डॉ. बाबासाहेब आंबेडकर मराठवाडा विद्यापीठ, औरंगाबाद

परिपत्रक क्रमांक/एस.यू./विज्ञान/अभ्यासक्रम/७४/२०१४

या परिपत्रकाद्वारे सर्व संबंधीतांना सुचित करण्यात येते की, विज्ञान विद्याशाखेने शिफारस केल्यानुसार बी. एस्सी. / एम. एस्सी. प्रथम व द्वितीय वर्षाच्या सुधारित अभ्यासक्रमास आणि बी. एस्सी. प्रथम वर्षाच्या अभ्यासक्रमात किरकोळ बदल करण्यास विद्यापरिषदेच्या वतीने मा. कुलगुरु यांनी, त्यांना प्राप्त असलेल्या विशेष अधिकार महाराष्ट्र विद्यापीठ अधिनियम-१९९४ कलम १४(७) अन्वये मान्यता दिलेली आहे. त्या अनुषंगाने सुधारीत तयार केलेल्या अभ्यासक्रमाची प्रत या परिपत्रकासोबत आपल्या पुढील कार्यवाहीसाठी पाठविण्यात येत आहे.

[1]	B.Sc. Physics	Semester-III & IV,
[2]	B.Sc. Chemistry	Semester-III & IV,
[3]	B.Sc. Botany	Semester-III & IV,
[4]	B.Sc. Zoology with minor changes	Semester-I & II,
[5]	B.Sc. Zoology	Semester-III & IV,
[6]	B.Sc. Fisheries	Semester-III & IV,
[7]	B.Sc. Electronics (Opt.)	Semester-III & IV,
[8]	B.A./B.Sc. Mathematics	Semester-III & IV,
[9]	B.Sc. Computer Science	Semester-I & II,
[10]	B.Sc. Information Technology	Semester-I & II,
[11]	B.C.A.	Semester-I & II,
[12]	B.Sc. Computer Science(Opt.)	Semester-I & II,
[13]	B.Sc. Information Technology(Opt.)	Semester-I & II,
[14]	B.Sc. Computer Application(Opt.)	Semester-I & II,
[15]	B.Sc. Computer Maintenance(Opt.)	Semester-I & II,
[16]	B.Sc. Biotechnology (Progressively)	Semester-I to VI,
[17]	B.Sc. Biotechnology (Opt.) (Progressively)	Semester-I to IV,
[18]	B.Sc. Sericulture Technology	Semester-I & II,
[19]	B.Sc. Networking Multimedia	Semester-III & IV,
[20]	B.Sc. Bioinformatics	Semester-I & II,
[21]	B.Sc. Hardware & Networking	Semester-I & II,
[22]	B.Sc. Animation	Semester-I & II,
[23]	B.Sc. Dairy Science & Technology	Semester-III & IV,
[24]	B.Sc. Biochemistry	Semester-III & IV,
[25]	B.Sc. Analytical Chemistry	Semester-III & IV,
[26]	B.Sc. Textile & Int. Decoration with minor changes	Semester-I & II,
[27]	B.Sc. Textile & Int. Decoration	Semester-III & IV,
[28]	B.Sc. Home Science with minor changes	Semester-I & II,
[29]	B.Sc. Home Science	Semester-III & IV,
[30]	B.Sc. Agro.Chem. & Fertilizers	Semester-III & IV,

..2..

[31]	B.Sc. Geology	Semester-III & IV,
[32]	B.A. Statistics with minor changes	Semester-I & II,
[33]	B.A. Statistics	Semester-III & IV,
[34]	B.Sc. Statistics with minor changes	Semester-I & II,
[35]	B.Sc. Statistics	Semester-III & IV,
[36]	B.Sc. Industrial Chemistry	Semester-III & IV,
[37]	B.Sc. Horticultural	Semester-I & II,
[38]	B.Sc. Dry land Agriculture	Semester-I & II,
[39]	B.Sc. Microbiology	Semester-III & IV,
[40]	M.Sc. Computer Science	Semester-I to IV,
[41]	M.Sc. Information Technology	Semester-I to IV.

हा सुधारीत व नवीन तयार केलेल्या अभ्यासक्रमाचा आराखडा शैक्षणिक वर्ष २०१४-१५ करिता मर्यादित असेल व विद्यापरिषदेच्या अंतिम मान्यतेनंतर हे परिपत्रक नियमित ठेवण्याबाबत या कार्यालयाद्वारे नवीन परिपत्रक पारीत करण्यात येईल. तसेच सुधारीत व नवीन तयार केलेल्या अभ्यासक्रमाची प्रत विद्यापीठाच्या संकेतस्थळावर उपलब्ध आहे.

करिता, या परिपत्रकाची सर्व संबंधितांनी नोंद घ्यावी.

विद्यापीठ प्रांगण,
औरंगाबाद-४३१ ००४.
संदर्भ क्र.एस.यु./सा.शा./सबवि /२०१३-१४/
६५९९-७०२
दिनांक :- २७-०५-२०१४.

संचालक,
महाविद्यालये व विद्यापीठ
विकास मंडळ.

****

या परिपत्रकाची एक प्रत :-

१) मा. परिक्षा नियंत्रक, परिक्षा विभाग,
२) मा. प्राचार्य, सर्व संलग्नीत महाविद्यालये,
३) संचालक, युनिक यांना विनंती करण्यात येते की, सदरील अभ्यासक्रम विद्यापीठाच्या संकेतस्थंळावर उपलब्ध करुण देण्यात यावेत.
४) संचालक, ई-सुविधा केंद्र, विद्यापीठ परिसर,
५) जनसंपर्क अधिकारी, मुख्य प्रशासकीय इमारत,
६) कक्ष अधिकारी, पात्रता विभाग, मुख्य प्रशासकीय इमारत,
७) कक्ष अधिकारी, बी.ए. / बी.एस्सी./ बी.सी.एस./एम.एस्सी. विभाग, परीक्षा भवन,
८) अभिलेख विभाग, मुख्य प्रशासकीय इमारती मागे,

डॉ. बाबासाहेब आंबेडकर मराठवाडा विद्यापीठ, औरंगाबाद.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

B.Sc. BIOTECHNOLOGY

FIRST TO THIRD YEAR

THREE YEAR DEGREE COURSE

Semester–I to VI

[Effective for 2014-15]

B. Sc. Biotechnology Structure –Three Year Degree Course

Degree in B. Sc. Biotechnology is divided into 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. Each course/ paper will be scored for 50 marks. Total credits from theory for three years would be 108.

For B.Sc. I year there shall be three laboratory courses, each course of 45 contact hours, i.e. 1.5 credits to be scored for 50 marks. Thus there shall be 9 credits allotted to practical during first and second semester. For B. Sc. II and B. Sc. III year there shall be 18 credits allotted for practical, each year, each practical will be of 3 credits and scored for 100 marks. For B. Sc. III year a 3 credit (100 marks) dissertation should be included in lieu of a 3 credit Laboratory courses. Total credits from practical for three years will be 45.

At the end of B. Sc. Student will have completed 153 credits scoring out of 3300 marks.

1. Theory examination would be conducted after every semester.
2. Practical examination should be conducted only after completion of even semesters, although practicals should be completed during each semester.
3. Theory paper for 50 marks will include 5 compulsory questions, 10 marks each question, duration of examination would be of 3 hours.
4. In the case of practical each lab course should 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	1.5	50
8	LC-II	Microbiolology	1.5	50
9	LC-III	Instrumentation and techniques	1.5	50
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	1.5	50
17	LC-V	Biostatistics and Mathematics	1.5	50
18	LC-VI	Biomolecules and Macromolecules	1.5	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	Inheritance and Developmental Biology	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
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-	Metabolism of Macromolecules	3	50
50	XXXVII-	Ecology and Evolution	3	50
51	LC-XVI	RDT & Fermentation Technology	3	100
52	LC-XVII	Metabolism, Ecology and Evolution	3	100
53	LC-XVIII	Dissertation in Lieu of Genomics-Proteomics and Bioethics	3	100

B. Sc. First Year, Semester I

PAPER-I-PCH Physical Chemistry MARKS-50 (3 Cr)

1. **STRUCTURE OF ATOM** : Introduction, subatomic particals, quantum theory and Bohrs model, electromagnetic radiation, electromagnetic spectrum, Bohrs 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, co-ordinate bond-Werner's Theory, effective atomic numbers, isomerism in coordinate compounds. Hydrogen bonding, Vander Wall 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, carnots 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 - Heimholtz 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 Archaebacteria, 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 archaebacteria, 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, Adenovurses, 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-Hassalbach 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 (Andogens, 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. Estimaiton 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. Hypeconjugation: concept and consequences. Resonance effect- Resonance energy and its significance.

4. **STEREOCHEMISTRY:** Classification of stereomers, diastereomers, separation of enentiomers. Absolute configuration (R and S), Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms. Elelments of symmetry- Centre, plane, axis of symmetry, Stereochemistry of biphenyls and spiro compounds, Conformations: Confromations around a C-C bond in acyclic compounds, Structure of cycloalkanes. Cyclohexane conformations, Stereochemistry of distributed 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, inhibiter 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 reducting 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, trignometric, 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 preteins- 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

LAB COURSE I –Orgnic Inorganic Chemistry MARKS-100

Section A: Organic Chemistry

1. Systematic qualitative analysis of organic compounds (Single compound : i. Benzoic Acid ii. Salicylic acid iii. Pthalic 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 KMnO4 and estimation of Fe (II) Volumetrically.

LAB CORUSE 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

LAB COURSE III –Instrumentation and Techniques MARKS 100

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. Estimaiton 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 Laurys method
4. Protein Estimation by Biuret Method
5. Quantitative estimation of DNA by diphenylamine method.
6. Quantitative estimation of RNA by Orcinol method.

B. Sc. II Biotechnology,
Semester III,

Paper XIII-BIM **Basic Immunology** **Marks 50, (3 Cr) 45 Contact hours**

1. **Types of immunity :** innate, acquired, active and passive. Elements of immune system: Hematopoiesis, T-cells, B-cells, myeloid cells, antigen presenting cells, cell mediated subset of T-Cells, helper and suppressor cells, cell medicated and humor immunity, antibody dependent cell mediated cytotoxicity, natural killer cells. Primary and Secondary organs of immune system

2. **Cellular and molecular aspects:**

Antigens :- Immunogenicity Vs antigenicity, factors affecting antigenicity, epitopes, haptens, adjuvants.

Antigen antibody interactions :- forces of antigen antibody interaction, principle, methods and applications of precipitation and agglutination.

Antibody structure, function and diversity antigen-antibody reactions, T-Cells receptors, cell activation complement, lymphokines, regulation of immune response, immunological tolerance. Recognition of antigen: MHC, antigen processing and presentation, T-cell and B - cell activation.

3. **Hypersensitivity:** An allergy, types of hypersensitivity. Immunology of hypersensitivity. Secondary immune response. Autoantibodies – Autoimmune diseases. Examples such as; Rheumatoid Arthritis, Myasthenia Gravis, Systemic Lupes Erythematus, Rhesus incompatibility, Protection of fetus from immune response.

Immunotechniques: Immunodiffusion, immunoelectrophoresis ELISA, RIA, fluorescence activated cell sorter, PBMC, immunoblotting.

REFERENCE BOOKS

1. Immunology Kuby, R.A. Goldsby, T.J. Kind 1997, 4th Edition B.A. Osborne.
2. Essential of immunology Ivan Riot-Blakswel 1997, 4th Edition B.A. Osborne
3. Fundamentals of Immunology Paul W.E. (Eds.) 1998 Raven press, New York.
4. Text Book of Microbiology by Panikar and Anantnarayan 2009.
5. General Microbiology by Davis
6. Medical Microbiology by Duguid and Cruikshank

B. Sc. II Biotechnology,
Semester III,

Paper XIV-GVG General Virology Marks 50, (3 Cr) 45 Contact hours

Unit 1. General aspects

Classification and nomenclature of viruses in general, their properties, morphology and ultrastructure typical bacteriophage, animal virus and plant virus, types of envelope, their composition, Viroids and Prions.

Unit 2. Animal Viruses

Classification of animal viruses, life cycle and pathogenicity of important viruses, genome organization and replication of DNA viruses, RNA viruses, Adeno virus, Pox virus, SV40, Vaccinia, Lentivirus. Clinical diagnosis and treatment of HIV, Influenza and Hepatitis.

Unit 3. Plant Viruses

Classification plant viruses, life cycle and pathogenicity of important viruses. Genome organization and replication of common plant viruses, such as; TMV CaMV, Potato X Virus, Gemini Virus. Transmission of plant viruses by vectors and other means. Diganostic techniques in seed, seed stocks and diseased plants.

Unit 4. Bacteriophages

Structure and organization of bacteriophages, lytic and lysogenic life cycles –T4 and lambad. Genetic switch for control of lytic and lysogny of lambda phage. Genome organization, infection and multiplication of T odd and T even phages. Lambda phage, M13, Mu phage.

References:

1. General Virology by S. E. Luria
2. Molecular Virology, pathogenesis and control, ASM Press, Washington DC
3. Plant Virology by REF Matthews
4. Dimmock N. J., Primrose S. B. 1994 Introduction to modern Virology, 4th edition, Blackwell scientific Publications, Oxford.
5. Morag C and Embury M. C. 1994, Medical Virology 10th edition, Churchil Livingston, London.

B. Sc. II Biotechnology,
Semester III,
Paper XV-DVB Developmental Biology Marks 50, (3 Cr) 45 contact hrs

Unit 1 Developmental Biology an overview

Introduction of animal development: Development among unicellular eukaryotes – *Acetabularis*, *Naegleria*. The origins of sexual reproduction. Fertilization: structure of gamets, recognition of sperm and egg –action at distance and contact of gametes. Cleavage: Patterns of embryonic cleavage, radial holoblastic cleavage, spiral holoblastic cleavage, mechanisms of cleavage –regulation of cleavage cycles.

Unit 2 Early Embryonic Development

Gametogenesis, Fertilization, Embryo sac development and double fertilization in plants, blastula formation, Types of Cleavage, Gastrulation and formation of germ layers in animals.

Unit 3 Morphogenesis and organogenesis in animals

Cell aggregation and differential in *Dictyostelium;* axes and pattern formation in *Drosophila,* organogesis –vulva formation in *Caenorhabditis elegans;* eye lens induction, limb development in vetebrates, neuron differentiation, -larval formation, metamorphosis; environmental regulation of normal developopment.

Unit 4 Extra embryonic membrane, Cell death and regeneration

Study of extra-embryonic membrane in chick, concept of regeneration programmed cell death and aging and senescence.

References:

1. Developmental Biology by Scott Gilbert -9th edition
2. Balinsky –An introduction to embryology CBS college Publishers
3. Lodish H, *et. al.,* Molecular Cell Biology
4. Alberts Bruce, *et. al.,* Molecular Biology of the Cell Sinauer
5. Grant –Biology of Development systems, Holt. Reihart, Winston.
6. Developmental Biology website companion to Gilbert - http://www.devbio.com/contents.php

B. Sc. II Biotechnology,
Semester III,

Paper XVI-CSI **Chromosome Structure and Inheritance**
Marks 50, (3 Cr) **45 Contact hours**

Unit 1. **Genetic material: structural organization**

Discovery of genetic material –Experimental evidences. Genomes of bacteria, viruses and eukaryotic cell. Genome complexity in terms of C-value paradox, Denaturation –Renaturation kinetics –Cot Values, repetitive and non-repetitive DNA, Subcellular genomes, extrachromosomal genoems, Organelle genome, DNA topology and manipulation of DNA topology –Feulgen reaction, Structure of DNA and forms of DNA. **Chromosome:** Structure of a typical circular and linear chromosomes, molecular nature and functioning of centromeres and teleomeres, Giant chromosome, Polytene chromosome. Chromatin Organization: Euchromatin, Heterochromatin, Nucleosome as a subunit of chromatin, organization of hisotone octamer, acetylation and deacetylation of histones, roles of methylation and demethylation of DNA in CpG islands.

Unit 2. **Transmission and Dominance of Genetic Material**

Mendelian Principles: I Segregation; Mendels experiment, terminology, testing phenotypes, examples of gene differences and segregation. Mendelian Principles II: Independent Assortment; Genotypes of dihybrid crosses, testing dihybrid genotypes, crosses involvling three or more gene differences, history of Mendel's Discovery, Correspondence between Mendelian factors and chromosome symbols, segregation and Assortment in haploid organisms. Tetrad analysis : *Neurospora crassa*, *Saccharomyces cerevisiae* –gene conversion. Modern Evaluation of Mendels Conclusion. **Dominance relations and multiple alleles:** Incomplete dominance, overdominance, codominance and blood types, multiple alleles, Multiple-Allelic Blood-Group systems, RH and ABO incompatibility, Histocompatibility genes and antibody formation. **Gene interaction and Lethality:** Epistasis, Additivity, Interaction between more than two gene pairs, modifiers, lethality, segregation distortion.

Unit 3. Sex determination and cytoplasmic heredity

Sex determination: Simple mechanisms: one or a few genes. The XX-XY mechanism of sex determination, species with heterogametic females.The Sex Chromosome, The Y chromosome: dominant male determinants, but few other genes, compound sex chromosomes, sex determination, meiotic behavior of sex chromosomes and Nondisjunction. The balance concept of sex determination in *Drosophila.* Haplodiploidy and sex determination in Hymenoptera, mosaics and gynandromorphs. Sex linked dominance, sex limited gene expression and sex linked inheritance. Sex linkage, Bridges' demonstration of Nondisjunction, attached-X, Sex Linkage in Moths and Birds, Reptiles (Snake), Detection of Sex linked diseases in humans, Sex ratio, X-inactivation, dosage compensation. X-linked disorder –females as carriers, hemophilia, sickle cell anemia, fragile-X-syndrome, Huntingtons disease, (only introductory). **Maternal Effect and Cytoplasmic heredity:** Maternal effect –P element, Pila genetics, mitochondrial DNA (mtDNA), chloroplast DNA (cpDNA), Streptomycin resistance in chlamydomonas, respiratory deficiencies, cytoplasmic DNA criteria for extrachromosomal inheritance, infectious heredity.

Unit 4. Quantitative Inheritance and linkage

Johannsen's pure lines, multiple factors, effect of dominance, genes with multiplying effects and the scale of measurements, polygenes in Discontinuous traits.

Linkage: linkage groups, complete linkage, incomplete linkage and recombination, four-strand crossing over, detection of linkage. Calculation of autosomal recombination frequencies by backcrossing to homozygous recessives, recombination frequencies for Sex-linked genes, rexcombination frequencies in F_1 X F_1 crosses.

References:

1. Genetics, Third edition by Monroe W. Strickberger First Indian Impression 2006.
2. Principles of Genetics, Eighth edition, Gardner, Simmons and Snustad.2001.
3. Molecular Genetics An introductory Narrative. Second edition, by Gunther S. Stent and Richard Calendar –University of California Berkley 1986 first Indian edition and reprint 2004.

4. Principles of Genetics, Temin Baltimore.
5. Genetics By Wintergreen.

B. Sc. II Biotechnology,
Semester III,

Paper XVII-BEZ Basic Enzymology Marks 50, (3 Cr) 45 contact hrs

Unit 1. Introduction to enzymes

Definition of enzymes, importance of enzymes: Physiological and industrial, enzyme classification, chemical nature of enzymes, structure of enzyme proteins determination of enzyme structure by X-ray crystallography.

Unit 2. Enzyme Action

Concept of activation energy, active site of an enzyme, Enzyme specificity : Group specificity Substrate specificity Stereo-Specificity & product specificity. Hypotheses of enzyme action-Hypotheses lock and key Hypothesis, induced fit Hypothesis, Hypotheses involving strain or transition state stabilization Uni-Uni, Bi-Bi, enzyme reactions involving one and two substrate molecules, Ping-pong Bi-Bi mechanism, Random Order mechanism, compulsory order mechanism.

Unit3. Types of Enzymes

Monomeric Enzymes (Serine Proteases) Oligomeric Enzymes (laactate Delydrogenase) Metallocenzyme Complex (Pyruvate Dedrydrogenase) Metalloenzymes & Metal activated enzymes Isozymes Ribozymes, Abzymes & Extremozymes & allosteric Enzymes.

Unit 4. Co–Enzymes & Co-factors

Introduction : NAD, NADP, FMN, FAD, Adenosine Phosphates Co-enzyme A, Thiamine Pyrophosphate, Pyridoxal Phosphate, Lipoic Acid Tetrahydro folate & Vitamin B12.

Reference Books :

1) **Enzymes –** Biochemistry, Biotechnology, Clinical chemistry, 2004 by Trevor Palmer, East – West Press Edition.
2) Fundamentals of Enzymology 2003 by Nicholas C. Price and Lewis Stevens Oxford University Press.
3) Enzyme kinetics by Paul Engal. 1977, John Willey and Sons Inc.
4) Enzymes by Dixon and Web. Acad. Press.
5) Principles of enzyme kinetics by Athel Cornish. 1976. Bowden and Butterworth and Co.
6) Laboratory manual in Biochemistry by J. Jayaraman. 2006, New Age International.
7) Source book of Microbiology by Primrose.

B.Sc.II Biotechnology

Semester III

PAPER- XVIII-APL **Animal Physiology** **Marks-50, (3 Cr)**

45 contact hours

Unit 1. Physiology of digestion and excretion (10 Lectures)

Definition of digestion and types of digestion – extra and intracellular. Digestion of Carbohydrates, proteins, lipids and cellulose digestion. Absorption and assimilation of digested food materials. gastrointestinal hormones- control of digestion.

Definition of excretion. Forms of nitrogenous waste material and their formation; classification of animals on the basis of excretory products. Structure and function of Nephron – Counter current mechanism.

Unit 2. Physiology of respiration and circulation (10 Lectures)

Types of respiration – external and internal respiration. Transport of oxygen – formation of oxyhaemoglobin and affinity of haemoglobin for Oxygen, Oxygen dissociation curves. Transport of CO_2 – Chloride shift, Bohr effect. **Open and closed circulation**. Heartbeat and cardiac cycle. Myogenic and neurogenic hearts. Regulation of heart rate – Tachycardia and Bradycardia.

Unit 3. Physiology of muscle contraction and nerve impulse (10 Lectures)

General structure and types of muscles. Ultra structure of skeletal muscle. Sliding filament mechanism of muscle contraction. Chemical changes during muscle contraction – role of calcium, ATP utilization and its replenishment.

Structure of nerve cell. Nature of nerve impulse – resting potential and action potential. Properties of nerve impulse – threshold value, refractory period, all or none response. Conduction of nerve impulse along an axon – local circuit theory and saltatory conduction theory. Structure of synapse, mechanism of synaptic transmission – electrical and chemical transmissions.

Unit 4. Physiology of endocrine system and homeostasis (15 Lectures)

Relationship between hypothalamus and pituitary gland. Hormones of hypothalamus. Hormones of Adenohypophysis and Neurohypophysis. Hormones of pineal gland, thyroid gland, parathyroid, thymus, adrenal and pancreas. Endocrine control of mammalian reproduction – Male and female hormones – Hormonal control of menstrual cycle in humans.

Concept of Homeostasis and its basic working mechanism. Mechanism of Homeostasis – giving three illustrations viz., Hormonal control of glucose levels, Water and ionic regulation by freshwater and marine animals and temperature regulation in man.

REFERENCE BOOKS

1. 'Essentials of Animal Physiology' by S.C.Rastogi'
2. 'Animal Physiology' by H.C. Nigam.
3. 'Biology' by Campbell & Reece.
4. 'Animal Physiology' – Agarwal, R.A. Srivastava, Kaushal, Anil and Kumar.
5. 'Animal Physiology and Biochemistry' by Dr. B.Annadurai.
6. 'Principles of Animal Physiology' by Christopher D.Moyes, Patricia M Schulte.
7. 'Biology: The Science of Life' by R.A. Wallace, G.P. Sanders & R.J. Ferl.
8. 'Biology: Concepts and Applications' by Starr
9. ' Cell Biology, Genetics, Evolution and Ecology' by P.S.Varma and V.K. Agrawal; S. Chand and Company.
10. ' Animal nutrition' by P.Mc Donald, R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan.

B. Sc. II Biotechnology,

Semester III,

LCVII **Immunology and Virology** **Marks 100, (3 Cr)**

PRACTICALS

Section A –Basic Immunology

1. Blood film preparation and identification of immune cells
2. Lumphoid organs and their microscopic organization
3. Immunization and collection of serum
4. Double Diffusion
5. Heamglutination
6. Detection of antigen
7. Seperation of monocular cells by Ficoll-Hypaque

Section B -Virology

1. Isolation of coliphages
2. Titration of bacteriophages
3. One step growth curve
4. Viral DNA extraction
5. Demonstration of nucleic acid type of viral sample
6. Isolation of plant virus from clinical specimen
7. Isolation of animal virus from clinical specimen.

B. Sc. II Biotechnology,
Semester III,

LCVIII Developmental Biology and Inheritance Marks 100, (3 Cr)

PRACTICALS

Section A –Developmental Biology

1. Study of meiosis in Grasshopper testis
2. Study of development of frog embryo from permanent slides (at least five)
3. study of different types of cancer cell

Section B –Chromosome structure and Inheritance

1. Determination of nucleic acid by Feulgen reaction
2. Isolation of Giant chromosome
3. Isolation of Polytene chrosome
4. Estimation of temperature melting
5. Problems based on monohybrid and back cross
6. Problems based on di-hybrid
7. Problems based on tri-hybrid
8. Problems based on pedigree analysis

B. Sc. II Biotechnology,
Semester III,

LC IX Enzymology and Animal Physiology Marks 100, (3 Cr)

PRACTICALS

Section A –Basic Enzymology

1. Detection of enzyme production by bacteria & Fungi: Proteases, alpha amylase, lipase, Cellulase.
2. Detection of B-Lactamase Production by Saureus / E coli.
3. Assay of urease.
4. Assay of alpha Amylase in terms of substrate consumpron.
5. Assay of alkaline phosphatane in human serum.
6. Detection of extremozymes production by bacterial isolates from extreme environment e.g. : salted fish.
7. Study of substrate specificity of enzymes.

Section B –Animal Physiology

1. Detection of normal and abnormal constituents of urine – sugar, albumen bile and blood cells.
2. Demonstration of salivary amylase.
3. Effect of temperature and pH on amylase

B. Sc.II Biotechnology,

Semester IV,

Paper XIX-CBG **Cell Biology** **Marks 50, (3 Cr)** **45 Contact hours**

Unit 1. **Cell Structure and organelles**

Cell theory. **Organisation-** prokaryotic and eukaryotic cells. **Origin** of eukaryotic cells-endosymbiotic theory, Giardia- a living fossil. **Overview of cell specializations**: **Plants**-epidermis, vascular tissue and cortex, **Animals**- epithelia, connective tissue, nervous tissue, muscle, blood, germ cells and sensory cells.

Structure and Functions of Organelles: Endoplasmic Reticulum, Lysosome, Golgi Complex, Peroxisome (Microbody), Centriole, Mitochondria, Cytoskeleton- microtubules, intermediates filaments, actin filaments, mechanism of muscle contraction, motors and movements, Cilia & Flagella, Nucleus, Special Properties of Plant Cells-cell wall, vacuoles and chloroplast.

Unit 2. **Membrane Structure** **Membrane models**- Overton's lipid nature of membrane, Langmuir's lipid monolayer, Gorter and Grendel's lipid bilayer, Davson and Danielli's lipid bilayer plus protein sheet, Robertson's Unit membrane, Singer and Nicolson's fluid mosaic. **Membrane structure-** 2D Lipid bilayer, composition of lipid bilayer, asymmetric nature, fluidity, membrane proteins and their function.

Unit 3. **Membrane Transport** Movement across membranes- **Passive transport**: simple diffusion, facilitated diffusion-transporters (uniporters and cotransporters) and channel proteins. **Active transport**: Pumps, Group Translocation and Electrochemical Gradients

Unit 4. **Cell Division and Cell Cycle**

Mitosis, Meiosis, and Cytokinesis, role of protein kinases and Cyclin-Cdk complex in controlling cell cycle, control of cell proliferation in multicellular organisms, programmed cell death.

References:

1. Cell Biology by Sadava
2. Molecular Cell Biology, Lodish *et al.,* Freeman and Company, New York, 1999
3. Essential Cell Biology- An introduction to the molecular Biology of the cell- Alberts, Bray, Johnson, Lewis, Raff, Roberts, Walter, Garland Publishing.
4. Molecular Biology of the cell- Bruce Alberts, Garland Publishing Inc.
5. Cell Biology- A short course, Second edition, Stephen R. Bolsover, Wiely Publication
6. Genes IX - Benjamin Lewin, Prentice Hall Publication

7. An introduction to Practical Biochemistry- David T Plummer, Tata McGraw-Hill Edition
8. Developmental Biology, Ninth edition, S. F. Gilbert, Sinauer Associates Inc.

B.Sc.II Biotechnology

Semester IV

Paper- XX-PPL **Plant Physiology** **Marks-50,(3 Cr) 45 contact hours**

Unit1. Plant water relations :

Cell as a physiological unit. Osmosis, Imbibition. Diffusion, D.P.D. Water potential, Absorption of water, (active & passive). Plasmolysis, cohesion, tension and transpiration pull theory. Significance, factors affecting transpiration, mechanism of stomatal opening and closing, (k+ transport theory). Guttation and antitranspirants. (**10 Lectures**)

Unit2. Photosynthesis :

Significance, site of photosynthesis, pigments, photochemical phase. Electron transport chain. Photophosphorylation, cyclic and non cyclic. Biosynthetic phase, Calvin cycle, C3 and C4 pathways. Photorespiration, Crassulacean Acid Metabolism, factors affecting photosynthesis. Law of limiting factors, light, temperature, water, nutrient supply. Leaf factor. Chemosynthesis- a brief account. Essential, non- essential, macro and micro elements, brief account only. **(10 Lectures**)

Unit 3. Plant Growth & Regulation:

Phases of growth, growth curve. Plant growth regulators - Auxins, Gibberillins, Cytokinins Ethylene, Absisic acid - physiological functions only. Senescence - brief account only.

(**5 Lectures**)

Unit 4. Photoperiodism And Vernalization :

Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; photoperiodism and biological clocks. Brief account only. (**5 Lectures**)

Unit 5. Stress Physiology:

Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress (**5 Lectures**)

REFERENCES

1. Bilgrami K.S & Dube - A text book 0n Modern Plant Pathology. Vikas Publishing House, New Delhi.

2. Develin & Witham - Plant Physiology-C.B.S.Publishers.

3. Fritsch F.E - Structure and reproduction of Algae. Vol 1 and Vol11 Cambridge University Press London.

4. Kumar & Purohith - Plant Physiology. Fundamentals- Agrobios.

5. Kumar. H.D& Singh A.N - A text book on Algae. Chand & Company.

6. Malik C.P & Srivastava.- A text book of Plant Physiology Kalayani Publishing Co. New Delhi.

7. Pandae & Trivedi - A text book of Fungi, Bacteria and Virus Vikas Publishing House New Delhi.

8. Parihar N.S - An introduction to Bryophyta Central Book Depot Allahabad

9. Smith G.M Cryptagamic Botany Vol 11Mc Grae Hill Co. New Delhi.

10. Smith K.M - A text book of Plant diseases S. Chand & Company.

11. Sporne K.R. - Morphology of Pteridophytes.- Hutchins university Library . London.

12. Vashista P.C. - Gymnosperms—S. Chand & Company. New Delhi

13. Vasistha B, - Bryophyta, S. Chand & Company.

14. Willam G. Hopkins. - Introduction to Plant Physiology. John Wiley.

15. Robert A Wallace. Biology, The world of life. Harper Collins

B. Sc. II Biotechnology,
Semester IV,

Paper XXI-GEN Genetics Marks 50, (3 Cr) 45 Contact hours

Unit 1. Genes and Mutation

The enzyme cannot make enzyme paradox, The one gene –one enzyme hypothesis, Bacterial mutants, Temperature sensitive Mutants, Pathway analysis, gene protein relations. **Mutation:** Spontaneous and Induced Mutation. Types of mutations :- point mutations, frameshift mutations, inversion and deletion mutations, null mutation, lethal and conditional lethal mutation. **Mutagenic Suppression:** Reversion of mutation, true reversion, second site suppression. Drug resistant mutants, forward, reverse and suppressor mutations. Scoring of Mutations –Mutation frequencies and mutation rates (Fluctuation test, replica plating), Enrichment of mutant single type,

Physical, Chemical and Biological mutagens.

Biological mutable agents: viruses, transposons. In vitro mutagenesis by transposons.

Unit 2. Repair and genetic recombination, complementation

Repair: Base excision repair, Mismatch repair, Photoreactivation, Dark repair, SOS, post replication repair (only at concept level not at molecular level), DNA safeguarding systems. **Genetic Recombination;** Bacterial transformation, bacterial conjugation, bacterial transduction. Phage mutants, the map, mapping pool, heterozygotes, mechanism of recombination, correspondence between genetic map and DNA molecule, **Fine structure analysis;** early evidence that the gene is subdivisible, the *cis-trans* or complementation test for functional alleilism, limitations of *cis-trans* test, Fine structure of the phage T4 *rII* locus.

Unit 3. Genetic Code

Amino acid replacements, artificial messenger RNA, the code table, direction of the code, the anticodon and tRNA –structure and classes of tRNA, nonsense codons, nonsense suppression, suppression and anti-suppression at the ribosomal level, intergenic frameshift suppressors, evolution of the code. Wobble pairing, code is degenerate, early evidences of *in vitro* amino acid synthesis, deciphering genetic code, codon usage, codon bias.

Unit 4. Population Genetics

Gene frequencies and Equilibrium; gene frequencies, gene pool, conservation of gene frequencies, attainment of equilibrium at two or more loci, sex linkage. Estimation of equilibrium frequencies in natural populations; codominance in natural populations, dominance in natural populations, multiple alleles, mutation rates, selection, fitness, gametic selection, zygotic selection, heterozygous advantage, unstable equilibrium, equilibrium between mutation and selection, estimates of mutation rates and equilibrium frequencies, migration, random genetic drift.

References

1. Genetics, Third edition, by Monroe W. Strickberger, first Indian impression 2006
2. Microbial genetics, by, David Frifelder
3. Molecular Genetics: an introductory narrative, Second edition, by Gunter S. Stent and Richard Calendar, University of California, Berkley, First Indian print 1986, Reprint 2004
4. Principles of Genetics, Eight Edition, by Gardner, Simmons and Snustad, first Indian print 2001, second print 2007.
5. Principles of Genetics by Temin Baltimore
6. Genetics by Wintergreen.

B. Sc.II Biotechnology

Semester IV

Paper XXII-CDG Central Dogma Marks 50 (3 Cr)

45 Contact Hours

Unit 1. Perpetuation and its connection with cell division

Replicon: Definition, types of bacterial replicon, eukaryotic replicon, extrachromosomal replicon –plasmid, virus, mitochondria and chloroplast. Experimental evidences of bidirectional replication.

Replication in Prokaryotes –*Escherichia coli* replication as role model, DNA polymerases –with reference to their functional properties, formation of replication fork, primer formation, replication on leading and lagging strand, termination of replication.

Eukaryotic DNA replication: Origin Recognition Complex, Licensing factor, components of replicase and other polymerases. Replication fork –experimental proof for multiple replication forks in eukaryotes. Process of replication, initiation, elongation and termination.

Replication of extrachromosomal material, plasmid replication –rolling circle, plasmid partitioning, plasmid incompatibility, mitochondrial DNA replication,

Regulation of Replication connection of replication with cell division, segregation. Consequences of mutations in replication assembly, mini-cells and maxi-cells.

Unit 2. Prokaryotic transcription

Transcription in *Escherichia coli* a role model for prokaryotes –RNA polymerase:- structural components and assembly of core and holoenzyme. **Transcrition initiation-** Bipartite structure of promoter, factors influencing promoter strength, consensus sequence, sigma mediated recognition of promoter, Formation of open complex, transcription bubble. Promoter clearance,

Transcription elongation (inchworm mechanism), what are road blocks and regions where polymerasue will pause.

Transcription termination –factor dependent and factor independent terminations. **Antiterminators from bacteria and bacteriophages –** their applications in genetic engineering.

Eukaryotic transcription

RNA polymerases Pol I, Pol II and Pol III –structural components and their roles.

Transcription initiation Promoters, promoter like elements, downstream promoter elements, Up elements, Activators, enhancers. Activation of basal apparatus, pre-initiation and initiation. TAFs, transcription factors,

Transcription elongation specific mechanisms for each type of polymerase.

Transcription termination –processing, formation of 5' Cap, 3' polyadenylation. Splicing, group I intron, splicosome, nucleoproteins, snRNA, hnRNA, and ribonucleoproteins.

Unit 3. mRNA Translation

Prokaryotic translation –translation initiation, ribosome assembly, RBS – Shine Dalgarno sequence, initiation codon, initiation complex, initiator tRNA, P site,A site and E site –their relevance in translation, translocation,

Translation elongation structural different between initiator tRNA and methionine tRNA during elongation, transpeptidation and chain elongation. Translation fidelity.

Translation termination factors and release of ribosomes and their recycling.

Eukaryotic translation Pre mRNA and mature mRNA –their differences and translocation (**–only review)**. Structural organization of functional ribosome and comparison with *E. coli* apparatus. Cozaks sequence, initiator tRNA, formation of initiation complex, P site, A site and E site, their role during mRNA translation. **Translation elongation** comparative studies of elongation with *E. coli*.

Translation termination factors, release of ribosomes and recycling, regulation.

Unit 4 **Post translational/co-translational processing for functional aspect**

Post translational modification Phosphorylation, Acetylation, Methylation, Glycosylation (introductory only with one popular example).

Protein Traffiking/ transport: types of transport :- cotranslational and post translational transport. Transport apparatus without carrier protein(s), with carrier protein, transport of proteins thru nuclear membrane. Endoplasmic reticulum mediated transport of proteins, need and significance of proteins involved in folding-unfolding of protein during translation, transport and after transport. Roles of chaperons, chaperoinin with suitable examples. Protein transport across mitochondria and chloroplast.

References:

1. Molecular Biology –David Frifelder
2. Genes IX –Benjamin Lewin
3. Molecular biology of the gene J. D. Watson and *et. al.,*
4. Molecular Biology of the Cell –Bruce Alberts and *et. al.,*

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Semester IV

Paper XXIII-AEX Advanced Enzymology Marks 50 (3 Cr) 45 contact hrs

Unit 1. Extraction & Purification of Enzymes

Different sources of enzymes, Extraction of soluble enzymes Physical and chemical methods of cell disintegration to obtain enzymes. Extraction of membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods : different electrophoresis and chromatographic methods.

Unit 2. Enzyme Kinetics

Effect of pH, temperature, substrate concentration enzyme concentration, reaction time, metal ions on enzyme catalyzed reactions. Kinetics of single substrate enzyme catalyzed reactions (Derivation of Michaelis Mentan Equation and its significance). Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots.

Enzyme inhibitors, Introduction to irreversible and reversible (competitive, uncompetitive and non competitive inhibitions with suitable examples.)

Allosteric enzymes, feed back inhibition and its significance in metabolic regulation. (Sequential and concerted).

Unit 3. Enzyme Immobilizaiton

Importance of enzyme immobilization, different methods of enzyme immobilization. Properties of immobilized enzymes and application of immobilized enzymes.

Unit 4. Applications of Enzymes

Uses of enzymes in food and beverages, textile industries, leather industries and detergents. Enzymes in clinical diagnosis and therapeutic applications. Enzymes as environmental and therapeutic biosensors.

Reference Books

1) **Enzymes –** Biochemistry, Biotechnology, Clinical chemistry, 2004 by Trevor Palmer, East – West Press Edition.
2) Fundamentals of Enzymology 2003 by Nicholas C. Price and Lewis Stevens Oxford University Press.
3) Enzyme kinetics by Paul Engal. 1977, John Willey and Sons Inc.
4) Enzymes by Dixon and Web. Acad. Press.
5) Principles of enzyme kinetics by Athel Cornish. 1976. Bowden and Butterworth and Co.
6) Laboratory manual in Biochemistry by J. Jayaraman. 2006, New Age International.
7) Source book of Microbiology by Primrose.

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Semester IV
Paper XXIV-AIG Advanced Immunology Marks 50 (3 cr.) 45 contact hrs

Unit 1. **Graft and its fate**: Types of graft, mechanism of graft rejection, prevention of graft rejection. Foetus as graft

Unit 2. Vaccines

Synthetic vaccines, automatically, hper- sensitivity, tumor immunity, tissue and organ transplant, ideotype network hypothesis, epitope mapping.
Vaccines: Live attenuated, Heat killed with suitable examples (Preparations, standardization and storage) Future developments- Recombinant Vaccines, Vaccines against alzheimeirs disease, Vaccines for AIDS, vaccine for Meningitis C, Super vaccine immunodulators, vaccine against Cervical Cancer.

3. **Fusion on myeloma cell with lymphocytes**

Production of monoclonal antibodies. Chimeric antibody, humanized antibody. Methods of preparation, their clinical applications and applications in Research and development. immunodeficiency.

4. **Cancer and immunology**

Cancer terminology Basic proportion of a cancer cell, the causes of cancer, the genetics of cancer- tumor- Suppressor genes and oncogenes, Tumor antigens, Cancer immunotherapy).

REFERENCE BOOKS

7. Immunology Kuby, R.A. Goldsby, T.J. Kind 1997, 4th Edition B.A. Osborne.
8. Essential of immunology Ivan Riot-Blakswel 1997, 4th Edition B.A. Osborne
9. Fundamentals of Immunology Paul W.E. (Eds.) 1998 Raven press, New York.
10. Text book of Microbiology , Panikar and Anantnarayan 2009
11. General Microbiology by Davis

12. Medical Microbiology by Duguid and Cruikshank.

B.Sc.II Biotechnology

Semester IV

LC X Cell Biology and plant physiology Marks-100,(3 Cr)

Section A –Cell Biology

1. Visualization of Chromosomes in mitotic/ meiotic stages in onion root tips / buds.
2. Isolation and confirmation of mitochondria from plant / animal cells.
3. Lipid solubility of membrane
4. Study of osmosis in blood cells
5. Isolation of Chloroplasts from Spinach leaves
6. Study of hill reaction using isolated chloroplast
7. The effect of detergents on the erythrocyte membrane
8. Effect of lipid composition on membrane permeability.

Section B –Plant Physiology

1. Explain with suitable diagrams and working of experiments setup to demonstrate various physiological phenomena.

a) Osmosis - Thistle funnel osmoscope.

b) Effect of stomatal number on rate of transpiration. (Cobalt chloride test)

c) Effect of root pressure on ascent of sap.

d) Relation between absorption and transpiration. (Water balance)

e) Rate of transpiration by Ganong’s potometer.

f) Separation of different photosynthetic pigment using paper chromatography.

g) Rate of photosynthesis by Wilmot’s bubbler.

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Semester IV

LC XI Genetics and Central Dogma Marks 100, (3 Cr)

Section A -Genetics

1. Determination of mutation rate
2. Fluctuation analysis
3. Spontaneous mutation –drug resistance phenotype
4. Mutations by UV rays
5. Mutations by chemical agents such as; base analogue, intercalating agents or Alkylating agents.
6. Bacterial transformation
7. Bacterial conjugation
8. Bacterial transduction
9. UV survival curve and Photo and/or Dark repair.

Section B –Central Dogma

1. Demonstration of Mitosis –onion root tips experiment
2. Meiosis slide demonstration (permanent slides)
3. Plasmid DNA isolation
4. Plasmid Curing
5. Isolation of total proteins from bacterial cell.

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Semester IV

LC XII Advanced Enzymology and Immunology Marks 100 (3 Cr)

PRACTICALS

Section A –Advanced Enzymology

1. Production of bacterial / fungal – alpha amylase.
2. Partial purification of – amylase by salt precipitation method.
3. Assay of alpha amylase in terms of reducing sugar produced & calculation of enzyme unit.
4. Extraction of unease from horse gram seed / jack bean meal & estimation of its activity in terms Ammonia.
5. Extraction of papain form papaya leaves. Estimation of its activity in terms of Ammonia.
6. Characterization of alpha Amylase, invertase using PAGE.

Section B – Advanced Immunology

1. Diagnosis of R.A. by lattic agglutination
2. Ames test
3. Visit to serum institute/Immunological institute or laboratory

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Semester V

Paper XXV-REG **Regulation of Gene Expression** **Marks 50 (3 Cr)**

45 contact hrs

Unit 1: Basics of Gene Expression

Regulatory elements/ factors: Inculcate concepts with suitable examples for; Cis acting elements, Trans-acting factors. Exceptional proteins behaving Cis-acting. Regulation of transposition of Tn3 and Tn9. Modifications of Cis-acting elements to influence and to affect regulation. Influencing or affecting gene expression as a presence / or absence of functional form of protein factor. Concept of Activator, Co-activator, Repressor (with suitable examples). Examples with mechanisms; specific regulator and global regulator. DNA protein interactions, RNA protein Interactions – conditions favoring and affecting these interactions (this is to be dealt with ref to Motifs).

Unit 2: Bacterial Gene Expression

Concept of Operon, Regulation of gene expression; positive control –the *ara* operon, negative control –paradigm the *lac* operon and attenuation mediated control or post-transcriptional regulatory control –the *trp* operon. Must include structural organization of above operons, functional relevance of genes within, regulatory circuit, modes by which the operon can be regulated other than above mentioned mode. Concept of Catabolite Repression. Examples of non-catabolite sugars and their regulation, catabolite repression in amino acid metabolism –examples at molecular level.

Unit 3: Eukaryotic Gene Expression

Activators :- gene specific and generalized type of activator. Domains of activators, protein and DNA/ or RNA binding domain. Modification of activator. Enhancer mediated gene expression –examples. Gene expression of metallothionine gene expression. Response elements such as; steroid hormone response elements, metal response elements, Basal Expression response elements. Regulation of gene expression at a step of activation of basal apparatus, Post initiation gene expression – mechanism of relieving roadblock (stuttering of RNA polymerase) with example. Regulation of mRNA molecules involving both nonstop and nonsense mechanisms.

Gene regulation with example –post transcriptional –yeast and *Drosophila* genes, insulators in genomic imprinting –concept and example.

References:

1. Biochemistry –Lehninger
2. Principles of Biochemistry –Nelson and Cox
3. Microbial genetics –David Frifelder
4. Molecular Biology –David Frifelder
5. Genes –IX
6. Genes -X
7. Principles of gene manipulations –Old and Primrose
8. Biochemistry –Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
9. Principles of Gene Manipulations LPE Pearson -Watson
10. Genetics –Strickberger

B.Sc. III Biotechology
Semester V
Paper XXVI-ITB **Introduction to Bioinformatics** **Marks 50 (3 Cr)**
45 contact hrs

UNIT 1

The Internet and Biologist: Internet basics, FTP, Gopher, World wide web. The Gen Bank Sequence Database: Introduction, Primary & Secondary database, Format vs content: computer vs humans, GenBank Flat File dissection, GCG, ACDEB.

Structure Databases: Introduction to structures, PDB, MMDB, Structure file formats, Visualizing structural information, Database structure viewers.

UNIT 2

Information Retrieval from Biological Databases: Retrieving database entries,
Integrated information retrieval: The entrez system, sequence databases beyond NCBI, Medical Databases The NCBI Database: Introduction, SeqIDS, Bioseq: Sequences, Bioseqsets: Collections of sequences, Seq. Annot: Annotating the sequence, Seqdiscr: Describing the sequence, Sequence Alignment and Database Searching: Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements

UNIT 3

Multiple Sequence Alignment: Progressive alignment methods, Motifs and patterns, Hocks, MOST, Probe, Presentation methods, Abscript Phylogenetic Analysis: Elements of phylogenetic models, data analysis: Alignment, substitution model building, tree building and tree evaluation, building methods, searching for trees, hooting trees, Evaluating trees and data, phylogenetic software Some simple practical consideration. Predictive Methods Using Nucleotide Sequence: Framework, marking repetitive DNA, Database search, Codon bias detection, Detecting function sites in the DM, Integrated gene passing, Finding tRMA genes

UNIT 4

Predictive methods Using Protein Sequences: Protein identity based on composition, Propsearch, Physical properties based on sequences, secondary structure and folding classes, Sspread sopma, Specialized structures of features, Tertiary structure Genome

Mapping: Different types of maps: physical, genetical, etc. Synteny, Human Genome Project, Application of genome mapping, Chromosome maps.

Submitting DNA Sequences to the Databses: Introduction, Where to submit, What to submit, How to submit on the world wide web, How to submit with sequin.

References:

1. Developmental Biology-Gilbert
2. Foundations of Embryology – Patten
3. Cell and Developmental Biotechnology – Raj Narian Desikar
4. Text book of Bryophytes, Pteridophytes , Gymnosperms and Paleobotany - Subramurti
5. Plant Anatomy and Embryology- S.N. Pandey, A. Chadha
6. Teresa K Attwood and David J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Asia, 2001
7. Bexavanis & Francis, Bioinformatics-A practical guide to the analysis of genes and proteins, John Wiley and Sons, 2001
8. Rushidi, Basics of Bioinformatics, CRC Publications, 2001
9. Irfan Khan and Atiya Khanum, Emerging trends in Bioinformatics, Ukaaz Publishers, 2002
10. David M. Hill, Craig Martiz and Barke Mable, Molecular systematics
11. Khan Imtiyaz alam ,Rai University, Hydrabad:- Elementry Bioinformatics
12. N. Gautam Bioinformatics- Databases and algorithm
13. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
14. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

B.Sc. III Biotechology

Semester V

Paper XXVII-PGE Principles of Genetic Engineering Marks 50 (3 Cr)

45 contact hrs

Unit 1: DNA modifications and DNA cutting

Systems safeguarding DNA –in detail. Concept of restriction endonuclease action with reference to DNA modification. **DNA cutting enzymes:** Type I, Type II, Type IIs and Type III with reference to properties, essential co-factors, mode of action – specificity and limitations of their applications.

DNA modifying enzymes with reference to their structure, function, requirements, reaction and applications: Exonucleases, Endonucleases acting on both single strand and double strand, Polymerases, phosphorylating enzymes, Phosphate removing enzymes, Enzyme adding base/s to the end.

Nucleic acid Joining Enzymes: RNA ligase, DNA ligases.

Unit 2: Vectors

Concept and types of vectors for genetic engineering, Review of plasmids and modifying natural plasmids to construct a plasmid vector –example of pBR322 – applications, versatility and limitations, cloning of DNA with gene disruption strategy. The pUC18/ pUC19 vectors –with reference to their desing, potential also as an inducible vector system.

Viral vectors: M13 life cycle and use of M13 as vector, M13mp1 and M13mp2 design, potential and limitations. Single strand preparations for sequencing reactions.

Study of λ-genome to estimate potential as vector system. Concept of insertion and replacement vectors –Two examples with design and application

Vectors with two replicons: Phagemids –concept, example with design and application potential and limitations.

Vectors for use in Eukaryotic cells- Vectors for plant cell: Ti-plasmid, viral Cauliflower mosaic virus, Binary vectors. Vectors for animal cell: P elements, SV40.

Artificial chromosomes, their limitations and applications.

Transcriptional and Translational fusion vectors –with examples at least two

Unit 3: Cloning and Sequencing

Shotgun cloning; with reference to use of plasmid as vector, mean of cloning foreign piece of DNA (Construction of Chimera), mean to construct genomic library, mean to select recombinant with the use of antibiotic marker –a direct selection example.

Generalized strategy of obtaining cDNA from mRNA as a template for PCR (do not teach PCR) or piece of DNA to be cloned in desired vectors.

DNA sequencing by chemical method, by Enzymatic method and Chemical synthesis of DNA.

References:

1. An introduction to Genetic Engineering –Desmond S T Nicholl ,Cambridge university press, 2nd Ed.
2. Recombinant DNA: A short Course, Watson J.D, CSHL press
3. Short course in Bacterial Genetics –J. H. Miller
4. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.
5. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.
6. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.
7. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.
8. D.M Glover , DNA cloning, A practical approach.
9. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.
10. Genes V –Benjamin Lewin

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Semester V

Paper XXVIII-FDP Fermentation Design and Process Marks 50 (3 Cr)

45 contact hrs

1. **THE ISOLATION, PRESERVATION AND IMPROVEMENT OF INDUSTRIALLY IMPORTANT MICRO-ORGANISMS: The isolation of industrially important micro-organisms:** Isolation methods utilizing selection of the desired characteristic , Enrichment liquid culture and solidified media, Screening methods **The preservation of industrially important micro-organisms**: Storage at reduced temperature, Storage on agar slopes, Storage under liquid nitrogen, Storage in a dehydrated form, Dried cultures, Lyophilization, Quality control of preserved stock cultures. **The improvement of industrial micro-organisms:** The selection of induced mutants synthesizing improved levels of primary metabolites, Modification of the permeability, The isolation of induced mutants producing improved yields of secondary metabolites where directed selection is difficult to apply, The isolation of auxotrophic mutants, The isolation of resistant mutants, Mutants resistant to the analogues of primary metabolic precursors of the secondary metabolites ,The isolation of revertant mutants

2. **The use of recombination systems for the improvement of industrial micro-organisms** : The application of the parasexual cycle, The application of protoplast fusion techniques, The application of recombinant DNA techniques.

3. **Design of Fermentor**: Basic design of fermenter: Culture vessel, aerators, agitators, valves, foam separators, ports, cooling and heating devices. Characteristic features of bioreactors. Types of bioreactors: continuous stirred tank reactors (CSTR), packed bed reactors, fluidized bed reactors, plug flow reactors, tube reactors, airlift fermenter, bubble column, tower fermenter. Online monitoring and computer control and computer control of fermentation process. 3. Fermentation Kinetics: Microbial growth: Batch , continuous, fed batch and steady state processes and their kinetics, Oxygen transfer, mass transfer, heat transfer. Methods of sterilization in fermentation process

4. **Downstream processing :** General steps in DST: Recovery of products, extraction, purification.

References

1. Principles of fermentation technology by Stanbury Whitekar and Hall Pergaman, McNeul, Harvey.
2. Biotechnology – A textbook of industrial microbiology by Creuger and Creuger
3. Bioprocess Engineering Principle by Doran Academic press.

B.Sc. III Biotechology

Semester V

Paper XXIX-TCT Tissue Culture Technology Marks 50 (3 Cr)

45 contact hrs

Unit 1: Terminology- Totipotency, Competency, Determinism, Requirements of tissue culture facilities, surface sterilization of materials, Basic procedure for Aseptic Tissue transfer, Culture media, composition of media, phytohormones, media components (Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, Activated charcoal) An appraisal of different media, Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene.

Unit 2: Establishing callus and cell culture, Dynamics of callus growth, callus subculture and maintenance, Growth Measurements, Organ cultures-Shoot cultures, root cultures. Somaclonol variation, cell suspension culture, **Plant Propagation—Meristem Cultures, Somatic Embryogenesis** and their practical applications, Plant Cell Cultures and Pharmaceuticals, and pigment Compounds.

Unit 3: Culture Media: **Natural media** –Plasma Clot, biological fluids tissue extract, Importance of Serum in media. **Chemically defined media**. Primary Culture – Cell lines, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. Secondary Culture – transformed animal cells and continuous cell lines.

Unit 4: Transfection of animal cell lines. Selectable Makers. Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies. Growth factors promoting proliferation of animal cells- EGF, FGF, PDGF, IL-1, IL-2, NGF and Erythropoietin. Transgenic Animals- Techniques and Applications (Transgenic mice and sheep).

References:

1. Plant Cell and Tissue Culture- A Tool in Biotechnology Basics and Application, Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, Springer-Verlag Berlin Heidelberg
2. Plant Tissue Culture: Theory and Practice, S.S. Bhojwani, M.K. Razdan - Elsevier Science.
3. Culture of Animal Cells. A Manual of Basic Technique, Freshney, Wiley
4. Cell Culture Lab Fax. Eds. M. Butler & M. Dawson, Bios Scientific Publications Ltd., Oxford.
5. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.

6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P. Mather and David Barnes. Academic Press.
7. Cell Growth and Division: A Practical Approach. Ed. R. Basega, IRL Press.

B.Sc. III Biotechology

Semester V

Paper XXX-CBC Clinical Biochemisry Marks 50 (3 Cr) 45 contact hrs

Unit 1: Basic concepts of clinical biochemistry, scope of clinical biochemistry in diagnostics, brief review of units and abbreviations used in expressing the concentrations and standard solutions, quality control. Manual versus automation in clinical biochemistry. Normal value of important constituents in blood, CSF and urine. Collection and preservation of blood, serum, plasma, urine, CSF. Chemical and microbial analysis of blood, urine, sputum and CSF. Basics and application of Colorimeter, Turbidometer, Nephlometer and Spectrophotometer, RIA, ELISA in clinical biochemistry. Defination of functional and non-functional plasma enzyme, isozyme and diagnostics test, enzyme pattern in health, disease and diagnostics related to plasma lipase, choline esterase, alkaline phosphatase, SGPT, SGOT, LDH, CKP, VDRL, immobilized enzymes in diagnostics. Hormonal disorders related to endocrine secretions eg. Thyroid etc.

Unit 2: Antibiotic sensitivity testing. Clearance test for urea, eosinophil sedimentation rate, Packed Cell Volume. Food infection and adulteration. Nutrition and chronic diseases. Physical and biochemical changes in ageing. Different theories in ageing, importance of superoxide dismutase in ageing, plasticity and regeneration.

Unit 3: Inborn errors related metabolic disorders, Galactosemia, Glycogen storage diseases, Phenylketonuria, type I and II Diabetes, Hypoglycemia, Lipid malabsorption, Statorrehea, Albinism. Chromosome aberration related disorders and their symptoms, diagnosis of Down's syndrome, Turner's syndrome. Neurological and psychiatric disorders as Schizophrenia, Depression, Dementia, Alzheimer's disease, Wilson's disease etc. metabolic disorders as gout, Atherosclerosis, Multiple sclerosis.

References:

1. Clinical biochemistry by Kaplan L.A. and Pesce A.J.C.V. Mosby 1998.
2. Clinical biochemistry by W.J. Marshall and S.K. Bangery, Chirchill Livinston N.Y. 1995
3. Textbook of Medical Laboratory Techniques P. B. Godkar and D.P. Godkar, second edition Bhalani publication.
4. Practical Clinical Biochemistry by Gowenlock.

5. Biochemical Aspects of Human Diseases by Elkeles and Tavill

6. Fundamentals of Biochemistry, A. C. Deb.

7. Biochemistry, Pamela Champe and R. Harvey 2 nd edition.

8. Text book of Microbiology Ixth edition Anantnarayan

B.Sc. III Biotechnology

Semester V

LC XIII Gene Expression and Bioinformatics Marks 100 (3 Cr)

PRACTICALS

Section A: Gene Expression

1. Isolation of Lactose negative mutants and mapping the mutation with reference to the *lacZ* or *lacY* genes only.
2. Study of catabolite repression with the example of *gal* operon
3. Study of non-catabolite repression.
4. Study of impact of catabolite repression on amino acid metabolism
5. Yeast β -galactosidase assay.
6. Two-hybrid system demonstration (demonstration thru kit –could be asked in examination).
7. Isolation of Trptophan negative mutant and theoretical mapping.
8. Isolation of Arabinose negative mutant and theoretical mapping.
9. Study of the β galactosidase assay of the *lacY and lacZ* mutants.
10. Study of mutants isolated with mutagen with reference to differential □-galactosidase activity.

Section B: Bioinformatics

1. Retrieving Nucleotide sequences from databases
2. Retrieving protein sequences from databases
3. Demonstration on submitting nucleotide/ protein sequence to database
4. Estimating scores with and without gap penalties
5. Allignment of nucleotide sequence
6. Alignment of protein sequence
7. Searching for homologues
8. Searching for paralogues
9. Searching for orthologues
10. Retrieving homologues DNA sequence using protein as query and vice versa

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Semester V

LC XIV Genetic Engineering and Fermentation Design

Marks 100 (3 Cr)

PRACTICALS

Section A: Genetic Engineering

1. Isolation of plasmid DNA from resistant clinical isolates
2. Transformation of resistance from clinical strain to laboratory strain (sensitive)
3. Blue-white selection assay
4. Study of restriction fragments of □-DNA
5. Study of impact of methylation on restriction activity.
6. Shotgun cloning –demonstration of plasmid resistance transfer
7. Shotgun cloning –to introduce chimeric construct
8. Preparation and demonstration of cDNA
9. Shotgun cloning –cloning of cDNA
10. Cloning of DNA with gene disruption strategy

Section B: Fermentation design

1. Study of fermenter design and parts.
2. Isolation of industrially important microorganisms from soil.
3. Isolation of microorganisms producing secondary metabolites.
4. Extraction and purification of secondary metabolites.
5. Study of Growth Curve
6. Study of bacteria and fungi in relation to their optimum growth conditions i.e pH, temp, Media components etc.

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Semester V

LC XV Genetic Engineering and Fermentation Design

Marks 100 (3 Cr)

PRACTICALS

Section A: Tissue Culture Technology

1. Plant tissue culture media preparation & sterilization.
2. Induction of callus using suitable explants
3. Anther culture.
4. Suspension culture.
5. Micropropagation.
6. Embryo Rescue.
7. Plant regeneration from callus.
8. Animal cell culture Preparation of media and filter sterilization
9. Anchorage Dependent Cell Culture
10. Anchorage Independent Cell Culture
11. Cell Viability analysis –by staining method

Section B: Clinical Biochemistry

1. Residual chlorine in water.
2. Qualitative test for food adulteration in food.
3. Analysis of blood group.
4. Haemocytometric analysis.
5. Serum protein fractionation.
6. Blood haemoglobin determination. Erythrocyte sedimentation rate (ESR).
7. Packed cell volume (PCV).
8. Glucose tolerance test (GTT).
9. Liver function test (SGPT, SGOT, alkaline phosphatase, serum bilirubin).
10. Cardiac function test (Serum cholesterol, LDH- cholesterol, CKP, Triglycerides).
11. Kidney function test (blood urea, creatinine, serum Na^+ K^+).

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Semester VI

Paper XXXII -GNP Genomics and Proteomics Marks 50 (3 Cr)

45 contact hrs

UNIT 1

Protein structure, secondary structure and super-secondary structure. Mechanisms of protein folding, tertiary folds. Formation of oligomers. Relationship between protein structure and function. Prions.

UNIT 2

Structure prediction and human proteomics. Mutant proteins. Use of computer simulations and knowledge-based methods in the design process. De-novo design; making use of databases of sequence and structure. Protein structure and drug discovery, Proteins in disease

UNIT 3

The structure, function and evolution of the human genome. Strategies for large-scale sequencing projects. Human disease genes. Expression.

UNIT 4

Bioinformatics for the analysis of sequence data; approaches for determining gene expression patterns and functions.

Reference

1) Lesk, Arthur M, Introduction to Informatics, 2nd Edition, Oxford University Press, 2005, ISBN 0 19 9277877. http://www.oup.com/uk/orc/bin/9780199277872/freelecturer/figures/

2) Lesk, Arthur M, Introduction to Protein Science, Oxford University Press, 2004, ISBN 0 19 926511 9. http://www.oup.com/uk/orc/bin/9780199265114/resources/figures/
3) Nature, Genome gateway: http://www.nature.com/nature/supplements/collections/humangenome/index.html
4) Science, Human Genome special issue http://www.sciencemag.org/content/vol291/issue5507/index.dtl
5) This Unit Web site: http://www.lsbu.ac.uk/biology/proteomics/
6) Campbell, A. Malcolm and Heyer, Laurie J., Discovering Genomics, Proteomics & Bioinformatics, Benjamin Cummings, 2002.
7) Fersht, A. Structure and Mechanism in Protein Science, W. H. Freeman (1999).
8) Carey P. R. (Ed.) Protein engineering and design, Academic Press (1996).
9) Strachan T. and Read A. P. Human Molecular Genetics, 2nd edition. Bios (1999)
10) Glick, Bernard R. and Pasternak J. J., Molecular Biotechnology: principles and applications of recombinant DNA, 2nd ed. ASM Press (1998)
11) Brown T. A. Genomes, Bios (1999)
12) Attwood T. K. and Parry-Smith D. J. Introduction to Bioinformatics, Longman (1999)
13) Rees A R., Sternberg M. J. E. and Westsel R., Protein Engineering - a practical approach, IRL Press (1992).
14) Walker J. M. and Rapley R., Molecular Biology and Biotechnology, 4th ed. Royal Society of Chemistry (2000).

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Semester VI

Paper XXXIII -RDT Recombinant DNA Technology Marks 50 (3 Cr)

45 contact hrs

Unit 1: Isolation, Identification, and Characterization of DNA Fragments:

Nucleic Acid Purification methods, Yield Analysis,

Radiolabelling of Nucleic acids: Probe preparation by random primer, nick translation, end labelling. Primer extension labelling, Non radioactiv probes, molecular probes (Immunogenetics purposes)

Southern and Northern Hybridization –principle, method and listing applications only. **Techniques of introducing DNA into cell**-calcium chloride transformation & High efficiency transformation by electroporation, Agrobacterium-mediated transformation, Protoplast transformation, Particle gun

Unit 2: Molecular Tools and Applications:

Polymerase Chain Reaction-Essential features, design of primers, DNA polymerases for PCR, study with reference to principle, methodology and single application in detail, conventional PCR, RT-PCR.

Mutagenesis: random mutagenesis and directed mutagenesis(primer extension method, error prone PCR methods)

Applications of rDNA technology – in understanding genes & genomes, in biotechnology (protein production & protein engineering), in medicine & forensics, transgenic plants & animals, Organism cloning, Engineering of β-carotene, engineering of abzymes and phage display for hormone engineering.

Mappping: promoter (Foot printing analysis), Transcriptional start site (Primer extension), Size of transcirpt –run off and run on assay.

Unit 3: Gene Cloning strategies and analysis

Cloning strategies- cloning from mRNA, cloning from genomic DNA, Cosntruction of Genomic library Maniatis Strategy, cDNA cloning with conventional cDNA and full length cDNA.

Genetic selection and screening methods- Chromogenic substrates, insertional inactivation, complementation

Screening using nucleic acid hybridization – Nucleic acid probes, screening clone banks

Immunological screening for expressed genes

Analysis of cloned genes- in vitro mRNA translation, restriction mapping, blotting techniques, DNA sequencing

References:

1. An introduction to Genetic Engineering –Desmond S T Nicholl ,Cambridge university press, 2nd Ed.
2. Recombinant DNA: A short Course, Watson J.D, CSHL press
3. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.
4. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.
5. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.
6. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.
7. Winneker From Genes to Clones.
8. Setlow & Hollander A, Genetic Engineering: Principles & Methods, Plenum Press.
9. D.M Glover, DNA cloning, A practical approach.
10. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.

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Semester VI

Paper XXXIV –FTC **Fermentation Technology** **Marks 50 (3 Cr)**

45 contact hrs

Unit I Microbial Fermentations

Media formulation, Industrial production, Downstream processing, Biosynthesis, Regulation and metabolic control of:

a) Organic acid – Citric acid

b) Enzyme –Protease

c) Organic Solvent –Ethanol

d) Amino acid –Lysine.

Unit II Modern trends in Microbial Production

Media formulation, Industrial production, Downstream processing, Biosynthesis, Regulation and metabolic control of: a) Antibiotic- Penicillin

a) Vitamin- Vitamin B_{12}
b) Microbial Polysaccharide- Xanthan
c) Vaccines – Polio vaccine
d) Mass production and field applications of *Rhizobium, Azotobacter, Azolla* bio-fertilizers.
e) Biopesticides - Principles and applications of biopesticide with reference to *Bacillus thuringiensis*
f) Milk Products- Cheese production
g) Single cell protein

References:

1. Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi
2. Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press.
3. Stanbury, P. F. and Whittaker, A. 1984 Principles of Fermentation technology, Pergamon press
4. Prescott. S.C and Dunn, C. G., 1983 Industrial Microbiology, Reed G. AVI tech books.
5. A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
6. Indian Pharmacopia and British Pharmacopia (Latest Edn).
7. Comprehensive Biotechnology volume 3 – Murray Moo- Young

8. Basic biotechnology- Colin Ratledge & Bijon Kritinsen, Cambridge university press, UK
9. Biotechnology: A textbook of microbiology by Cruger and Cruger, Sinaeur associates.
10. Industrial Microbiology by G.Reed (Ed.), CBS Publishers (AVI Publishing Co.)

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Semester VI

Paper XXXV –BET **Bioethics** **Marks 50 (3 Cr)45 contact hrs**

Unit 1

Biotechnology and Society: Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.

Unit 2

Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. **Ethical issues** – ethical issues against the molecular technologies. Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Legal issues – legal actions taken by countries for use of the molecular technologies. Social issues - public opinions against the molecular technologies. Intellectual Property Rights – Why IPR is necessary, TRIPS & IPR, IPR – national & international scenario, IPR protection of life forms.

Unit 3

Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

Unit 4

Biosafety concepts and issues: Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world. Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution Biosafety regulations in the

handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad

Text / Reference Books:

1. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
2. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed).
ASM Press, Washington.
3. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.
4. Encyclopedia of Bioethic

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Semester VI

Paper XXXVI –MML Metabolism of Macromolecules Marks 50 (3 Cr)

45 contact hrs

Unit I: Carbohydrate Metabolism

Importance of glucose in metabolism, glucose transport, Definition, concept, Metabolic map with enzyme and overall Balance sheet of Net gain of ATP; Glycolysis, TCA, HMP, Gluconeogenesis. Electron transport & Oxidative phosphorylation, components involved in Electron transport, Respiratory chain, Oxidative phosphorylation & mechanism. Energies of oxidative phosphorylation.

Unit II: Lipid Metabolism:

Fatty acid are activated and transported in Mitochondria. Oxidation of fatty acid (Palmitic acid) Fatty acid biosynthesis : Formation of malonyl COA from Acetyl COA, FAS – Multienzyme complex & Reaction of palmitic acid.

Unit III: Biosynthesis of Amino Acid

Metabolic fates of amino groups, Deamination, Decarboxylation & Transamination reactions. Biosynthesis of phenylalanine, Tyrosine & Tryptophan; Biosynthesis of Chorismate, Chorismate to Tryptophan, Phenylalanine & Tyrosine with chemical reaction and enzymes.

Unit IV: Biosynthesis of nucleotides: -

Denovo & Salvage pathway (introductory) Denovo purine nucleotide synthesis from PRPP to IMP, IMP to AMP& GMP; Pyrimidine nucleotide biosynthesis Denovo.

References:

1. Biochemistry by Lubert Stryer,III edn,1988. W.H. Freeman & Co.
2. Principles of Biochemistry by Lehninger, II edn, 1978, Worth Publisher Inc.
3. Biochemistry by Zubay, III edn, 1933, W.C Brown Publisher.
4. Outline of Biochemistry by Cohn and Stump.
5. Practical Biochemistry by D. Plummer.
6. Practical Biochemsitry by J. Jayraman

B.Sc. III Biotechology

Semester VI

Paper XXXVII –EEL Ecology and Evolution Marks 50 (3 Cr)

45 contact hrs

Unit 1: Introduction: Definition of ecology, branches of ecology, ecological tools and techniques, significance of ecology for man.

Unit 2: Environment: Definition, types, Abiotic and biotic factors, Biotic communities, Ecosystem and its structure: abiotic & biotic living components, food chains and its types (Grazing, detritus), food pyramids, energy flow in ecosystems.

Unit 3: Evolution: Introduction, theories of organic evolution, Examples and types of natural selection, classification of evolution, evidence for evolution through cladogenesis and natural selection, evolutionary trends and systematics

Unit 4: Adaptation, Adaptive radiation, Speciation: Nature of speciation, Modes of speciation, instantaneous speciation.

References:

1. Darwin's Universe: Evolution from A to Z by Richard Milner
2. Cell biology, genetics,Molecular biology, evolution and ecology by P.S Verma and V.K Agrawal
3. Fundamentals of ecology by Eugene Odum

B.Sc. III Biotechnology

Semester VI

LC XVI r-DNA Technology and Fermentation Technology

Marks 100 (3 Cr)

PRACTICALS

Section A:r-DNA Technology

1. Isolation of genomic DNA from bacterial cell.
2. PCR amplification of isolated bacterial genomic DNA using universal primers
3. Extraction and purification of amplified DNA fragment from gel.
4. Ligation of amplified DNA fragment in cloning vector (T/A cloning)
5. Transformation E. coli and screening of recombinants by blue white selection
6. Plasmid Isolation and Characterization from recombinant bacterial colonies
7. Restriction digestion for confirmation of cloned DNA
8. Sequencing of clones
9. Preparation of Biotinylated Probes by Nick Translation
10. Southern Hybridization using Biotinylated probe

Section B: Fermentation Technology

1. Citric Acid Fermentation and CT
2. Ethanol fermentation and CT
3. Vitamin B12 fermentation and CT
4. Xanthan production,
5. Azotobacter as biofertilizer
6. BT biopesticide preparation
7. Study of cheese production
8. SCP.

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Semester VI

LC XVII Metabolism, Ecology and Evolution

Marks 100 (3 Cr)

Section A: Metabolism

1. Detection of Phospholipids content in oil.
2. Isolation & Detection of Succinate dehydrogenase.
3. Separation of DNA, RNA, Protein from tissue extract.
4. Estimation of amino acid by ninhydrin Method.
5. Estimation of aromatic amino acid by Folin-Phenol reagent.

Section B: Ecology and Evolution

1. Isolation of microorganisms from different habitats and study their morphological and biochemical characteristics.
2. Study of Symbiotic association between microbes and plant -mycorrhiza
3. Study of plant-plant interactions –orchids
4. Stud of Symbiotic association between Microbes and Sea animal – Bioluminescence
5. Study of Parasitism –plant –plant
6. Poisonous sea fishes –demonstration
7. Mapping plant diversity of specific location

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Semester VI

LC XVIII

Project in lieu of Genomics –proteomics and Bioethics

Marks 100 (3 Cr)

Project : Guidelines

1) Project should be NOT less than 10000 word
2) One copy of the project should be hand-written
3) Other 3 copy typed and submit to Collage/ Institute / Department
4) Project should be written in International standard with at least or not less than 25 references.
5) References quoted should be from peer reviewed international journals, available on Scopus/ Research Gate/ Or Pubmed and **should not be merely from www.google.com**.
6) The dissertation preparation must be as per ***research article published in "CELL" http://www.cell.com/cell/authors*** **. Please avoid *guidelines provided for Resource article,Theory articles matters arising article or review.***
7) Your dissertation may include figures and tables more than in number prescribed by Cell for a Research article. This is because, you are not additionally providing "Supplement information" all data is to be included in the dissertation.
8) Project may pertain to the above mentioned themes or relevant to any course studied during last three years.

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