Interpret the enzyme inhibition by various factors
CO4: Illustrate the enzymatic activity

Exercise:

1. Estimation of enzymes
2. Separation, purification of sub-cellular organelles & assay of marker enzymes.
3. Methods of purification of an enzyme - ion-exchange, gel filtration
4. Test of homogeneity by SDS-PAG E
5. Kinetics of an enzymatic reaction
6. Effect of various toxicants on serum enzymes and proteins
7. Enzyme modeling: Validation Criteria by WHATIF, Verify3d, PROSA and DOPE score
8. Verification of Ramachandran Plot: Estimation of interaction energy per residue by PROSA and Verify3D.
9. Enzyme packing quality: Assessed by WHATIF.

Books Recommended:

Brandon and Tooze Introduction to Protein Structure
Campell Discovering Genomics, Proteomics and Bioinformatics,
Dan Gusfield Algorithms on Strings Trees and Sequences
Lesk, A.M Introduction to Protein Architecture
Mcpherson, A. Introduction of Molecular Crystallography
Pennington Proteomics from Protein Sequence to Function
Durbin, Eddy, Anders & Graeme Biological Seq. Analysis: Probabilistic Models of Proteins & Nucleic Acids
S.A. Bbernhard The structure and function of enzymes
J. Palmer Enzymes: biochemistry, Biotechnology, Clinical chemistry

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M. Sc. Biochemistry
FOURTH SEMESTER (JANUARY 2025 – JUNE 2025)
PAPER – I: Genetic Engineering [Credit: 4 and Maximum Marks: 80]

Course Objective: This module is a general introduction of both the principles and application of molecular and genetic engineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behavior of the whole body.

Course Outcomes (COs)

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

CO.1 – Compute the basic steps of genetic engineering according to the species.
CO.2 – Modify the DNA recombinant molecules according to the target cell.
CO.3 – Apply the knowledge of DNA sequencing while genetic engineering.
CO.4 – Convert the genetic information into cDNA library and genomic library that would be beneficial for the preparation of transgenic organisms.
CO.5 – Choose the appropriate gene delivery system for the target cell.

UNIT- I Milestones of genetic engineering: isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation of clones, cloning and patenting of life forms, genetic engineering guide lines. Molecular tools and their applications: restriction enzymes, modification enzymes. Molecular techniques: gel electrophoresis, polymerase chain reaction, DNA sequencing, DNA microarray.

UNIT-II Gene cloning vectors: plasmids and transformation, bacteriophages and in vitro packaging, cosmids, artificial chromosomes. Genomic library: strategies of genomic DNA library construction, transformation, construction of eukaryotic genomic library, screening methods. cDNA library: isolation and purification of mRNA, first strand synthesis, second strand synthesis, cDNA library construction. Study of gene regulation: reporter assays Expression strategies for heterologous genes: vector engineering and codon optimization, host engineering, in vitro transcription and translation.

UNIT-III Processing of recombinant proteins: recombinant proteins purification, refolding, characterization and stabilization Site directed mutagenesis, protein engineering Gene knockout technique

UNIT-IV Plant transformation technology: basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes. Vector-less or direct DNA transfer: particle bombardment, electroporation, microinjection. Application of plant transformation for productivity and performance, herbicide resistance, insect resistance, virus resistance, long shelf-life of fruits

Lab Course

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:
CO. 1- Demonstrate isolation of nucleic acid from microorganisms.
CO. 2- Demonstrate digestion reaction in nucleic acids of various samples.
CO. 3- Illustrate PCR methods.
CO. 4- Sketch Complementation by various techniques.
CO. 5- Illustrate hyper expression of poly histidine-tagged recombinant protein and purification.

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Exercises:

1. Bacterial culture and antibiotic selection media. Preparation of competent cells
2. Isolation of plasmid DNA.
3. Isolation of Lambda phage DNA.
4. Quantitation of nucleic acids.
5. Agarose gel electrophoresis and restriction mapping of DNA.
6. Construction of restriction map of plasmid DNA.
7. Cloning in plasmid/phagemid vectors.
8. Isolation of RNA.
9. Synthesis of cDNA.
10. RAPD analysis by PCR.

Books Recommended:

1. Genes VIII Benjamin Lewin
2. An Introduction to Genetic Engineering DST Nicholl
3. Principles of Gene Manipulation and Genomics SB Primrose and Richard
4. Gene Cloning and Manipulation CJ Howe
5. Genetic Engineering (Genetics and Evolution) R Hodge
6. Introduction to Biotechnology & AJ Nair
7. Genetic Engineering
8. Genetic Engineering A Kumar & N Garg
9. Biotechnology & Genetic Engineering L Yount
10. DNA Microarrays & Gene Expression: from P Baldi& G Wesley

M. Sc. Biochemistry
FOURTH SEMESTER (January 2025 – June 2025)
PAPER- II: Nutraceutical Biochemistry and Functional Foods
[Credit: 4 and Maximum Marks: 80]

Course Objectives:

i) Provide basic knowledge on nutraceuticals/bioactive compounds (e.g. carotenoids, glucosinolates, and polyphenols);
ii) Familiarize students with the scientific evidence about the role of diet and dietary components in the modulation of risk factors associated with chronic diseases (e.g cardiovascular diseases) and human health;
iii) Enable students to understand the concept of functional foods and their role in the human health and well-being.

Course outcomes:

On successful completion of the course, the student shall be able to:
CO1: Basic knowledge on the nutraceuticals in the context of the human well-being.
CO2: Equipped with knowledge necessary to understand the diet-health relationships and the importance of human evidence-based nutrition.
CO3: Learn the regulatory aspects of functional foods and the requirements for safety and efficacy assessment of nutraceutical and functional food.
CO4: Perspectives about the application of biotechnology for improving the formulation of potential functional ingredients/foods will be mastered.

Unit-I: Introduction to Nutraceuticals as Science:

Historical perspective, classification, scope and future prospects. Scrutinising the term 'nutraceutical', Regulation of various countries. Medicinal Plants: Ethnomedicine in India, Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science

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with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition

Unit-II: Properties, structure and functions of various Nutraceuticals:
Glucosamine, Octacosanol, Lycopene, Falvanoids, Carnitine, Melatonin and Ornithine alpha, ketoglutarate.Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals. Nutraceutical Industry and Market Information, New technologies in development of Nutraceuticals and functional foods Functional Foods, Scope of Genetic engineering, Nutritional Genomics

Unit-III: Food as remedies
Nutraceuticals bridging the gap between food and drug, Special Dietary Needs, Disease and Nutrition; Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc.

Unit-IV: Anti-nutritional Factors present in Foods
Types of inhibitors present in various foods and how they can be inactivated. General idea about role of Probiotics and Prebiotics as nutraceuticals. Recent advances in techniques & feeding of substrates. Assessment of nutritional status and Recommended Daily allowances.

Lab Course

Course outcomes:
On successful completion of the course, the student shall be able to:
CO1: Student will be skilled with basic Research on bioactive compounds.
Experiments:
Identification using characteristic features of nutracuetically important plants like;
Phyllanthusemblica, Curcuma longa, Zinziberofficinalis, Solanaceae (*Withaniasomnifera)*, *Aloe vera*, Lilliaceae (*Aliumsativum*), Lamiaceae (*Ocimum sanctum*), Apiaceae (*Coriandrumsps*) and Liliaceae (*Asparagus sps.*), *Centellaasiatica.*
Study of following Parasites/ Vectors/ pests: Identification, Habits and control measures (museum Specimens / slides): *Entamoebahistolytica, Taeniasps, Ascarislumbricoides, Ancylostomadueodenaei, Trichinellaspiralis, Trichuratrichuris,* Mosquito (*Culex and Anopheles*), House fly, Green bottle fly, Head Louse, Cockroach (*Periplanata&Blatta*), bed bug, *Mus*sps. (Mouse) and *Rattus*sps. (House rat)
Reactions of mono, di and polysaccharides and their identification in unknown mixtures
Determination of Acid value, Saponification and Iodine number of natural fats & oils.
Estimation of proteins with Bradford's and other methods.
Extraction and estimation of total sugars from food products (dairy product, fruit juices, bread).
TLC separation of Plant pigments – Curcumin and carotene.
To isolate DNA and RNA from given plant/ animal material and estimate DNA by Diphenylamine (DPA) method and RNA by Orcinol reagent
Extraction, purification and evaluation of activity of any one digestive enzyme (e.g. Beta amylase from sweet potato)
Estimation of ascorbic acid from lemon &amla juice by titration method
Estimation of total Nitrogen of foods by Kjeldahl and Micro Kjeldahl methods.
Chromatography: Paper, TLC, adsorption, ion exchange, gel filtration, affinity, GC & HPLC.
Separation of Milk proteins on Native and SDS gels.

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Books Recommended:

1. Stryer E.A., Biochemistry
2. Zubay, Geoffrey L. Biochemistry,
3. Greenberg David M. Metabolic Pathways, Vol 3 Todd and others, Clinical Diagnosis and Management, 17th Ed,
4. Gopalan C., et al Dietary Allowances for Indians, NIH, Hyderabad.
5. Anita F.P. Clinical Dietetics and Nutrition, 4th Ed, 1997,
6. Devlin, T.M. Text Book of Biochemistry with Clinical Correlation,
7. Mahan, L.K. &Ecott- Stump, S. [Ed.] Krause's Food, Nutrition and Diet Therapy
8. Lehninger Nutrition Concepts & Controversies,
9. W. Jeffrey, Hursts Methods of Analysis for Functional Foods and Nutraceuticals

M. Sc. Biochemistry
FOURTH SEMESTER (January 2025 – June 2025)
SPECIAL PAPER – III (A): Plant Biotechnology
[Credit: 4 and Maximum Marks: 80]

Course Objective: This module will help to understand production of plats in the lab, production of high quality seeds, plants and plant products, engineering with plant genome.

Course Outcomes (COs)

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

CO.1 – Requirement and essentials of a plant tissue culture laboratory.
CO.2 –Skilled with plant tissue culture laboratory.
CO.3 – Socially aware with hybrid and indigenous verity and quality of plant based foods.
CO.4 – understand research area and research possibility towards plant science.
CO.5 – Apply plant tissue culture and its importance in various fields for development of new crops.

UNIT- I Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids. Tissue culture media (composition and preparation). Initiation and maintenance of callus and suspension culture; single cell clones. Organogenesis; somatic embryogenesis; transfer & establishment of plants in soil. Shoot tip culture: Rapid clonal propagation and production of virus free plant.

UNIT-II Embryo culture and embryo rescue. Anther, pollen and ovary culture for production of haploid plants & homozygous lines. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Germplasm conservation: Cryopreservation & slow growth cultures. Chloroplast Transformation: Advantages, vectors, success; tobacco & potato.

UNIT-III Plant transformation technology: Basis of tumor formation, Mechanism of DNA transfer, Features of Ti and Ri plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, use of scaffold attachment regions, multiple gene transfers, particle bombardment, electroporation, microinjection. Applications of plant transformation for productivity and performance: herbicide resistance, insect resistance, Bt genes, Non–Bt like protease inhibitors & amylase inhibitors, virus resistance, nucleocapsid gene, disease resistance, PR (Pathogenesis Related) proteins, nematode resistance, abiotic stress, male sterile lines.

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UNIT-IV Metabolic Engineering and Industrial Products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, biodegradable plastics, therapeutic proteins, antibodies, edible vaccines. Molecular Markers– RFLP maps, linkage analysis, RAPD markers, STS (Sequence Tagged Strands), microsatellites, SCAR (Sequence characterized amplified regions), SSCP (Single strand conformational polymorphism), AFLP, map based cloning, molecular marker assisted selection.

Lab Course

Course Objective: This module will help to understand production of plats in the lab, production of high quality seeds, plants and plant products, engineering with plant genome.

Course Outcomes (COs)

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

CO.1 – Skilled with plant tissue culture laboratory.

Experiments:

1. Preparation of culture media.
2. To perform meristem/ bud culture, shoot multiplication & rooting phenomenon.
3. To study organogenesis.
4. To perform somatic embryogenesis.
5. To study the process of plantlet acclimatization.
6. To perform embryo culture.
7. To study the process of another culture development.
8. Study of molecular markers.
9. Extraction of DNA from plant cultures.
10. Estimation & separation of DNA: Agarose gel electrophoresis & spectrophotometer.

Books Recommended:

Razdan MK Introduction to Plant Tissue Culture
Vasil IK Plant Cell and Tissue Culture
Bhojwani SS and Razdan MK Plant Tissue Culture
Singh BD Biotechnology: Expanding Horizons
RH Smith Plant Tissue Culture Techniques and Experiments
L Kyte and J Kleyn Plants from Test Tubes: An Introduction to Micropropagation
M Smith Plant Propagator's Bible
MR AhujaMicropropagation of Woody Plants
YPS Bajaj Trees III
YPS Bajaj Trees IV

M. Sc. Biochemistry

FOURTH SEMESTER (January 2025 – June 2025)

Special Paper: PAPER- III (B): Infectious Diseases: Molecular Basis, Spread, Control and Prevention

Course Objectives:

The objective is to offer detailed knowledge about the mechanisms of disease, cause, transmission, detection, treatment and prevention.

Course Learning Outcomes:

1. Students will gain overall knowledge about the mechanisms of disease cause, transmission, detection, treatment and prevention.
2. Students will develop the ability to relate to any existing or emerging infection as well as will learn about drug resistance and its mechanisms.
3. The students will have the know-how to research and develop new tools for their management.

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Contents:

Unit I: Overview of infectious diseases, infectious agents - Bacteria, Viruses, protozoa and fungi, pathogenicity and virulence; Facultative / obligate intracellular pathogens. Emerging and re-emerging infectious diseases and pathogens including X-MDR M. tuberculosis, MRSA, SARS virus, Bird flu, prions, AIDS, Dengue Hemorrhagic Fever, and Chlamydiae, opportunistic fungal pathogens.

Unit II: Bacterial disease, epidemiology, signs and symptoms, causative agent, history, infection and pathogenicity, Diagnostics, Therapeutics and vaccines. Drug resistance, mechanisms, Multidrug efflux pumps, extended spectrum β-lactamases (ESBL) and implications on public health, molecular mechanisms for Tuberculosis, Typhoid, Cholera

Unit III: Viral diseases, epidemiology, signs and symptoms, causative agent, history, infection and pathogenesis, Detection, Drugs and inhibitors, Vaccines, molecular mechanisms for AIDS, hepatitis, influenza, dengue, polio, herpes.

Unit IV: Parasitic diseases epidemiology, signs and symptoms, causative agents, history, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development, molecular mechanisms for Malaria.

Lab Course

Course level learning outcomes:

Students will acquire the knowledge to isolate bacteria from water/sewage samples, to stain bacteria, fungi, acid fast bacilli and to perform important diagnostic tests for infectious diseases such as WIDAL test. Students will be exposed to permanent slides of pathogens in order to get hands-on training to know nature of various pathogens causing diseases.

Practical content

1. Grams staining for bacteria
2. Isolation and culture of bacteria from water/sewage samples.
3. Demonstration of various media for bacterial culture
4. Isolation and enumeration of bacteriophages (PFU) from water/sewage samples
5. WIDAL test
6. Acid fast staining
7. Permanent slides of pathogens: Mycobacterium tuberculosis, Leishmania, Plasmodiumfalciparum
8. Fungal staining
9. Case Study

Suggested readings

1. Klein's Microbiology (2008) 7th Ed., Prescott, Harley, Willey, J.M., Sherwood, L.M.,Woolverton, C.J. McGraw Hill International Edition (New York) ISBN: 978-007-126727.
2. Principles and practices of Infectious diseases, 7th edition, Mandell, Douglas andBennett. S, Volume, 2. Churchill Livingstone Elsevier. ISBN: 978-0-443-06839-3
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases. (2010).Kenneth J. Ryan, C. George Ray, Publisher: McGraw-Hill. ISBN-13: 978-0071604024 ISBN-10: 0071604022
4. Medical Microbiology. (2012). Patrick R. Murray, Ken S. Rosenthal, Michael A.Pfaller, Elsevier Health Sciences. ISBN: 978-0-323-08692-9.
5. Bacterial Pathogenesis: A molecular approach by Salyers AA and Whitt DD eds.American Society for Microbiology Press, Washington, DC USA. 2002

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FOURTH SEMESTER (January 2025 – June 2025)
Special Paper: PAPER- IV (A): Life style Disorders: Cancer and Cardiovascular Diseases

Course Objectives:
The objective is to provide knowledge about common life style disorders with detailed insight in to two major killers: Cancer and Cardiovascular diseases.

Course Learning Outcomes:
1. Students will learn about the various life styles associated disorders.
2. Students will gain detailed insight into Cancer and Cardiovascular diseases with regards to the molecular mechanisms, causes, symptoms, stages, diagnosis and treatments.
3. Students will learn about alternative medicines; current research status, various ethical, social and regulatory issues.

Contents:

Unit I: Introduction: Life style associated disorders like obesity, diabetes, chronic obstructive pulmonary diseases (COPD), cancer and cardiovascular diseases (CVDs); Causes, symptoms, complications, diagnosis, intervention and management of disease; Two major killers: Cancer and Cardiovascular diseases

Unit II: Cancer: History of cancer; Characteristics of normal and transformed cells; Hallmarks of cancer; Causes and symptoms; Pathophysiology; Stages of cancer; Molecular basis of neoplastic growth and metastasis, Key oncogenic pathways; Proto-oncogenesis and Tumor suppressor genes; Cancer causing mutations; Tumor viruses, Overview of important techniques related to cancer research.

Unit III: Cardiovascular diseases: Definition; The origin of cardiovascular diseases (electrical, structural and circulatory) and types of CVDs; Defining the broad spectrum of ailments; Understanding the underlying factors; Stages of CVDs; Molecular basis of CVDs like hypertension, coronary heart (artery) disease, cerebrovascular disease, cardiomyopathy, cardiac hypertrophy, atherosclerosis, myocardial infarction.

Unit IV: Diagnosis and Treatment strategies : Biochemical analysis of cancer and screening methods; Current treatment modalities and their disadvantages, major side effects; Molecular approaches to cancer treatment; Factors affecting prognosis of cancer; Challenges of treatment and disease control strategies. Diagnosis and biomarkers for CVDs; Treatment strategies and management of the condition; Drugs and their discovery; Model systems and animals for CVDs.

Lab course
1. Case Studies
2. Power point presentations; discussion of research articles and reviews on it.
3. Identification of modifiable behavioral risk factor in case study.
4. Identification of Nonmodifiable behavioral risk factors in different life style disorder.
5. Students may be given short term project work (05 to 15 Days) to analyze risk factors for a life style disorder through case studies.

Suggested Readings:
1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Introduction to Human Physiology (2012) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning. ISBN-13: 978-1133104544 ISBN-10: 1133104541

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3. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0- 87893-300-6.
4. The World of the cell, 7th edition (2009). Lewis J. Kleinsmith, Jeff Hardin, Gr Wayne M.Becker. ISBN-13: 978-0805393934 ISBN-10: 0805393935.
5. Life style disorders, National health portal of India (https://www.nhp.gov.in/lifestyledisorder_ mtl)

M. Sc. Biochemistry
FOURTH SEMESTER (January 2025 – June 2025)
Special Paper: PAPER- IV (B): Bioinformatics
[Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction & detailed information on storing, retrieving, analyzing biological data in silico.

Course Outcomes (COs)

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

CO1: Discuss the various databases and GenBank used in storing biological data.
CO2: Identify the basic concepts of sequence similarity by BLAST and FASTA algorithms.
CO3: Explain the phylogenetic analysis and various genome projects.
CO4: Apply the techniques for the protein structure prediction.
CO5: Summarize the cheminformatics and medicinal chemistry.

Unit I Introduction to bioinformatics and data generation

Bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pub med, PDB) and software (RASMOL, Ligand Explorer). Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

Unit II Biological Database and its Types

Introduction to data types and Source.Population and sample. Classification and Presentation of Data.Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB sum)

Unit III Data storage and retrieval and Interoperability

Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.Data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

Unit IV Gene Expression and Representation of patterns and relationship

General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS. Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.

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Lab Course

Course Objectives: The module is designed to provide a detailed knowledge of online databases available and functioning of all the software to study the bio molecules of life.

Course Outcomes (COs):
On successful completion of the course, the student shall be able to:
CO1: Demonstrate the use of databases.
CO2: Demonstrate the gene and protein sequence retrieval techniques.
CO3: Produce novel DNA and protein structures to be used in therapeutics.
CO4: Perform phylogenetic studies to establish the relationship between two genomes.

Exercises:
01. Retrieval of sequences from NCBI, EBI and EMBL databases.
02. Retrieval of sequences from NBRF-PIR, SWISSPROT and P databases.
03. Transition and Translation of sequences.
04. Retrieval of genome from genome databases.
05. Exploring DIP and PPI.
06. Exploring BIND and PIM.
07. Exploring MINT and GRID.
08. Analysis of phylogenetic tree
09. Exploring PDB file.
10. Analysis of active site by pymol

Books Recommended:
BAXEVANIS, AD & OUELLETTE, BFF : Bioinformatics: a practical guide to the analysis of genes and proteins. 2nd Ed.. 2002.
BAXEVANIS, AD, DAVISON, DB, PAGE: Current protocols in bioinformatics. 2004.
RDM & PETSKO, GA ORENGO, C, JONES, D & : Bioinformatics: genes, proteins and computers. 2003
THORNTON, J Ingvar Eidhammer, IngeJonassen, : Protein Bioinformatics. 2003
William R Taylor HIGGINS, D & TAYLOR, W : Bioinformatics: sequence, structure, and databank. 2000.
David Mount: Bioinformatics: sequence and genome analysis. 2004

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