2015
-16

Multani Mal Modi College, Patiala

Unit Planning B. Sc Biotechnology

Department of Biotechnology

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
B. Sc. Biotechnology -I(SEMESTER-Ist)
Paper: I
(2015-16)
Subject: PUNJABI COMPULSORY (ELEMENTARY KNOWLEDGE)

Max Marks: 75 **Maximum Time: 3 Hrs.**

TILLMST-I
ਭਾਗ–ੳ (1). ਗੁਰਮ੍ਖੀ ਵਰਣਮਾਲਾ ਤੇ ਲੇਖਣ–ਪ੍ਰਬੰਧ (ੳ) ਅੱਖਰ ਸਿੱਖਿਆ: ਤਰਤੀਬਵਾਰ ਤੇ ਭੁਲਾਵੇਂ ਅੱਖਰ। (ਅ) ਅੱਖਰ ਬਣਤਰ: ਅੱਖਰ ਰੂਪ ਤੇ ਲੇਖਣ ਦੇ ਨਿਯਮ (2). ਗੁਰਮ੍ਖੀ ਅੱਖਰ ਤੇ ਪੰਜਾਬੀ ਧੁਨੀਆਂ ਦਾ ਪ੍ਰਬੰਧ (ੳ) ਸਵਰ ਤੇ ਵਿਅੰਜਨ: ਵਰਗੀਕਰਨ ਦੇ ਸਿਧਾਂਤ ਤੇ ਉ੍ਚਾਰਨ। (ਅ) ਸਵਰ ਸੂਚਕ ਅੱਖਰਾਂ ਤੇ ਧੁਨੀਆਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ। (ੲ) ਵਿਅੰਜਨ ਸੂਚਕ ਅੱਖਰਾਂ ਤੇ ਧੁਨੀਆਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ। (ਸ) ਲਗਾਂ–ਮਾਤਰਾਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ। (ਹ) ਲਗਾਖਰਾਂ ਦੀ ਪਛਾਣ।
TILLMST-II
ਭਾਗ– ਅ (1). ਲਿਪੀ ਦੇ ਅੱਖਰਾਂ ਦੀ ਵਰਤੋਂ ਦੇ ਨਿਯਮ (ੳ) ਪੂਰੇ ਤੇ ਅੱਧੇ ਅੱਖਰਾਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ। (ਅ) ਸਵਰ ਸੂਚਕ ਅੱਖਰਾਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ। (ੲ) ਸਵਰ ਵਾਹਕਾਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ। (ਸ) ਮਾਤਰਾ ਤੇ ਸਵਰ ਵਾਹਕਾਂ ਦੀ ਸਾਂਝੀ ਵਰਤੋਂ। (ਹ) ਮਾਤਰਾ ਦੀ ਵਿਅੰਜਨ ਸੂਚਕਾਂ ਨਾਲ ਵਰਤੋਂ।
TILLFINAL EXAM
ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ ਨਾਲ ਜਾਣ ਪਛਾਣ (ੳ) ਗਿਣਤੀ (ਅ) ਹਫ਼ਤੇ ਦੇ ਦਿਨ (ੲ) ਮਹੀਨਿਆਂ ਦੇ ਨਾਂ (ਸ) ਰੰਗਾਂ ਦੇ ਨਾਂ (ਹ) ਫਲਾਂ–ਸਬਜ਼ੀਆਂ ਦੇ ਨਾਂ (ਕ) ਪਸ਼ੂ–ਛਪੰਛੀਆਂ ਦੇ ਨਾਂ (ਖ) ਪੰਜਾਬੀ ਰਿਸ਼ਤਾ–ਨਾਤਾ ਪ੍ਰਬੰਧ ਦੀ ਸ਼ਬਦਾਵਲੀ (ਗ) ਘਰੇਲੂ ਵਸਤਾਂ ਦੀ ਸ਼ਬਦਾਵਲੀ

Mode of Assessment

Mode of Assessment

Sr. No.	Component	Weightage
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part 1 (Semester-1)
Paper -II
Subject: INORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of, Ψ and , Ψ 2 , quantum numbers, radial and angular wave functions and probability distribution curve, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements and ions. Chemistry of Noble gases 3 hrs. Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds. Covalent Bond-Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. BeF2 , BF3 , CH4, PF 5, SF 6, IF 7, Sncl2 , XeF 4, BF4 - , PF 6 - , Sncl6 -2 . Section - B 1. Valence shell electron pair repulsion (VSEPR) theory to NH3, H3O + , SF4, CIF3, ICI2, and H2O. MO theory, homonuclear (elements and ions of 1st and 2nd row), and heteronuclear (BO, CN, CO+ , NO+ , CO, CN), diatomic molecules, multicenter bonding in electron deficient molecule (Boranes) percentage ionic character from dipole moment and eIectronegativity difference
TILLMST-II
Ionic SolidsConcept of close packing, Ionic structures, (NaCl type, Zinc blende, Wurzite, CaF2, and antifluorite), radius ratio rule and coordination number. Limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.
TILLFINAL EXAM
Metallic bond-free electron, valence bond and bond theories, Weak Interactions Hydrogen bonding, van der Walls forces.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part 1 (Semester-1)
Paper -II
Subject: ORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Walls interactions, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding. Curved arrow notation, drawing electron movements with half- headed and double headed arrows, homolytic and heterolytic bond breaking. Types of reagents of organic reaction. Energy considerations. Reactive intermediates-bocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effect, kinetic and stereo-chemical studies). Isomerism in alkanes, sources, methods offormation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes--nomenclature, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. The case of cyclopropane ring: banana bonds.
TILLMST-II
Concept of isomerism. Types of isomerism Optical isomerisin-elements of symmetry, molecular chirality, enantiomers, stereogenic centrec, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & Land R & S systems of nomenclature. Geometric isomerism-determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.
TILLFINAL EXAM
Conformational isomerism-conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between conti ration and conformation.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)

2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

Class – B.Sc. Biotechnology Part 1 (Semester-1)

Paper -II

Subject: PHYSICAL CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Logarithmic relations. curve sketching, linear graphs and calculation of slopes, differentiation of functions like kx, ex , x n , sin x, log x, maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions permutations and combinations. Factorials. Probability . Terms of mean and median, precision and accuracy in chemical analysis, determining accuracy of methods, improving accuracy of analysis, data treatment for series involving relatively few measurements, linear least squares curve fitting, types of errors, standard deviation, confidence limits, rejection of measurements (F-test and Q-test) numerical problems related to evaluation of analytical data. Intermolecular forces, structure of liquids (a qualitative description) Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid, Classification, structure of nematic and eholestric phases. Thermography and seven segment cell.
TILLMST-II
Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, Liquifacation of gases (based on Joule-Thomson effect).
TILLFINAL EXAM
Polarization-(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment. Induced dipole moment, measurement of dipole moment temperature method and refractivity method. Dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

Class – B.Sc. Biotechnology Part 1 (Semester-1)

Paper -III

Subject: CELL BIOLOGY

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Cell as basic unit: Cell theory and cell principle. living systems, Broad classification : PPLO's bacteria, plant and animal cells, cell, of cell types tissue, organ and organism as different level of organization of otherwise genetically similar cells. Types of cells in organisms, size, shape and organization.

Evolution : Pre-cell evolution, artificial creation of cells. Structure of eukaryotic and prokaryotic cell.

Ultrastructure: Cytoplasm: Cytoskeleton, endo-membrane system function of cell and membrane organelles. organelles Nucleus: Ultrastructure of nucleus, nuclear envelope, euchromatic, microfilaments. : Brief account of chromosomes.

Biological Membrane: Ultrastrucuture of plasma membrane and cell wall. Transportation across the plasma membrane; Model membranes and liposomes; Functions of biological membranes

Endoplasmic reticulum: structure, function of cell organelles types,biogenesis and functions of RER and SER. : General account on microsomes and signal hypothesis : Golgi bodies: Morphology of golgi complex. Cyochemistry of golgi complex.

TILL MST-II

Function of golgi complex. : Endocytosis, Recycling for secretion process and account on GERI, region : Ribosomes: Ultra structure of r-DNA, m-RNA and t-RNA. : Prokaryotic and eukaryotic ribosomes. r-DNA biogenesis. Function of ribosomes.

Ultrastructure and function : Mitochondria ultrastructure and function of cell organelles of mitochondria. Biogenesis of mitochondria. Bioenergetics – Role of mitochondria in Kreb's cycle , respiratory chain complexes, electron transport system, mitochondrial ATP'ase proton pump complexes.

Chloroplast: Cell wall of plants, morphology of chloroplast. Function and biogenesis of chloroplast.

TILL FINAL EXAM

Lysosomes and peroxisomes: Major characteristics of lysosomes. : Functions-Intracellular digestion of endocytosis. : Morphology of perexiosomes and microperoxisomes.

Biogenesis of peroxiosomes: Cytoskeletal structure (microtubules, cilia, flagella, centrioles, etc.): Microtubular organelles, ultrastructure and function of cilia flagella, centrioles and microfilaments.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-I Biotechnology SEMESTER-I

PAPER-IV

Subject: Microbiology-I

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Introduction : Historical developments and applications of microbiology 2. Modern microbiology : Relevance of microbiology to biotechnology; current status of microbiology in India.

Microscope & Microscopy: Brief account of structure, operation, principle and applications of bright field, fluorescence & electron scanning microscopes (SEM & TEM). Staining Techniques Fixation and fixatives, positive, negative, capsule staining, flagella staining, acid fast, Gram staining.

Microbial diversity: Micbiological diversity, microbial nomenclature, concept of microbial species, classification of microorganisms, Microbial taxonomy: General methods of characterization, classification and identification of microorganisms. Molecular techniques for identification of microorganisms.

Prokaryotes: A general account on characteristics, structure reproduction and functions of cell organelles of bacteria, archaebacteria, cyanobacteria, actinomycetes, mycoplasma.

TILL MST-II

Eukaryotes: A general account of characteristics, morphology, nutrition, fine structure, & functions of cell organelles of molds & slime molds, yeast, algae, protozoa, etc.

Economic importance : Economic importance of prokaryotic and of microbes eukaryotic microorganisms. Bacteriophages & : Brief account of bacteriophages (Structure & life cycle lamba phage) and cyanophages. Cyanophage.

TILL FINAL EXAM

Plant & animal viruses: Structure and reproduction of plant viruses (Tobacco mosaic virus) and animal viruses (HIV).

Microorganisms as geochemical agents : Cycles of matter (nitrogen, carbon, water, oxygen, sulphur and phosphorus) and other interactions of microbes.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
BSc-I Biotechnology SEMESTER-II
Paper- V
Subject : Punjabi

Max Marks: 75 **Maximum Time: 3 Hrs.**

TILLMST-I
ਭਾਗ–ਓ (1). ਸ਼ਬਦ ਪ੍ਰਬੰਧ: ਸ਼ਬਦ ਜੋੜਾਂ ਦੀ ਵਰਤੋਂ (ਓ) ਦੋ ਅੱਖਰੀ ਸ਼ਬਦਾਂ ਦੇ ਸ਼ਬਦ–ਜੋੜ (ਅ) ਤਿੰਨ ਅੱਖਰੀ ਸ਼ਬਦਾਂ ਦੇ ਸ਼ਬਦ–ਜੋੜ (ਏ) ਬਹੁ ਅੱਖਰੀ ਸ਼ਬਦਾਂ ਦੇ ਸ਼ਬਦ–ਜੋੜ (2). ਸ਼ਬਦਾਂ ਦੀਆਂ ਸ਼ਰੇਣੀਆਂ ਤੇ ਵਿਆਕਰਨਕ ਵਰਗਾਂ ਦੀ ਪਛਾਣ
TILLMST-II
(ਓ) ਸ਼ਬਦਾਂ ਦੀਆਂ ਸ਼ਰੇਣੀਆਂ ਦਾ ਸਿਧਾਂਤ, ਪਛਾਣ ਤੇ ਵਰਤੋਂ (ਨਾਂਵ, ਪੜਨਾਂਵ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ ਆਦਿ) (ਅ) ਵਿਆਕਰਨਕ ਵਰਗਾਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ (ਲਿੰਗ, ਵਚਨ, ਪੁਰਖ, ਕਾਲ ਆਦਿ) (1). ਸ਼ਬਦ ਬਣਤਰਾਂ ਤੇ ਵਿਆਕਰਨਕ ਇਕਾਈਆਂ ਦਾ ਸਿਧਾਂਤ ਤੇ ਵਰਤੋਂ (ਓ) ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰਾਂ ਦਾ ਸਿਧਾਂਤ, ਪਛਾਣ ਤੇ ਵਰਤੋਂ (ਅਗੇਤਰ, ਪਿਛੇਤਰ, ਸਮਾਸ, ਦੁਹਰੁਕਤੀ)
TILLFINAL EXAM
(ਅ) ਵਿਆਕਰਨਕ ਇਕਾਈਆਂ ਦਾ ਸਿਧਾਂਤ, ਪਛਾਣ ਤੇ ਵਰਤੋਂ (ਵਾਕੰਸ਼, ਉਪ–ਵਾਕ ਤੇ ਵਾਕ) (ਏ) ਸ਼ਬਦਾਂ ਦਾ ਵਿਆਕਰਨਕ ਮੇਲ: ਸਿਧਾਂਤ ਤੇ ਵਿਹਾਰ (2). ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹਾਂ ਦੀ ਪਛਾਣ ਤੇ ਵਰਤੋਂ .

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

Class – B.Sc. Biotechnology Part 1 (Semester-1I)

Paper -VI

Subject: INORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Position of elements in the periodic table, effective nuclear charge and its calculations. Atomic and ionic radii, ionization energy, electron affinity and electronegativity-definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavious. Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and arys. Comparative study (including diagonal relationship) of groups 13 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13; hydrides of boron-diborane and higher boranes, borazine, borohydrides.
TILLMST-II
Comparative study (including diagonal relationship) of groups 14-l7 elements, compounds like hydrides, oxides, oxyacids and halides of groups 14-17; fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride.
TILLFINAL EXAM
Basic properties of halogens, interhalogens and polyhalides.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part 1 (Semester-1I)
Paper -VI
Subject: ORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula vand Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: the Huckel rule, aromatic ions. Aromatic electrophilic substitution-general pattern of the mechanism, role of σ and π complexes. Mechanism or nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Methods of formation and chemical reaction of alkylbenzenes alkynyl benzenes. Nomenclature of alkenes-methods of formation, mechanisms and dehydration of alcohols and dehydrohalogenation of alkyl halides regioselectivity in alcohol dehydration. The Saytzeffrule, Hofmanr elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions Markownikoff's rule, hydroboration-oxidation, oxymercuration reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO4. Polymerization ofalkenes. Substitution and the allylic and vinylic positions of alkenes. Industrial application of ethylene and propene. Methods or fonnation, conformation and chemical reactions of Cycloalkenes.
TILLMST-II
Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions-I,2 and l,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidityn of alkynes. Mechanism of electrophilic and nucleophilic addition reactions hydroboration-oxidation. metal-ammonia reductions, oxidation and polymerization. Nomenclature and classes of alkyl halides, methods of formation chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2and SN1 reactions with energy profile diagrams.
TILLFINAL EXAM
Methods of formation of aryl halides, nuclear and side chain reactions. The addition elimination and the elimination-additional mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part 1 (Semester-1I)
Paper -VI
Subject: PHYSICAL CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Ideal and non-ideal solutions, methods of expressing concentration of solutions, activity and activity coefficients. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes. Definition of colloids, classification of colloids Solids in liquids (sols): properties-kinetic, optical and electrical; stability of colloids protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions) types of emulsions, preparation, Emulsifiers. Liquids in solids, (gels) classification, preparation and properties inhibition. General applications of colloids. Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero order, first order, second order, pseudo order, half life and mean life.
TILLMST-II
Determination of the order of reaction-s-differential method, method of integration, method of half life period and isolation method. Radioactive decay as a first order phenomenon. Theories of chemical kinetics, effect of temperature on rate of reaction. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.
TILLFINAL EXAM
Catalysis and general characteristics of catalytic reactions. Homogeneous catalysis, acid base catalysis and enzyme catalysis including their mechanisms, Michaelis Menten equation for enzyme catalysis and its mechanism.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)

2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-I Biotechnology SEMESTER-II

PAPER-VII

Subject: Cell Biology-II

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Biochemical composition: Cellular pool, water, mineral salts, proteins, of cells. carbohydrates, lipids & nucleic acids.

Cell Division & Cell cycle and general description of mitosis & meiosis; binary fission; amitosis; molecular organization of mitotic spindle apparatus.

Cellular interactions: Cell recognition & cell coat; differentiation of cell membrane; cell surface of cancer cells & altered coupling of cancer cells; inter cellular communication & gap junctions.

Cell locomotion: Cytoplasmic streaming in plant cells. : Amoeboid motion. : Cilial & flagellar movements.

TILL MST-II

Cell senescene & death : Apoptosis & necrosis. Cell differentiation in plants & animals : General characteristics of cell. Differentiation; molecular mechanism of cell differentiation.

Cellular & molecular : General organization of nerve fibres; neurobiology. functions of nerve fibres; structure of synapse & synaptic transmission; synaptic vesicles & synaptic receptor. **Cellular & molecular :** Structure of striated muscle fibre; biology of muscle molecular organization of contractile system.

TILL FINAL EXAM

Regulation and energetic of contraction: sliding mechanism of muscle contraction; excitation contraction coupling.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%

3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-I Biotechnology SEMESTER-II

PAPER-VIII

Subject: Microbiology-II

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Microbial nutrition: Requirement of nutrients for microbes and nutritional categories among microorganisms; choice of media and conditions of Incubation. Culture characteristics : Colony and broth culture characteristics. Maintenance and preservation of pure Cultures.Culture media : Preparation of culture media; types of culture media- selective/enrichment, differential, empirical and synthetic media.

Pure culture: Pure culture techniques; methods of culturing aerobic and anaerobic bacteria; culture characteristics, smearing and staining, sterilization techniques. Microbial growth : Growth curve, mathematical expression of growth, methods of measurements of growth. Factors affecting growth in continuous and batch cultures, synchronous and diauxic growth.

Strain improvement: Methods of improvement and stability of biotechnologically importance cultures. Microbial Genetics : Modes of bacterial conjugation, transduction, transformation; role of surface proteins in conjugation.

Mutation: Spontaneous and non-spontaneous mutations. Origin and use of mutations. Mutagenesis : Physical and chemical mutagenesis in microbes.

TILL MST-II

Biological Nitrogen: Microbiology of symbiotic and Fixation. Non-symbiotic nitrogen fixation.Symbiotic Nitrogen fixing system, process of root nodule formation. Metabolism of free living and symbiotic microorganism. Nitrogen fixation mechanism with structure and function of nitrogenase. Microbiology of food intoxications. Epidemiology of food intoxications.

Food borne infections-mode of Transmission and ther control (Clostridium, Salmonella, Shigella, Escheria Coli Staphylococcus aureus, Aflatoxin and Algal toxins).

TILL FINAL EXAM

Human Microflora: Microbial flora of healthy human host- origin, distribution and occurrence of normal flora germ free and gnotobiotic life.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
B. Sc. Biotechnology -II(SEMESTER-III)
Paper: I (2015-16)
Subject: English

Max Marks: 75 **Maximum Time: 3 Hrs.**

TILLMST-I
An essay of 300-350 words on a topical or reflective subject (one to be attempted out of the five given). Letter-writing with internal choice between personal and official letters. Precise. Comprehension of an unseen passage Translation of a given passage from Punjabi/Hindi into English.
TILLMST-II
Analysis of sentences: Converting simple sentences into complex and compound ones and identifying adverb clause, noun clause and adjective clause in the given sentences. Synthesis of sentences: (i) combining two simple sentences into a single simple sentence by using a participle, an infinitive, a noun or phrase in apposition, too/ enough + adjective/adverb + infinitive and the bare infinitive. (ii) Combining simple sentences into complex ones by using a noun clause, adjective clause or an adverb clause. (iii) Combining simple sentences into compound ones by using conjunctions such as 'and', 'as well as', 'not only….but also' or 'either….. or', 'neither……..nor', 'but yet', 'nevertheless', 'so', 'therefore', for each. Transformation of sentences. (i) Transformation of degree, i.e., from positive to comparative degree and positive to superlative degree.
TILLFINAL EXAM
Transformation of kinds of statements, i.e. from rhetorical or interrogative into assertive statements, from affirmative into negative sentences and from statement into exclamatory sentences. (iii) Transformation from active into passive voice and vice-versa and from direct speech into indirect speech and vice-versa.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part II (Semester-III)
Paper -II
Subject: INORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability to water-Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.
TILLMST-II
Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood solvent system and Lewis concepts of acids and bases. Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics.
TILLFINAL EXAM
reaction in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part II (Semester-III)
Paper -II
Subject: ORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Carboxylic Acids: Nomenclature, structure and bonding. physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of amides, Reactions of carboxylic acids, Mechanism of decarboxylation. Methods of formition and chemical reactions of halo acids. Hydroxyacids, maleic and tartaric acid, citric acids. (Structural formula only). Methods of formation and chemical reaction of unsaturated nonocarboxylic acids. Dicarboxylic acids, methods of formation and effect of heat and dehydrating agents. Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters. amides and cid anhydrides. Relative stability and reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophillic acyl substitution. Preparation of carboxylic derivatives, chemical reactions, Mechanism of esterfication and hydrolysis (acidic and basic).
TILLMST-II
Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions-cleavage and autooxidation, Ziesel' s Method. Synthesis of epoxide, add and base catalysed ring opening of epoxide, orientation of ring opening reactions ofGringard and organolithium reagents with epoxide. (3 Hrs.) Fats, Oils and Detergents: Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates. (3 Hrs.) Organic Compounds of Nitrogen (a) Nitro Compounds: Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reactions in acidic, neutral and alkaline media, Picric acid.
TILLFINAL EXAM
Amines: Reactivity, structure and nomenclature of amines, physical properties. Stereochemistry of amines Separation of a mixture secondary and tertiary amines. Structural features effecting the basicity of amines. Amine salts as phase-transfer catalyst and preparation of alkyl and aryl amines (reduction of nitro compounds and nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Haffmann bromamide reaction.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part II (Semester-III)
Paper -II
Subject: PHYSICAL CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I

Phase Equilibrium: Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule; phase equilibria of one component system-water and S systems.

Phase equilibria of two component systems-solid-liquid equilibria, simple eutectic Pb-Ag sytems, desilverisation of lead.

Solid Solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCI-Hp), ($FeCI_3H_2O$) systems. Freezing mixtures, acetone-dry ice.

Liquid-Liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law.

Non-ideal system-azeotropes-HCI-HP and ethanol-water systems.

Lower and upper consolute temperature, Effect of impurity on consolute temperature, immiscible liquids, steam distillation.

Nernst distribution law, thermodynamic derivation & applications.

Electrochemistry-l (a): Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance with dilution.

Migration of ions and Kohlrausch law. Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementa treatment only).

TILLMST-II

Transport number, definition and deterriilfiafion by Hittorf method and moving boundary method. Applications of conductance measurements: determination of degree of dissociation, determination of K. of acids, determination of solubility product of a sparingly soluble salts, conductometric titrations.

Electrochemistry-II: Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode. potential, sign conventions, electrochemical series and its significance.

Electrolyte and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements, Computation of cell EMF. Calculation of thermodynamic quantities of cell reaction (G, H and K), polarization, over potential and hydrogen over voltage.

TILLFINAL EXAM

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient potentiometric titrations.

Definition of pH and pK., determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiomentric methods.

Buffers - mechanism of buffer action, Henderson-Hazel equation, Hydrolysis of saits,

Corrosion - types, theories and methods of combating it.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part II (Semester-III)
Paper III
Subject: Biochemistry

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Introduction to Biochemistry, water as a biological solvent, dissociation of water, pH, buffer solutions, Handerson Hasselbalch equation. Amino acids, amino acids titration curves, physical & chemical properties of amino acids, peptide bonds, rigid & planar nature of a peptide bond, Ramachandran Plot, folding of peptide chains into regular repeating structure (helix, pleated sheets), β turns in polypeptides.

Amino acid sequencing of polypeptides. Proteins: Levels of structure in protein architecture, forces stabilizing structure and shape of proteins, native proteins & their conformations, denaturation of proteins, protein folding & design.

Carbohydrates: Fisch & Hawarth structures of carbohydrates, stereoisomerism & mutarotation, anomeric forms of monosaccharides, eractions of monosaccharides, characteristics of the aldehyde, ketones and hydroxyl groups, glycosidic bonds, amylase, amylopectin, starch., cellulose, chitin, pectins, glycosaminoglycans (mucopolysaccharides).

Structure & functions of lipids, fatty acids, triacylglycerols, glycerophospholipids, sphingmylins, lipoproteins, Liposomes, biological membranes and micelles.

β-Oxidation of fatty acids, formation of Ketone bodies, Biosynthesis & catabolism of triglycerides, phosphoglycerides & sphingolopids, synthesis of cholesterol and fatty acids.

TILL MST-II

Nucleic Acids: Structure & properties of purine and pyrimidine bases. Nucleosides and nucleotides, biological function's of DNA and RNA species. Double helical model of DNA & forces responsible for it. Short hand representation of nucleic acid back bone, denaturation of DNA, methods for isolation and purification of nucleic acids. Biosynthesis & degradation of purines and pyrimidines.

Deamination, Transamination, decarboxylation reaction, hormones and vitamins, Urea cycle.

Metobolic pathways: Basic concept & design, glycolyis, TCA cycle, Pentosephosphate pathway, gluconeogenesis & glycogen metabolism.

TILL FINAL EXAM

Enzymes and coenzymes, units of enzyme activity, enzyme nomenclature and classification. Enzyme Kinetics, effect of substrate concentration on Michaelis - Menten equation, effect of pH and temperature on rates of enzymes catalyzed reaction.

Enzyme inhibitors and their importance, chemical methods of active site studies, Introduction of multi substrate enzymes, allosteric enzymes and enzyme regulation, isoenzymes, enzyme immobilization.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-II Biotechnology SEMESTER-III

PAPER-IV

Subject: Genetics

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Genetic material: Evidence of DNA as genetic material; Griffith's transformation experiments Hershey and Chase experiment; Structure of DNA: Watson-Crick model; Structure of RNA: Clover leaf structure of RNA; eukaryotic mRNA-capping, polyadenylation.

Genome concept: Chromosome structure-Prokaryotic and eukaryotic chromosome nucleosome structure; Chromosome morphology: Position of centromere banding pattern, Telomeres; Nucleolar organizer region (NOR); Heterochromatin and euchromatin. Aneuploidy and polyploidy, Trisomy 21, Down's syndrome.

Mendel's Laws: Principle of segregation; Principle of independent assortment; Mode of inheritance: Recessive, Dominant, Sex linked, etc.; Extra chromosomal-Mitochondrial, chloroplast and plasmid inheritance DNA.

Mutations: Spontaneous (Basic mechanism) and induced mutagens; chemical: Base analogs, Base modifiers, intercalating agents; Physical: Ionizing and non-ionizing radiations.

DNA replication: Photoreactivation; Excision repair; Mismatch repair; SOS repair. Bacterial DNA replication; DNA replication in eukaryotes; Reverse transcription in retrovirus.

Gene transcription: Characteristics of genetic code, Transcription in prokaryotes and Transcription in eukaryotes: RNA polymerase, I, II, and III; Transcription factors, promoters and initiation complex.

TILL MST-II

Regulation of gene expression in prokaryotes: Organization of *E. coli* genes, Operon hypothesis. Regulations of gene expression in eukaryotes: Promoters enhancers, Response elements motifs: Zinc finger, Helix turn helix; Transcription factors, Hormones, Cytokines.

Translation: Charging of RNA initiation, elongation termination; Post translational modifications.

Population genetics: Genetics in population: Lardy-Weinberg equilibrium; factors

distorting equilibrium selection mutation, migration; Chi-square test.
TILL FINAL EXAM
Genetic diversity and evolution: Source of variation, Mutation Vs selection, heterozygote advantage, drift and founder effect; chromosomal changes: Karyotype & banding pattern, chromosomal rearrangement; deletion, duplication, translocation inversion, sex chromosome anomalies, evolutionary effects; molecular clocks; phylogenetic trees.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
BSc-II Biotechnology SEMESTER-IV
Paper- V
Subject : English

Max Marks: 75 **Maximum Time: 3 Hrs.**

TILLMST-I
An essay of 300-350 words on a topical or reflective subject (one to be attempted out of the five given). Letter-writing with internal choice between personal and official letters. Precise. Comprehension of an unseen passage Translation of a given passage from Punjabi/Hindi into English.
TILLMST-II
Analysis of sentences: Converting simple sentences into complex and compound ones and identifying adverb clause, noun clause and adjective clause in the given sentences. Synthesis of sentences: (i) combining two simple sentences into a single simple sentence by using a participle, an infinitive, a noun or phrase in apposition, too/ enough + adjective/adverb + infinitive and the bare infinitive. (ii) Combining simple sentences into complex ones by using a noun clause, adjective clause or an adverb clause. (iii) Combining simple sentences into compound ones by using conjunctions such as ‘and’, 'as well as', 'not only….but also' or 'either….. or', 'neither……..nor', 'but yet', ‘nevertheless’, 'so', ‘therefore’, for each. Transformation of sentences. (i) Transformation of degree, i.e., from positive to comparative degree and positive to superlative degree.
TILLFINAL EXAM
Transformation of kinds of statements, i.e. from rhetorical or interrogative into assertive statements, from affirmative into negative sentences and from statement into exclamatory sentences. (iii) Transformation from active into passive voice and vice-versa and from direct speech into indirect speech and vice-versa.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part II (Semester-1V)
Paper -VI
Subject: INORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability to water-Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.
TILLMST-II
Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood solvent system and Lewis concepts of acids and bases.
TILLFINAL EXAM
Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

Class – B.Sc. Biotechnology Part II (Semester-IV)

Paper -VI

Subject: ORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Nomenclature, structure and bonding. physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of amides, Reactions of carboxylic acids, Mechanism of decarboxylation. Methods of formition and chemical reactions of halo acids. Hydroxyacids, maleic and tartaric acid, citric acids. (Structural formula only). Methods of formation and chemical reaction of unsaturated nonocarboxylic acids. Dicarboxylic acids, methods of formation and effect of heat and dehydrating agents. Structure and nomenclature of acid chlorides, esters. amides and cid anhydrides. Relative stability and reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophillic acyl substitution. Preparation of carboxylic derivatives, chemical reactions.
TILLMST-II
Mechanism of esterfication and hydrolysis (acidic and basic). Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions-cleavage and autooxidation, Ziesel' s Method. Synthesis of epoxide, add and base catalysed ring opening of epoxide, orientation of ring opening reactions ofGringard and organolithium reagents with epoxide. Fats, Oils and Detergents: Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates. (3 Hrs.) Organic Compounds of Nitrogen (a) Nitro Compounds: Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reactions in acidic, neutral and alkaline media, Picric acid.
TILLFINAL EXAM
Amines: Reactivity, structure and nomenclature of amines, physical properties. Stereochemistry of amines Separation of a mixture secondary and tertiary amines. Structural features effecting the basicity of amines. Amine salts as phase-transfer catalyst and preparation of alkyl and aryl amines (reduction of nitro compounds and nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Haffmann bromamide reaction.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

LEAD ME TO LIGHT FROM DARKNESS

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part 1 (Semester-1I)
Paper -VI
Subject: PHYSICAL CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I

Phase Equilibrium: Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule; phase equilibria of one component system-water and S systems.
Phase equilibria of two component systems-solid-liquid equilibria, simple eutectic Pb-Ag sytems, desilverisation of lead.
Solid Solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCI-Hp), ($FeCI\text{-}_3H_2O$) systems. Freezing mixtures, acetone-dry ice.
Liquid-Liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law.
Non-ideal system-azeotropes-HCI-HP and ethanol-water systems.
Lower and upper consolute temperature, Effect of impurity on consolute temperature, immiscible liquids, steam distillation.
Nernst distribution law, thermodynamic derivation & applications.
Electrochemistry-l (a): Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance with dilution.
Migration of ions and Kohlrausch law. Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementa treatment only).
Electrochemistry-I (b): Transport number, definition and deterriilfiafion by Hittorf method and moving boundary method. Applications of conductance measurements: determination of degree of dissociation, determination of K. of acids, determination of solubility product of a sparingly soluble salts, conductometric titrations I

TILLMST-II

Electrochemistry-II: Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode. potential, sign conventions, electrochemical series and its significance.
Electrolyte and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells.
EMF of a cell and its measurements, Computation of cell EMF. Calculation of thermodynamic quantities of cell reaction (G, H and K), polarization, over potential and hydrogen over voltage.
Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient potentiometric titrations.

TILLFINAL EXAM

Definition of pH and pK., determination of pH using hydrogen, quinhydrone and glass

electrodes, by potentiomentric methods.
Buffers - mechanism of buffer action, Henderson-Hazel equation, Hydrolysis of saits, Corrosion - types, theories and methods of combating it.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-II Biotechnology SEMESTER-IV

Paper VII

Subject: Biophysics

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Thermodynamics: Laws of thermodynamics, concept of enthalpy, heat capacity at constant volume and pressure, isothermal expansion, differential scaning calorimetry, concept of entropy, statistical and thermodynamic definitions of entropy, entropy change due to mixing of ideal gases, entropy change due to heating, Gibb's free energy, free energy spontaneity criteria, dependence of free energy on temperature (Gibb's Helmholtz equation), dependence of free energy on pressure, Vant Hoff equation, bioenergetics, physical chemist and biochemist standard states, coupled reactions, high energy bonds.

Chemical Kinetics: Reaction rate, order of reaction, revaluation of DNA case study, half life of a reaction. Determination of reaction order, molecularity of reaction. Complex reaction, consecutive kinetics, isotope effect, reactions in solution, fast reaction in solution (the flow method and the relaxation method).

Quantum Mechanics: Wave theory of light. Planck's quantum theory, photoelectric effect, de Broglie's postulate, Bohr's theory of atomic spectra, Huckel theory; Schrodinger's wave equation, Heisenberg's uncertainty principles, particles in one dimensional box, quantum mechanical tunnelling.

TILL MST-II

Spectroscopic Techniques: Beer's Lambert Law, U.V. visible spectrophotometry, IR spectroscopy and spectro fluorimetry: principle & biological applications. ORD & CD spectroscopy, NMR & mass spectrometry Principle & biological applications.

Electrophoretic Techniques: Principles and applications of electrophoretic techniques in purification and characterization of biomolecules isoelectric focusing, & immunoelectrophoresis, SDS - PAGE & agarose gel electrophoresis.

Chromatographic Techniques: General principle of gas chromatography, HPLC.

TILL FINAL EXAM

Chromatographic Techniques: General principle of chromatography and applications of adsorption, partition and thin lager chromatography, Ion exchange, exclusion and affinity

chromatography.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-II Biotechnology SEMESTER-IV

PAPER-VIII

Subject: R-DNA Technology

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

- Introduction: A brief introduction to R-DNA technology
- Tools of R-DNA technology: DNA cutting tool, Restriction enzymes; DNA end modifying tools; 3' nucleotidyl transferase; 5 nucleotidyl kinase; alkaline phosphates; T4 DNA ligase joining DNA fragments; nucleic acid probes.
- Techniques for genetic engineering: Southern blotting, Northern blotting and Western blotting.
- DNA Sequencing: Maxam-Gilbert technique, Sanger's dideoxy chain termination; Polymerase chain reaction; Agarose gel electrophoresis.
- Introduction to Cloning Genes: Cloning by direct cDNA cloning.
- Vectors: Plasmids, bacteriophages, Shuttle vectors, Retro viruses.
- Transformation Techniques: Competent *E. coli* cells, Yeast spheroplasts, *Bacillus* protoplast; $CaCl_2$ method, Biolistic gun; Electroporation, Phage transfection.

TILL MST-II

- Cloning in *E. coli*: Selection of transformants.
- Cloning in yeast: Selection of transformants.
- Cloning in plant cells: Selection of transformants.

TILL FINAL EXAM

- Application of R-DNA technology in agriculture, Medicine and Industry.
- RFLP and prenatal diagnosis.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

B. Sc. Biotechnology –III (SEMESTER-V)

Paper -I

Subject: INORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Metal-ligand bonding in transition metal complexes*:* Limitations of valence bond theory, an elementary idea of crystal- field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.
Thermodynamic and kinetic aspects of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.
Magnetic properties of transition metal complexes: Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling.
TILLMST-II
Correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moment, application of magnetic moment data for 3d-metal complexes.
Electronic spectra of transition metal complexes: Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series.
TILLFINAL EXAM
Orgel-energy level diagram for d^1 and d^9 states, discussion of electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complexion.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part III (Semester-V)
Paper -I
Subject: ORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Spectroscopy: Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2 tribromoethane, ethyl acetate, toluene and acetophenone. Electromagnetic spectrum: Absorption spectra-ultraviolet (UV) absorption spectroscopy, absorption laws (Beer-Lambert's law, Molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation; Concept of chromophore and auxochrome; Bathochromic, hypsochromic, hyperchromic and hypochromic shifts; UV spectra of conjugated enes and enones. Infrared (IR): Infrared (IR) absorption spectroscopy-molecular vibrations, Hooke's law, Selection rules, intensity and position of IR bands, measurement of lR spectrum, fingerprint region.
TILLMST-II
Characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds; Problems pertaining to the structure elucidation of simple organic compounds using UV, IR, and PMR spectroscopic techniques. Organometallic compounds: Organomagnesium compounds - the Grignard reagents formation, structure and chemical reactions; Organozinc compounds - formation and chemical reactions; Organolithium compounds - formation and chemical reactions.
TILLFINAL EXAM
Organosulphur compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, and sulphonamides.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part III (Semester-V)
Paper -I
Subject: PHYSICAL CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Elementary quantum mechanics: Black-body radiations, Planck's radiation law, photoelectric effect, heat capacity of solids; Sinusoidal wave equation Hamiltonian operator, Schrodingcr wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box; Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions. Introduction to spectroscopy: Electromagnetic radiation, regions of spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degrees of freedom.
TILLMST-II
Rotational spectrum: Diatomic molecules; Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, determination of bond length, qualitative description of non-rigid rotor, isotope effect. Vibrational spectrum: Infrared spectrum-Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity.
TILLFINAL EXAM
Determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-III Biotechnology SEMESTER-V

Paper II

Subject: ENVIRONMENTAL BIOTECHNOLOGY

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Introduction: Brief introduction to environment; Indicators of pollution: Physicochemical and Biological

Pollution: Air pollution: Units of measurements, sources of pollutants and hazards. Soil pollution: sources of pollutants and hazards. Water pollution: sources of pollutants and hazards.

Waste-water treatment: Aerobic: Brief account of activated sludge reactors, aerated ponds and lagoons, trickling filters.

Anaerobic waste-water treatment: Outline of biogas production, up-flow anaerobic sludge blanket reactor, anaerobic filter reactor, contact reactor, factors affecting process operation, status of biogas production in India.

TILL MST-II

Vermicomposting: Vermicomposting process, types of vermicomposting systems, vermicomposting product, waste management by vermicomposting, effect of wastes vermicompost on the growth and yield of plants.

Bioremediation: General description of bioremediation and application of biotechnology; Removal/remediation of heavy metals, pesticides and xenobiotics, paper, dye and textile industry effluents

TILL FINAL EXAM

Pollutant monitoring I: Biosensors: Introduction Principle and Applications for the detection of heavy metal ions, pesticides and pathogens. Pollutant monitoring II: Principle, working and applications of GC and HPLC. Pollutant monitoring III: Spectroscopic techniques for monitoring pollutants.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%

3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-III Biotechnology SEMESTER-V

Paper III

Subject: Immunology

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Introduction: Basic concepts and history of immunology. Active and Passive immunity, Innate and Adaptive immunity;Antigen and antigenicity.

Cells and organs involved in immune response; Compliment system; Macrophage structure and function.

Immune response: Humoral immunity and cell mediated immune response.

Immunoglobulins: Structure and functions; Brief account of antibody diversity.

Immunotechniques: Techniques to evaluate humoral and cell mediated immune response.

Hypersensitivity: Types, mechanism and mediators.

Auto immunity and AIDS: Introduction, causes, prevention and vaccines.

TILL MST-II

Major Histocompatibility complex: Structure of MHC I and MHCII, tissue typing, Applications in immunity, diseases (Graft versus Host reaction)

Transplantation. Basic concept of immunomodulation: immunosuppression and immunopotentiation

Hybridoma technology: Introduction, production of monoclonal antibodies; Applications.

TILL FINAL EXAM

Vaccines: Introduction to conventional and modern vaccines; Advantages, mechanism of action, mode of secretion.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
BSc-III Biotechnology SEMESTER-V
Paper IV
Subject: Biochemical Engineering

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Basic concepts of biochemical engineering, outlines of bioprocess development.

Sterilization: Medium sterilization in batch and continuous systems; Sterilization of air filters.
Bioreactor: Introduction to types of bioreactors; Aeration and agitation, Batch, fed batch and continuous systems of fermentation; Scale-up. Kinetics.

Bioprocess control and monitoring systems: General introduction on instrumentation for monitoring and controlling of bioreactors.

Transport phenomena in bioreactors: Mass transfer coefficient (KLa) for gases and liquids; Heat transfer coefficient; Determination of KLa; Factors affecting KLa in bioprocesses.
Cell separation methods: Extraction methods for products recovery.

TILL MST-II

Principles of solid-liquid extraction and liquid-liquid extraction.
Microbial cell disruption of cells: Physical, chemical and enzymatic methods. **Downstreaming processing** I: Separation of cells-foam separation, flocculation, agglomeration, filtration and centrifugation.

Chromatography: Brief account of chromatographic techniques for purification of bioproducts.

TILL FINAL EXAM

Finishing steps of purification: Brief account of distillation, electrodialysis, evaporation, drying and crystallization. A brief account of cost determination of bioprocesses.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)

2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-III Biotechnology SEMESTER-VI

Paper- V

Subject: INORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Hard and soft acids and bases (HSAB): Classification of acids and bases as a hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness; Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness. Bioinorganic chemistry: Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin; Biological role of alkali and alkaline earth metal ions with special reference to Ca^{+2}, nitrogen fixation.
TILLMST-II
Silicones and phosphazenes: Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes. Organometallic chemistry: Definition, nomenclature and classification of organometallic compounds; Preparation, properties, bonding and applications of alkyls of' Li, Al, Hg, Sn and Ti.
TILLFINAL EXAM
Brief account of metal-ethylene complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Mode of Assessment

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part II (Semester-IV)
Paper -VI
Subject: ORGANIC CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Heterocyclic compounds: Introduction – Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine; Methods of synthesis and chemical reactions with particular emphasis on mechanism of electrophlic substitution; Mechanism of nucleophlic substitution reaction in pyridine derivatives; Comparison of basicity of pyridine, piperidine and pyrrole; Introduction to condensed five and six membered heterocycles; Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler- Napieralski synthesis; Mechanism of electrophlic substitution reactions of indole, quinoline and isoquinoline. Synthesis of polymers: Ziegler-Natta polymerziation and vinyl polymers; Condensation or step growth polymerization; Urea formaldhehyde resins, epoxy resins and polyurethanes; Natural and synthetic rubbers. Organic synthesis via enolatcs: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate; Synthesis of ethyl acetoacetate – Claisen condensation; Keto-enol tautomerism of ethyl acetoacetate; Alkylation and acylation of enamines.
TILLMST-II
Carbohydrates: Classification and nomenclature, monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses; Configuration of monosaccharides; Erythro and threodiastereomers; Conversion of glucose into mannose; Formation of glycosides, ethers, and esters; Determination of ring size of monosaccharides; Cyclic structure of D (+)-glucose; Mechanism of mutarotation; Structures of ribose and deoxyribose; An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharide starch and cellulose without involving structure determination. Amino Acids, peptides, proteins and nucleic acids: Classification, structure and stereochemistry of amino acids; Acid base behaviour, isoelectric point and electrophoresis; Preparation and reactions of α-amino acids.
TILLFINAL EXAM
Structure and nomenclature of peptides and proteins; Classification of proteins; Peptide structure determination, end group analysis, selective hydrolysis of peptides; Classical levels of protein structure; Protein denaturation/renaturation; Nucleic acids – Introduction, constituents of nucleic acids, ribonucleosides and ribonucleotides, the double helical structure of DNA.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)

2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA
UNIT PLAN
Class – B.Sc. Biotechnology Part 1 (Semester-1I)
Paper -VI
Subject: PHYSICAL CHEMISTRY

Max Marks: 35 **Maximum Time: 3 Hrs.**

TILLMST-I
Raman spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Electronic spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle; Qualitative description of σ, π and n M.O., their energy levels and their respective transitions. Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical process; Laws of photochemistry- Grothus-Drapperlaw, Stark-Einstein law, Jablonski diagram depiciting various processes occurring in the excited state, qualitative description of fluorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).
TILLMST-II
Solid state: Definition of space lattice and unit cell; Laws of crystallography – Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry elements in crystals; X-ray diffraction by crystals.
TILLFINAL EXAM
Derivation of Bragg's equation; Determination of crystal structure of NaCI, KCI and CsCI (Laue's method and powder method).

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-III Biotechnology SEMESTER-VI

Paper VI

Subject: Microbial Technology

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

A brief account of historical developments in microbial technology.

Primary metabolites: Production of vitamin B12, citric acid and lactic acid.

Secondary metabolites: Antibiotics (Penicillins, cephalosporins); Microbial lipids; Microbial siderophores.

Enzyme technology: Microbial production of alpha amylase, protease and lipase. Immobilization: Immobilization techniques, co-immobilization of cells and enzymes.

Microbial biomass for food and feed: Algal, bacterial, fungal and yeast biomass as single cell protein; Technologies for the production of SCP.

Microbial transformations: Types of transformation and industrial applications. Mineral leaching of copper and uranium.

TILL MST-II

Biopesticides and biofertilizers: A brief account of biopesticides/bioinsecticides and biofertilizers; Mass production.

Genetically modified microorganisms/products: Associated environmental hazards of genetically modified microorganisms and rDNA products.

Biosafety: Biohazard levels; Biosafety guidelines and regulations for rDNA products.

TILL FINAL EXAM

Legal biotechnology: Introduction to intellectual property rights, patents, copy rights, trade secrets and trade marks.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-III Biotechnology SEMESTER-VI

Paper VII

Subject: Tissue Culture Technology

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I
Plant tissue culture: Historical developments and major contributions; Culture media-composition and preparation. **Cellular totipotency:** Concept, callus culture and cell culture. Differentiation in callus culture: Organogenesis and embryogenesis. Micropropagation: Technique of micropropagation and virus free plant production. Protoplast isolation and culture: Fusion of protoplasts and selection of fusion products. **Transgenic plants:** *Agrobacterium* mediated-transgenic plants production. Animal cell culture: Culture media, substratum, requirement of gases, serum requirements in medium.
TILL MST-II
Establishment and maintenance of culture: From primary culture to cell line; Properties of suspension and monolayer culture. **Characterization of established cell culture**; Differentiation; Embryo transfer technology.
TILL FINAL EXAM
Somatic cell fusion: A brief discussion and applications. Industrial applications: A brief account of industrial applications of plant and animal tissue culture.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

MULTANI MAL MODI COLLEGE, PATIALA

UNIT PLAN

BSc-III Biotechnology SEMESTER-VI

Paper VIII

Subject: Fermentation Technology

Max Marks: 52 **Maximum Time: 3 Hrs.**

TILL MST-I

Raw materials: Carbon and nitrogen substrates for industrial fermentation and their composition.

Starter cultures: Techniques for the development of inoculum and aseptic inoculation for the industrial fermentation.

Fermentation types: Submerged, surface and solid state/substrate fermentation, factors affecting these fermentations.
Recombinant fermentations: Applications of recombinant microbes in fermentation industry.

Biofuels: Fermentative production of ethanol, acetone-butanol.
Alcoholic beverages: Raw materials, culture, fermentation technology and post fermentation processing of distilled alcoholic beverages (Whisky, rum, brandy). Beer and wine: Types, production and post fermentation processing.

TILL MST-II

Vinegar: Raw materials, culture, fermentation conditions and recovery.
Microbial polysaccharides: Fermentative production of dextran, xanthan gum and pullulan.
Food additives and ingredients: Fermentative production of amino acids i.e., L-glutamic acid and L-aspartic acid.

TILL FINAL EXAM

Microbial flavours: Fermentative production of vanillin, benzaldehyde and lactones.

Mode of Assessment		
Sr. No.	**Component**	**Weightage**
1	Mid Semester Test (MST)	40% (Average of 2 MST)
2	Written Assignments	40%
3	Attendance	20%

LEAD ME TO LIGHT FROM DARKNESS