

B. Sc. Biotechnology structure –Three year degree course

Degree in B. Sc. Biotechnology is divided in six semesters and with credit system. Each semester will have six theory courses, each will be of 45 contact hours, comprising 3 credits to each course/paper and each paper/course will be scored for 50 marks. There shall be three lab courses completed in each semester, each lab course of 90 contact hours, 3 credits and of 100 marks wattage. Therefore each semester will have 18 theory credits and nine practical credits accounting for 27 credits per semester. Course as divided in six semester total credits solitarily for the Biotechnology subject will be 162. Third year there will be additional 6 credits of Communication English and Scientific English divided into two semesters accounting each with 3 credits. At the end of B. Sc. Student will have completed 172 credits scoring out of 3700.

1. Theory examination would be conducted after each semester.
2. Practical examination would be conducted only after completion of even semesters.
3. Theory paper for 50 marks will include five compulsory questions, 10 marks each question, duration of examination will be three hours.
4. In the case of practical each lab course will have two independent sections.

Following is a skeleton of the courses offered for three year B. Sc. Biotechnology course.

General Outline of courses/papers offered for Degree in B. Sc. Biotechnology.

Sr. No	Paper/Course code	Title of the course/Paper	Credits	Marks
B. Sc. First Year, Semester I			3	50
1	I-PCH	Physical Chemistry	3	50
2	II-OIC	Organic and Inorganic Chemistry	3	50
3	III-MCD	Microbial Cell and Diversity	3	50
4	IV-BST	Biostatistics	3	50
5	V-INS	Instrumentation	3	50
6	VI-BML	Biomolecules	3	50
7	LC-I	Organic and Inorganic Chemistry	3	100
8	LC-II	Microbiology	3	100
9	LC-III	Instrumentation and techniques	3	100
B. Sc. First Year, Semester II				
10	VII-OIC	Organic Chemistry	3	50
11	VIII-IPC	Inorganic and Physical Chemistry	3	50
12	IX-MGC	Microbial growth and control	3	50
13	X-BMT	Biomathematics	3	50
14	XI-MML	Macromolecules	3	50
15	XII-BTC	Biotechniques	3	50
16	LC-IV	Inorganic and Physical Chemistry	3	50
17	LC-V	Biostatistics and Mathematics	3	50
18	LC-VI	Biomolecules and Macromolecules	3	50
B. Sc Second Year, Semester III				
19	XIII-BIM	Basics of Immunology	3	50
20	XIV-GVG	General Virology	3	50
21	XV-DVB	Developmental Biology	3	50
22	XVI-CSI	Chromosome structure and Inheritance	3	50
23	XVII-BEZ	Basics of Enzymology	3	50
24	XVIII-APL	Animal physiology	3	50
25	LC-VII	Immunology and Virology	3	100
26	LC-VIII	Developmental Biology and Inheritance	3	100
27	LC-IX	Enzymology and animal physiology	3	100
B. Sc. Second Year, Semester IV				
28	XIX-CBG	Cell Biology	3	50
29	XX-PPL	Plant Physiology	3	50
30	XXI-GEN	Genetics	3	50
31	XXII-CDG	Central Dogma	3	50
32	XXIII-AEZ	Advanced Enzymology	3	50
33	XXIV-AIG	Advanced Immunology	3	50
34	LC-X	Cell biology and Plant Physiology	3	100
35	LC-XI	Genetics and central dogma	3	100

36	LC-XII	Enzymology and Immunology	3	100
B. Sc. Third Year, Semester V				
37	XXV-REG	Regulation of gene expression	3	50
38	XXVI-ITB	Introduction to Bioinformatics	3	50
39	XXVII-PGE	Principles of Genetic Engineering	3	50
40	XXVIII-FDP	Fermentation Design and Process	3	50
41	XXIX-PTC	Plant Tissue Culture	3	50
42	XXX-CBC	Clinical Biochemistry	3	50
43	LC-XIII	Gene Expression and Basic Bioinformatics	3	100
44	LC-XIV	Genetic Engineering and Fermentation	3	100
45	LC-XV	Plant tissue culture and clinical Biochemistry	3	100
46	XXXI-CEG	Communication English –Additional course	3	50
B. Sc. Third Year, Semester VI				
45	XXXII-GNP	Genomics and Proteomics	3	50
46	XXXIII-RDT	Recombinant DNA technology	3	50
47	XXXIV-FTC	Fermentation Technology	3	50
48	XXXV –BET	BioEthics	3	50
49	XXXVI-		3	50
50	XXXVII-		3	50
51	LC-XVI	RDT and genomics -proteomics	3	100
52	LC-XVII	Fermentation and Bioethics	3	100
53	LC-XVIII		3	100
54	XXXVII-SEG	Scientific English	3	50

B. Sc. First Year, Semester I
PAPER-I-PCH Physical Chemistry MARKS-50 (3 Cr)

1. **STRUCTURE OF ATOM** : Introduction, subatomic particles, quantum theory and Bohr's model, electromagnetic radiation, electromagnetic spectrum, Bohr's model of atom, quantum numbers electronic configuration of atoms.
2. **CHEMICAL BONDING**: Ionic Bond; energy changes, lattice energy, Born Haber Cycle, Covalent bond energy changes, potential energy curve for H₂ molecule, characteristics of covalent compound, coordinate bond-Werner's Theory, effective atomic numbers, isomerism in coordinate compounds. Hydrogen bonding, Vander Waal forces, hybridization and resonance, Valence Shell Electron Repulsion Theory (VSEPR), Discussion of structures of H₂O, NH₃, SiF₄, Molecular Orbital Theory, Linear combination of atomic orbitals (LCAO) method. Structure of simple diatomic molecules like H₂, N₂, O₂, F₂.
3. **THERMOCHEMISTRY**: Hess's Law, heat of reaction, effect of temperature on heat of reaction, at constant pressure (Kirchoff's Equation) heat of dilution, heat of hydration, heat of neutralization and heat of combustion, flame temperature.
4. **THERMODYNAMICS**: Definition and explanation of terms - intensive and extensive properties - types of systems - thermodynamic process - cyclic, reversible, irreversible, isothermal and adiabatic. Thermodynamic functions - complete differential zeroth law of thermodynamic - concept of heat and work. First law of thermodynamics Statement and equation Second law of thermodynamics - need for the II law, statements of the second law. Spontaneous process, Carnot's cycle - efficiency - Carnot's theorem (statement only) Concept of entropy - definition - entropy of an ideal gas - entropy changes in cyclic, reversible and irreversible processes and physical transformations. Gibbs free energy - Helmholtz free energy - their variations with temperature, pressure and volume.

REFERENCE BOOKS

1. Physical Chemistry. By G.M. Barrow.
2. Inorganic Chemistry by J. D. Lee
3. Physical Chemistry by Lewis
4. Systematic Experimental Physical Chemistry by S.W. Rajbhoj and Dr. T.K. Chodhekar, Anjali Publication Aurangabad.
5. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.

B. Sc. First Year, Semester II
PAPER-VII-OIC Organic and Inorganic Chemistry MARKS-50 (3 Cr)

1. **ALKANES:** Methods of preparation, Source- petroleum and coal in brief, Cracking and reforming.
2. **ALKENES:** Methods of preparation. Reactions: Hydrogenation, oxidation, hydroxylation, addition- Markonikoff rule with explanation and peroxide effect. Dienes- types of dienes and their characteristic reactions. Diels-alder reaction in detail with its stereochemistry. Polymerisation of olefinic compounds, use and mechanism of Ziegler-Natta catalysis, Hydroboration reaction, Claisen rearrangement.
3. **ALKYL AND ARYL HALIDES:** Nomenclature and classes of alkyl halide, methods of formation, chemical reactions, mechanism of nucleophilic substitution reactions of alkyl halides, SN1 and SN2 reactions with energy profile diagrams. Polyhalogen compounds: Chloroform, carbon tetrachloride. Methods of formation of aryl halides, nuclear and side chain reaction. The elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides Vs allyl, vinyl and aryl halides.
4. **Modern Periodic Table :** Mendeleef's periodic law and Mendeleef's periodic table, Defects of Mendeleef's Periodic Table, Mosley's Modern periodic law, Extended periodic table. General characteristics of Groups, general characteristics of periods. Division of the elements into s-,p-,d- and f-Block Elements.

REFERENCE BOOKS

1. Organic Chemistry by Vogel.
2. Organic Chemistry by Morrison & Boyd, 6th Edition.
3. Organic Chemistry by I.L. Finar.
4. Organic Chemistry Reaction Mechanism by Jerry March.
5. Organic Chemistry by Bahl and Bahl.
6. Organic Chemistry by P.L.Soni.
7. Organic Chemistry by O.P. Agrawal.
8. A guide book to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition.
9. Reaction and Recovery of Chemicals by S.N. Sanyal.
10. Stereochemistry by Nosipuri.
11. Satya Prakash's Modern Inorganic Chemistry, R D Madan , S Chand Publishers, N Delhi.
12. Advanced Practical Inorganic Chemistry, Prof. Gurdeep Raj, Goel Publishing House, Delhi

Paper III-MCD MICROBIAL CELL AND DIVERSITY(3 Cr)

1. CHARACTERISTIC AND IMPORTANCE OF MICRO-ORGANISMS:

Bacterial classification. Numerical taxonomy, major characteristics used in taxonomy. Bacterial classification depending on cell wall and other characteristics.

General properties and importance of Archaeobacteria, Actinomycetes, Fungi, Slime molds, Algae, Protozoa, Mycoplasma, and Rickettsia –*from Bergey's manual of systematic bacteriology (only introductory).*

2. CYTOLOGY OF BACTERIA

Ultra-structure of bacterial cell. **Studies of cell organelles such as;** Capsule, Cell wall of eubacteria and archaeobacteria, Flagella, Fimbriae, Cell membrane, Cytoplasmic inclusion bodies –Polyhydroxy butyrate granules, polymetaphosphate granules, glycogen granules, Mesosomes, Nucleolus, and Ribosomes. Ultra-structure of a typical endospore, conditions in which endospore formation occurs, stages of endospore formation. Classification of bacteria based on types and position of endospore. Biochemical events parallel to endospore formation. Germination of endospore.

3. STAINS AND STAINING PROCEDURE

Staining methods, principle, methodology and applications/significance of –

- A. Negative staining,
- B. Monochrome staining,
- C. Differential staining examples –Grams staining, Acid Fast staining, Capsule staining, Cell wall staining, Flagella staining, DNA staining, staining of PHB granules, staining of Phosphate granules, staining of endospore – at least one method in depth and mention other available methods of staining.

4. VIRUSES

General properties and classification of viruses.

Structural properties and life cycles (in brief) of.

Plant viruses for example –potato X virus, Tobacco Mosaic Virus, Cauliflower Mosaic Virus, and Gemini virus.

Animal viruses for example Herpes virus, Adenoviruses, Influenza virus, Poliomyelitis, Hepatitis A and Hepatitis B virus.

Bacteriophages such as; T4, Lambda, M13 and Mu.

References:

1. General Microbiology –R. Y. Stanier VIth edition.
2. Microbiology –Pelczar
3. Principles of Bacteriology –A. J. Salle
4. Microbiology by Prescott
5. Text book of Microbiology by Tortora
6. Microbiology by Brock
7. General Virology –S. E. Luria
8. Chemical Microbiology -Rose

B.Sc Biotechnology(First Year)

Paper-IV-BST: BIOSTATISTICS Marks -50 (3 Cr)

1.Introduction to statistics

Introduction to Biostatistics: Basic definitions, notations and applications.

Sampling: Representative sample, sample size, sampling techniques.

Data collection and presentation: Types of data, methods of collection of primary and secondary data, Data presentation (Histogram, polygon, ogive curves and Pie diagram).

2.Statistical Measures

Measures of Central Tendency: Mean, Mode, Median.

Measures of Variability: Standard deviation, standard error, Range, Mean deviation , Quartile deviation and coefficient of variation.

Correlation and Regression: Positive and negative correlation, calculation of correlation coefficient, regression, linear regression and regression equation.

ANOVA : ANOVA,one and two way classification.

3.Test of significance

Tests of significance: Chi square test, t-test, F-test, Z-test.

Probability theory and distribution: Concept of probability. Binomial, Poisson and Normal distribution.

REFERENCES

1. Campbell R.C.- Statistics for Biologists, Cambridge University Press, Cambridge.
2. Ward Law A.C. (1985)- Practical statistics for Experimental Biologists.
3. Baily N.T.J- Statistical Methods in Biology, English University Press.
4. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India.

B. Sc. First Year, Semester I

Paper V-INS INSTRUMENTATION Marks: 50 (3 Cr)

- I) **Basic Laboratory Instruments:** Principle and working of pH meter, autoclave, HAO laminar air flow
- II) **Spectroscopy:** Basic principles theory instrumentation and applications of UV-visible, Infra- Red, NMR, (Nuclear magnetic resonance) AA (Atomic absorption) Mass and Raman Spectroscopy.
- III) **Microscopy:** Microscope Types: Light and electron, Resolving power, Numerical aperture, limit of resolution, magnification, principle, working, ray-diagram and applications of bright field, dark field, fluorescent and phase contrast microscopy, Transmission and scanning electron microscopy.
- IV) **Flow cytometry:** Principle, working, instrumentation and applications of a flow cytometry.

REFERENCES

- 1) Biophysical Chemistry by Nath and Upadhya.
- 2) Practical biochemistry principles and techniques by Wilson and Walker.
- 3) Instrumental methods of chemical analysis by Chatwal and Anand.
- 4) Lab Manual in Biochemistry by J. Jayaraman.
- 5) Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.
- 6) Analytical Biochemistry by Holme.
- 7) Spectroscopy by B.P. Straughan and S. Walker
- 8) Introduction to HPLC by R.J. Hamilton and P.A. Sewell

B. Sc. Biotechnology Semester I
Paper VI-BML BIOMOLECULES Marks 50 (3 Cr)

- 1. Basic Concepts:-** Introduction to Biochemistry, its significance, scope and application.
Chemical bonding, molecular and structural formulae: Chemical bonding and functional groups, anomers and stereo isomers, cis-trans isomers.
Nomenclature of chemical compounds, types of chemical reactions.
Concept and definition of acid, base, buffers and pH, Buffers and biological systems, Henderson-Hasselbalch equation (pKa).
- 2. Carbohydrates:-** Definition, classification of carbohydrates.
Monosaccharides: Classification, structure, function, chemical and physical properties.
Disaccharides: Classification, structure, function, chemical and physical properties.
Polysaccharides: Classification, structure, function, chemical and physical properties.
- 3. Vitamins:** Definition and classification of vitamins,
Water soluble vitamins:- Structure, function and properties of Vit. B1, B2, B6 and C. Deficiency disorders and clinical significance. Recommended dietary requirement and sources
Fat soluble vitamins: Structure, function and properties of Vit. A,D,E,K
Deficiency disorders and clinical significance. Recommended dietary Requirement and sources.
- 4. Hormones:** Classification of hormones, regulation of secretion and metabolic role. Structure, function and role of Thyroid hormones (Thyroxine and triiodothyronine), Parathyroid hormones (Parathormone and Calcitonin), Gonadal hormones (Androgens, prostaglandins and estrogen), Adrenals (Epinephrine and Norepinephrine), Pancreatic hormones (Insulin and Glycogen). Deficiency disorders and clinical significance.

PRACTICALS

1. Qualitative tests for carbohydrates.
2. Quantitative tests for carbohydrates
3. Estimation of reducing sugars concentration by Sumner's method.
4. Estimation of Vit. C concentration by DCPIP method.
5. Isolation of cholesterol and lecithin from egg yolk.

REFERENCE BOOKS

1. Biochemistry by Lubert Stryer, III edn, 1988, W.H. Freeman & Co.
2. Principle's of Biochemistry by Lehninger, II edn, 1978, Worth Pulishers. Inc.
3. Biochemistry by Zubay, III edn 1993, W.C. Brown Publishers.
4. Outline of Biochemistry By Cohn and Stump.
5. Harper's review of Biochemistry.
6. Practical Biochemistry by J. Jayraman.
7. Practical Biochemistry by D. Plummer.

B. Sc. First Year, Semester I

PAPER-II-OCH ORGANIC CHEMISTRY MARKS-50 (3 Cr)

1. **ARENES AND AROMATICITY:** Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Resonance structure. MO picture. Aromaticity: The Huckel rule, aromatic ions.
2. **IUPAC N:** Systematic IUPAC nomenclature of different classes of compounds including aromatic, bicyclic and polyfunctional compounds.
3. **REACTIVE INTERMEDIATES :** Generation, structure, stability and general reactions of carbocations, carbanions, free radicals and carbenes (singlet and triplet). Wagner-Meerwein rearrangement, electrophiles and nucleophiles, concepts of acids and bases. Bronsted theory, Lewis theory and Pearson's classification (HSAB). Correlation of structure with acidity and basicity. Hyperconjugation: concept and consequences. Resonance effect- Resonance energy and its significance.
4. **STEREOCHEMISTRY:** Classification of stereoisomers, diastereoisomers, separation of enantiomers. Absolute configuration (R and S), Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms. Elements of symmetry- Centre, plane, axis of symmetry, Stereochemistry of biphenyls and spiro compounds, Conformations: Conformations around a C-C bond in acyclic compounds, Structure of cycloalkanes. Cyclohexane conformations, Stereochemistry of substituted cyclohexanes. Geometrical isomerism- concept, E and Z nomenclature, Stereoselective and specific reactions. Introduction to asymmetric synthesis.

REFERENCE BOOKS

1. Organic Chemistry by Vogel.
2. Organic Chemistry by Morrison & Boyd, 6th Edition.
3. Organic Chemistry by I.L. Finar.
4. Organic Chemistry Reaction Mechanism by Jerry March.
5. Organic Chemistry by Bahl and Bahl.
6. Organic Chemistry by P.L.Soni.
7. Organic Chemistry by O.P. Agrawal.
8. A guide book to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition.
9. Reaction and Recovery of Chemicals by S.N. Sanyal.
10. Stereochemistry by Nosipuri.

B. Sc. First Year, Semester II

PAPER-VIII-IPC **Inorganic and Physical Chemistry** MARKS-50 (3 Cr)

1. **REACTION KINETICS** : Significance of rate law and rate equations, order and molecularity, determinations of order of simple reactions-experimental method, Equilibrium constant and reaction rates- Lindemann, collision and activated complex theories, complex reactions of first order, characteristics of consecutive, reversible, and parallel reactions-steady state and non steady state approach.
2. **CATALYSIS**: Criteria of catalysis-Homogeneous catalysis, acid-base, enzymatic catalysis, catalysis by metal salts. Heterogeneous catalysis – concepts of promoters, inhibitor and poisoning, Physiosorption, chemisorption, surface area, Industrially important process. Theories of catalysis.
3. **ELECTROCHEMISTRY**: Electric transport – conduction in metal and electrolyte solution. Types of reversible and electrodes- gas metal ions, metal-metal ion, metal insoluble salt anion and redox electrodes.
4. **Oxidation-Reduction Reactions & Modern concepts of Acids and Bases**: Covalency, Oxidation Number and Oxidation state. Difference between oxidation number and valency. Rules for calculating oxidation number. Oxidation and Reduction, Redox Reactions and Half Reactions. Oxidising agent and Reducing agent. Concepts of acids and bases: Arrhenius concept, Bronsted-Lowry concept, Cadey-Esley Concept, Lux-Flood Concept, Lewis concept and Usanovich concept (their advantages and disadvantages).

REFERENCE BOOKS

1. Physical Chemistry. By G.M. Barrow.
2. Inorganic Chemistry by J. D. Lee
3. Physical Chemistry by Lewis
4. Systematic Experimental Physical Chemistry by S.W. Rajbhoj and Dr. T.K. Chodhekar, Anjali Publication Aurangabad.
5. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
6. Satya Prakash's Modern Inorganic Chemistry, R D Madan , S Chand Publishers, N Delhi.
7. Advanced Practical Inorganic Chemistry, Prof. Gurdeep Raj, Goel Publishing House, Delhi
8. Essentials of Physical Chemistry by Bahal & Tuli
9. Advanced Physical Chemistry by Puri & Sharma
10. Experiments in Physical Chemistry by J B Yadav

11. Qualitative Analysis Vol. 1 and Vol. 2 by Vogel
12. Quantitative Analysis Vol. 1 and Vol. 2 by Vogel
13. Physical Chemistry through solved problems by Maron & Proton
14. Inorganic Chemistry by P.L.Soni.

Paper IX-MGC MICROBIAL GROWTH AND CONTROL (3 Cr)

4. MICROBIAL NUTRITION

Major and Micro bioelements and growth factors –C, N, P, S, sources, Peptone, Tryptone, Meat extract, yeast extract, Various amino acids, various vitamins, trace elements. Nutritional classification of bacteria.

Culture medium

–synthetic media

–with only salts,

-with salts and carbon,

-with salts, carbon and nitrogen source,

-highly complex medium. Auxotroph and Prototroph, role of minimal medium in isolating/ or studying auxotrophic and prototrophic micro-organisms.

Construction of and application of -

Selective and Enrichment media with appropriate examples such as; *Enterobacter* from soil, *Escherichia coli* from water and clinical samples, sulphate reducing bacteria from anaerobic sludge and photoautotrophs.

Indicator medium –with appropriate example. Selective and differential medium with suitable examples (lactose fermenter and nonlactose fermenters, deoxycholate agar, Salmonella Shigella agar).

5. MICROBIAL GROWTH

Definition of growth. Growth curve with reference to stages both by cell count and optical density, diauxic growth and diauxic growth curve –glucose and lactose as source of carbons, mechanism of glucose effect at introductory level only. Mathematical expression of growth (generation time, number of generations). Measurement of growth in terms of cell number, cell mass, cell constituents.

Continuous growth, methods for obtaining continuous growth –turbidostat, chemostat.

Synchronous growth, methods to obtain synchrony –such as; nutritional starvation, stationary phase induction, micromanipulator, filtration, helmstetter and cummings.

6. CONTROL OF MICROORGANISMS

Effect of following factors on growth: temperature, pH, Heavy metal ions, oxygen, pressure and radiation.

Methods of sterilization of micro-organisms. Physical methods such as heat, radiation, filtration.

Disinfection: Properties of an ideal disinfectant should bear in. terminologies such as; antiseptic/sepsis, decimal reduction temperature, decimal reduction time, disinfection, antibiotic, stasis and cidal/lethal effect. Classes of chemical compounds applied as disinfectants, their mode of action and applications. Estimation of efficacy of disinfection ability of antiseptic strength by phenol coefficient method.

Antimicrobial compounds: history, examples of chemical compounds used to treat wounds and infections before penicillin. antibiotics affecting cell wall, antibiotics affecting cell membrane, antibiotics affecting protein synthesis, antibiotics or chemotherapy targeting enzymes, antifungal antibiotics, antiviral compounds.

7. Microbial physiology

Sporulation: Method of differentiation, endospore formation, stages of spore formation, biochemistry of spore structure and synthesis. Event parallel to spore formation. Germination of endospore.

Toxins: Microbial toxins. Endotoxins and Exotoxins, Enterotoxins, neurotoxins, food poisoning due to toxin production.

References:

9. General Microbiology –R. Y. Stanier VIth edition.

10. Microbiology –Pelczar

11. Principles of Bacteriology –A. J. Salle

12. Microbiology by Prescott

13. Text book of Microbiology by Tortora

14. Microbiology by Brock

15. Microbiology -Davis

B. Sc. Biotechnology Semester II
PaperX –BMT BIOMATHEMATICS Marks -50 (3 Cr)

1. Determinants and Matrices

Determinants: Introduction, expansion by co-factors, properties of determinants.

Matrix Algebra: Definition, various types of matrices, matrices as a rectangular array of real numbers, equality of matrices, addition, multiplication by a scalar and product of matrices, transpose of a matrix, determinant of the square matrix (order upto three) Inverse of a square matrix (order upto three), Properties of these matrix operations, Diagonal, symmetric and skew-symmetric matrices and their properties, Solutions of simultaneous equations.

2. Boolean Algebra- Introduction, application to switching networks

3. Differential Calculus: Real valued functions of a real variable, into, onto, one-to-one function, sum, difference, product and quotient of two functions. Composite functions, absolute value, polynomial, rational, trigonometric, exponential and logarithmic functions.

Limit and continuity of a function, limit and continuity of the sum difference, product and quotient of two functions. L'Hospital rule of evaluation of limits of functions. Even and odd functions, inverse of a function, continuity of composite functions, intermediate value property of continuous functions

Derivatives: Derivative of the sum, difference, product and quotient of two functions, chain rule, derivatives of polynomial, rational, trigonometric, inverse trigonometric, exponential and logarithmic functions.

4. Integration: Integration as the inverse process of differentiation, indefinite integrals of standard functions, definite integrals and their properties, applications of the Fundamental Theorem of Integral Calculus.

Integration by parts, integration by methods of substitution and partial fractions, application of definite integrals to the determination of areas involving simple curves.

REFERENCES

5. Fundamentals of Mathematical Statistics by S.C. Gupta and V.K.Kapoor. Sultan Chand & Co.
6. Discrete Mathematics By B.S. Verma, Vishwa Prakashan.

B. Sc. Biotechnology First Year Second Semester
Paper XI-MML MACROMOLECULES Marks 50 (3 Cr)

5. Amino acids and proteins:

Aminoacids- Classification, structure, physical and chemical properties of amino acids. Essential and non-essential amino acids. Peptide bond.

Proteins: Classification, physico chemical properties. Structure (primary, secondary, tertiary and quaternary). Bonds involved in the spatial structure of proteins- disulphide bond, ionic bond, hydrogen bond, and hydrophobic bond. Denaturation of proteins. Biological significance of proteins.

6. Nucleic acids: Nucleic acid, Physico-chemical properties of Nucleic acids, nitrogenous bases (Purines and Pyrimidines), structure of pentoses, nucleosides and nucleotides. Structure of DNA- Watson and Crick Model, DNA forms and conformations Denaturation of DNA.
RNA- types, structure and role.

7. Lipids: Classification, structure of saturated and unsaturated (Monounsaturated and polyunsaturated), hydroxylated, branched fatty acids, properties of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, prostaglandins, leukotriens, lipoproteins and lipopolysaccharides. Glycerolipids (Glycerines, glycerophospholipids and glycosyldiglycerides). Properties and biological functions of lipids.

REFERENCES

8. Biochemistry by Lubert Stryer, III edn, 1988, W.H. Freeman & Co.
9. Principle's of Biochemistry by Lehninger, II edn, 1978, Worth Pulishers. Inc.
10. Biochemistry by Zubay, III edn 1993, W.C. Brown Publishers.
11. Outline of Biochemistry By Cohn and Stump.
12. Harper's review of Biochemistry.
13. Practical Biochemistry by J. Jayraman.
14. Practical Biochemistry by D. Plummer.

B. Sc. First Year, Semester II

Paper XII-BTC Biotechniques Marks: 50 (3 Cr)

- I) **Centrifugation-** types, preparative, analytical and differential, sedimentation velocity and sedimentation equilibrium.
- II) **Chromatographic Techniques:** Theory, Principle and applications of Thin layer chromatography, paper chromatography, Ion exchange, chromatography, affinity chromatography and HPLC.
- III) **Electrophoresis:** Basic principle of electrophoresis theory and applications of paper and gel electrophoresis.
- IV) **Radioisotopic Techniques:** Structure of an atom, types of radioactive emission, concepts of half life period and isotope, use of radioisotopes in life sciences.

REFERENCES

- 9) Biophysical Chemistry by Nath and Upadhya.
- 10) Practical biochemistry principles and techniques by Wilson and Walker.
- 11) Instrumental methods of chemical analysis by Chatwal and Anand.
- 12) Lab Manual in Biochemistry by J. Jayaraman.
- 13) Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.
- 14) Analytical Biochemistry by Holme.
- 15) Spectroscopy by B.P. Straughan and S. Walker
- 16) Introduction to HPLC by R.J. Hamilton and P.A. Sewell

Section A: Organic Chemistry

1. Systematic qualitative analysis of organic compounds (Single compound :
i. Benzoic Acid ii. Salicylic acid iii. Phthalic acid iv. Cinnamic acid v. β -naphthol
vi. *p*-nitro-aniline vii. Acetanilide viii. Naphthalene ix. *m*-dinitrobenzene) for
nature, functional group, elements, derivatives and physical constant.
2. Determination of Viscosity.
3. Determination of surface tension.
4. Purification of organic compound by crystallization-Benzoic acid
5. Purification of organic compound by sublimation- Naphthalene.
6. Purification of organic compound by distillation.

Section B: Inorganic Chemistry

Volumetric analysis

7. Acid-base titration using two burettes of (on micro scale)
8. Standardization of KMnO_4 and estimation of Fe (II) Volumetrically.

LAB COURSE II –MICROBIOLOGY

MARKS 100

Section A

1. Simple staining/Monochrome staining
2. Negative staining
3. Differential staining –Grams staining and Acid Fast staining
4. Cell wall staining
5. Capsule staining
6. Flagella staining
7. Spore staining
8. Nucleic acid staining
9. Wet mount of fungi
10. Microscopic observation of algae with classification in brief
11. Staining of Actinomycetes

Section B

1. Media construction, minimal and complex medium
2. Selective medium for Salmonella
3. Differential medium for Lactose fermenters and non lactose fermenters
4. Sugar fermentation with andrades indicator,
5. Growth curve for *E. coli* strain and LB medium
6. Testing efficiency of sterilization
7. Phenol coefficient –to test efficacy of disinfectant
8. IMViC test with both *Escherichia coli* and *Enterobacter aerogenes*
9. Bioassay for antimicrobial compounds such as
 - a. Penicillin –*Staphylococcus aureus*
 - b. Streptomycin –*Escherichia coli*
 - c. Nalidixic acid –*Escherichia coli*
10. Isolation of soil, water and air bacteria by
 - a. Pour plate method
 - b. Spread plate method
 - c. Streak plate –four quadrant method

Section A

- I) Study of titration curve of acetic acid and determination of its pka.
- II) Study of UV absorption spectra of macromolecules (protein and nucleic acid)
- III) Determination of λ max of a dye solution.
- IV) Determination of protein concentration by spectrophotometric method.
- V) Microscopic examination of bacteria, yeasts and molds.
- VI) Micrometry.
- VII) Spectrophotometric determination of nucleic acid purity and concentration.

Section B

- II) Sizing yeast cells using centrifugation technique.
- III) Separation of serum proteins by horizontal submerged gel electrophoresis.
- IV) Separation and identification of amino acids using TLC and circular paper chromatography.
- V) Separation and identification of sugars using ascending paper chromatography.
- VI) Separation and identification of lipids by TLC.

LAB COURSE IV –Inorganic and Physical Chemistry
MARKS-100

Section A: Physical Chemistry

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl acetate catalyzed by hydrogen ion at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To study kinetically the reaction rate of decomposition of iodide by H₂O₂.
4. To study the distribution of iodine between water and CCl₄.
5. To determine the percentage composition of a given mixture by viscosity methods.
6. To determine the percentage composition of a given binary mixture by surface tension method.
7. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.

Section B: Inorganic Chemistry

8. Qualitative analysis :Four binary mixtures to be analyzed

Gravimetric analysis

9. Determination of water of crystallization of given salt. BaCl₂·2H₂O, Mg·SO₄·7H₂O.
10. Determination of Percentage Purity of given Salt.

LAB COURSE V –Biostatistics and Biomathematics
MARKS 10

Section A

1. Representation of statistical data by histogram, ogive curves and pie diagrams.
2. Measurement of central tendencies: Arithmetic mean, median and mode.
3. Calculation of measures of dispersion: mean deviation, standard deviation and coefficient of variation, quartile deviation.
4. Problems based on Tests of significance: Chi square test, t-test, standard deviation and ANOVA(one –way ,two-way).

Section B

1. Representation of statistical data by histogram, ogive curves and pie diagrams.
2. Measurement of central tendencies: Arithmetic mean, median and mode.
3. Calculation of measures of dispersion: mean deviation, standard deviation and coefficient of variation, quartile deviation.
4. Problems based on Tests of significance: Chi square test, t-test, standard deviation and ANOVA(one –way ,two-way).
5. Solving assignment problems based on determinants- evaluation of determinants using factor theorem, application of determinants in solving a system of linear equations, application of determinants to co-ordinate Geometry.
6. Solving assignment problems based on matrices:- Scalar multiplication, subtraction, transpose of a matrix, matrix multiplication, elementary transformations of a matrix.
7. Solving assignment problems based on function and its domains, limit and continuity of the function.
8. Solving assignment problems based on integration by substitution, by parts, partial fractions and application of definite integrals.

LAB COURSE VI –Biomolecules and Macromolecules

Section A

6. Qualitative tests for carbohydrates.
7. Quantitative tests for carbohydrates
8. Estimation of reducing sugars concentration by Sumner's method.
9. Estimation of Vit. C concentration by DCPIP method.
10. Isolation of cholesterol and lecithin from egg yolk.

Section B

1. Preparation of reagents and various buffers.
2. Determination of pKa of amino acids.
3. Protein Estimation by Lowry's method
4. Protein Estimation by Biuret Method
5. Quantitative estimation of DNA by diphenylamine method.
6. Quantitative estimation of RNA by Orcinol method.