

**Syllabus for three-year  
B.Sc DEGREE COURSE (Hons)  
in  
Biotechnology**

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**DURATION : Six Semesters (Three Years)  
Total Marks = 3600**

**Theoretical Papers  
24 Papers (Marks = 2400)  
Total Credit = 16 Credits per semester = 6 x 16 = 96**

**Practical / Project Papers  
12 papers (Marks = 1200)  
Total Credit = 4 Credits per semester = 6 x 4 = 24**

**Total Credit in 6 Semesters = 96 + 24 = 120**

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**4 credit (Theory) means 3 lecture hours & 1 Tutorial per week  
or 42 lectures per semester per paper**

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**2 credit (Lab.) means at least 40 hours of lab work per semester per paper**

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**COURSE STRUCTURE**

1. In view of the increasing demand for training manpower in the area of Molecular Biology, Genetic Medicine and Biotechnology, it was consensus of the committee (Faculties & experts) that this course should be broad based and should be able to give a good insight into modern biology and important component of hands-on training to the students. Thus by nature it will be an interdisciplinary course.
2. a) For admission, students from Science stream with 10+2 (HS exam) or equivalent, ISC, CBSE exam will be eligible.  
b) Admission will be through selection test **CET (Common Entrance Examination)** and also on the basis of the merit.  
c) The number of students for this course to be admitted this year will be 60.
3. The fee structure should be on no grant basis as applicable to technical courses.

**BSc : Biotechnology (Hons) Syllabus**

**FIRST SEMESTER**

**Paper (Theoretical) :**

<b>Paper Code</b>	<b>Name of the Paper</b>	<b>Marks</b>	<b>Credit hrs</b>	<b>Classes / Semester</b>
MSA-101	<b>Macromolecular Structure &amp; Analysis</b>	100	3+1	42
BPI-102	<b>Biophysics &amp; Instrumentation</b>	100	3+1	42
CSD-103	<b>Cell Structure &amp; Dynamics</b>	100	3+1	42
BMT-104	<b>Biomathematics - I</b>	100	3+1	42
CH-101	<b>Chemistry (Pass)</b>	100	3+1	42

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CA-101	<b>Introduction to Computer (Pass)</b>	100	3+1	42
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**Paper (Practical) :**

BMI-192	<b>Basic Microscopy &amp; Instrumentation</b>	100	2	40
BCH-191	<b>Biochemistry</b>	100	2	40
CH-191	<b>Chemistry (Pass)</b>	100	2	40
CA-191	<b>Introduction to Computer (Pass)</b>	100	2	40

**SECOND SEMESTER**

**Paper (Theoretical) :**

<b>Paper Code</b>	<b>Name of the Paper</b>	<b>Marks</b>	<b>Credit hrs</b>	<b>Classes / Semester</b>
OMB-201	<b>Organic Mechanisms in Biology</b>	100	3+1	42
PTG-202	<b>Principles of Transmission Genetics</b>	100	3+1	42
POM-203	<b>Principles of Microbiology</b>	100	3+1	42
BMT -204	<b>Biomathematics - II</b>	100	3+1	42
CH-201	<b>Chemistry (Pass)</b>	100	3+1	42
CA-201	<b>Introduction to C-Programming &amp; Digital Logic (Pass)</b>	100	3+1	42

**Paper (Practical) :**

CGT-292	<b>Cyto-genetic Techniques</b>	100	2	40
MIC-293	<b>Microbiology</b>	100	2	40
CH-291	<b>Chemistry (Pass)</b>	100	2	40
CA-291	<b>Introduction to C-Programming &amp; Digital Logic (Pass)</b>	100	2	40

**THIRD SEMESTER**

**Paper (Theoretical) :**

<b>Paper Code</b>	<b>Name of the Paper</b>	<b>Marks</b>	<b>Credit hrs</b>	<b>Classes / Semester</b>
MCG-301	<b>Microbial Genetics</b>	100	3+1	42
POI-302	<b>Principles of Immunology</b>	100	3+1	42
PAT-303	<b>Plant and Animal Tissue Culture Techniques and applications</b>	100	3+1	42
PBT-304	<b>Plant Biotechnology</b>	100	3+1	42
CH-301	<b>Chemistry (Pass)</b>	100	3+1	42

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CA-301	<b>Introduction to Data Structure &amp; Computer Organization (Pass)</b>	100	3+1	42
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**Paper (Practical) :**

IMN-392	<b>Immunology</b>	100	2	40
TCT-393	<b>Tissue Culture Techniques</b>	100	2	40
CH-391	<b>Chemistry (Pass)</b>	100	2	40
CA-391	<b>Introduction to Data Structure &amp; Computer Organization (Pass)</b>	100	2	40

**FOURTH SEMESTER**

**Paper (Theoretical) :**

<b>Paper Code</b>	<b>Name of the Paper</b>	<b>Marks</b>	<b>Credit hrs</b>	<b>Classes / Semester</b>
MOG-401	<b>Molecular Genetics</b>	100	3+1	42
CBB-402	<b>Computational Biology &amp; Bio-informatics</b>	100	3+1	42
BDT-403	<b>Biodiversity &amp; Taxonomy</b>	100	3+1	42
ABT -404	<b>Animal Biotechnology</b>	100	3+1	42
CH-401	<b>Chemistry (Pass)</b>	100	3+1	42
CA-401	<b>Introduction to DBMS, Computer Network &amp; Numerical Analysis (Pass)</b>	100	3+1	42

**Paper (Practical) :**

MBT-491	<b>Molecular Biology Techniques</b>	100	2	40
BIN-492	<b>Bio-informatics</b>	100	2	40
CH-491	<b>Chemistry (Pass)</b>	100	2	40
CA-491	<b>Introduction to DBMS, Computer Network &amp; Numerical Analysis (Pass)</b>	100	2	40

**FIFTH SEMESTER**

**Paper (Theoretical) :**

<b>Paper Code</b>	<b>Name of the Paper</b>	<b>Marks</b>	<b>Credit hrs</b>	<b>Classes / Semester</b>
DPB-501	<b>DNA Typing, Proteomics &amp; Beyond</b>	100	3+1	42
RDT-502	<b>Recombinant DNA Technology</b>	100	3+1	42
EVB-503	<b>Environmental Biotechnology</b>	100	3+1	42
IBT -504	<b>Industrial Biotechnology</b>	100	3+1	42

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**Paper (Practical) :**

GET-591	<b>Genetic Engineering Techniques</b>	100	2	40
BFT-592	<b>Basic Fermentation Techniques</b>	100	2	40

**SIXTH SEMESTER**

**Paper (Theoretical) :**

<b>Paper Code</b>	<b>Name of the Paper</b>	<b>Marks</b>	<b>Credit hrs</b>	<b>Classes / Semester</b>
MHG-601	<b>Model Organisms in Human Genome Project</b>	100	3+1	42
EME-602	<b>Elements of Management &amp; introduction to Entrepreneurship</b>	100	3+1	42
MBT-603	<b>Medical Biotechnology</b>	100	3+1	42
BTL-604	<b>Biotechnology – Social, Legal &amp; Ethical issues</b>	100	3+1	42

**Paper (Practical) :**

PRO-691	<b>Project on Biodiversity</b>	100	2	40
DSS-692	<b>Dissertation on Biotechnology</b>	100	2	40

**BSc (H) Syllabus in  
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**FIRST SEMESTER**

**Paper Code : MSA –101 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Macromolecular Structure & Analysis**

**Lecture period : 42L**

- Carbohydrates** : Structural aspects – Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, Constitution of Glucose & Fructose, Osazone formation, Pyranose & Furanose forms, Determination of ring size, Inter-conversion of mono-saccharides. **(4 Periods)**
- Lipids** : Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membrane, Membrane protein – structural aspects, Lipoproteins (elementary idea). **(4 Periods)**
- Proteins** : Structural aspects – General introduction, Classification & General characteristics, Structure of Primary, Secondary, Tertiary & Quaternary proteins (elementary idea), □- & □-

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chains of proteins (elementary idea), Classification of Amino acids.

**(5 Periods)**

4. **Nucleic acid** : Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA. **(5 Periods)**

5. **Chemical & Enzymatic Kinetics** - An introduction to enzyme; How enzyme works; Reaction rate; Thermodynamic definitions; Principles of catalytic power and specificity of enzymes; Enzyme kinetics – Approach to mechanism. **(5 Periods)**

6. **Genes are DNA** – DNA is the genetic material, DNA is a double helix, DNA replication is semi-conservative, mutations change the sequence of DNA, a gene codes for a single polypeptide, recombination occurs by physical exchange of DNA, genetic code is triplet. **(5 Periods)**

7. **Mutation** – Occurrence, kinds of Mutation, spontaneous & induced Mutation, Mutagens, detection of Mutation, Lethal Mutations, Biochemical Mutations, Phenotypic effects of Mutation, Molecular basis of Mutation, Significance & Practical applications of Mutation. **(4 Periods)**

8. **Expression of genetic information : from Transcription to Translation** - The Relationship between genes and protein, The transcriptions : The basic process, Transcription and RNA Processing in Eukaryotic Cells, Encoding genetic information, Decoding the codons : the role of transfer RNAs. **(5 Periods)**

9. **Regulation of mRNA stability** – capping, polyadenylation, pre-mRNA splicing, formation of commitment complex, creation of catalytic sites, trans-esterification reactions, mRNA surveillance. **(5 Periods)**

**Paper Code : BPI -102 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Biophysics & Instrumentation**

**Lecture period : 42L**

1. **General Biophysical methods** – Measurement of pH, Radioactive labeling & counting, Autoradiography. **(3 Periods)**

2. **Separation & Identification of Materials** - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis). **(8 Periods)**

3. **Centrifugation** – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation. **(5 Periods)**

4. **Microscopy** – Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM. **(6 Periods)**

5. **X-Ray Crystallography** – X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure [concept of rotating crystal method, powder method]. **(6 Periods)**

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- 6. Spectroscopy: Raman Spectroscopy** – What is Raman effect, Quantum mechanical reason of Raman effect, Molecular Polarizability, Polarizability ellipsoid, Experimental technique of Raman effect, Basic concept of Pure Rotational & Vibrational, Raman spectra of simple molecule (linear molecule).  
**NMR Spectroscopy** – Basic principle of NMR spectroscopy, Experimental technique & instrumentation, Chemical shift, Hyperfine splitting, Relaxation process.  
**Absorption Spectroscopy** – Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Factors affecting the absorption properties of a Chromophore. **(14 Periods)**

**Paper Code : CSD -103 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Cell Structure & Dynamics**

**Lecture period : 42L**

- 1. Origin of life on Earth** - The theory of Extraterrestrial contact - import of life through meteorites. Theory of Chemical Evolution, Primitive Earth Conditions - anoxic reductive atmosphere, relatively high temperature, Volcanic eruption, radioactivity, high frequency UV radiation. Abiotic formation of sugars, amino acids, organic acids, purines, pyrimidines, glycerol and formation of nucleotides and their polymerization to RNA on reactive Surfaces, polymerization of amino acids to Polypeptides and Proteins. Ribozymes and RNA World. Formation of DNA, Formation of nucleoproteins, Prions, Natural Selection of Self replicating Polymers. **(8 periods)**
- 2. Basics of Cell Biology (structure & function)** – Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome and microbodies; Ribosome; Centriole; Nucleus; Chemical components of a cell; Catalysis and use of energy by cells. **(10 Periods)**
- 3. Biogenesis of Cellular organelles** – Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components. **(6 Periods)**
- 4. Structure and function of Prokaryotic cell & its components** - The Slime and the cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane of Gram-negative bacteria, the cytoplasmic membrane. Water and ion transport, mesosomes, flagella, Pilus, fimbriae, ribosomes, carboxysomes, sulfur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores, exospores, cysts. Mycelia of fungi and Actinomycetes, Cytoskeleton filament, heterocysts and akinets of Cyanobacteria, Gliding and motility. **(8 Periods)**
- 5. Membrane structure & transport** – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport **(6 Periods)**
- 6. Cell cycle** - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant. **(4 Periods)**

**Paper Code : BMT-104 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Biomathematics**

**Lecture period : 42L**

**Classical Algebra**

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Complex Number including D'Moivre's Theorem, Logarithm (only algebra, without Series expansion), Binomial Theorem (without infinite series).

Determinant, Matrix, Rank of Matrices by Diagonalisation method. **(12 Periods)**

**Calculus – I** [For functions of single variable]

Limit, Continuity, Differentiation (including differentiability), Successive Differentiation, Expansion of Functions – Rolle's theorem, Mean Value theorem, Integration – Definite and Indefinite (ordinary, method of substitution, special trigonometric function, partial fraction) Application of integration to find area, Differential equations --homogeneous and Linear ODE's and its simple applications to biological problems. **(20 Periods)**

**Calculus – II** [For functions of two variables]

Partial Differentiation including Euler's theorem and it's application. **(10 Periods)**

**Paper Code : BMI –105 (Practical)**

**Full Marks : 100**  
**Credit : 2**

**Paper Name : Basic Microscopy & Instrumentation**

**Practical period : 40**

1. Microscopy – Light microscopy : principles, parts & function, Operation. **(5 Periods)**
2. Image analysis of different classes of Microbes. **(5 Periods)**
3. Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa) **(5 Periods)**
4. Sterilization: principles & operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow **(4 Periods)**
5. Principles & operations of Incubators & Shakers **(4 Periods)**
6. Principle & operation of Centrifuge **(4 Periods)**
7. Principle & operation of pH meter **(3 Periods)**
8. Principle & operation of Colorimeter **(3 Periods)**
9. Principle & operation of Spectrophotometer **(3 Periods)**
10. Electrophoresis techniques **(4 Periods)**

**Paper Code BCH–106 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Biochemistry**

**Practical period : 40**

1. Estimation of protein by Folin Lowry method **(3 Periods)**
2. Determination of  $K_m$  and  $V_{max}$  of amylase. **(4 Periods)**
3. TLC separation of Amino acids /sugars **(3 Periods)**
4. Determination of Iodine number of a fat **(3 Periods)**
5. Estimation of RNA by Orcinol method **(3 Periods)**
6. Estimation of DNA by diphenyl amine method **(3 Periods)**
7. Verification of Beer's Law Spectrophotometrically **(4 Periods)**
8. Testing of Blood Sugar **(3 Periods)**
9. Testing of Liver Function Test (Bilirubin, SGOT, SGPT, Alkaline Phosphatase, Albumin, Globulin, Total Protein) **(8 Periods)**
10. Testing of Renal Function Test (Urea, Uric acid, Creatine, Creatinine) **(6 Periods)**

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**SECOND SEMESTER**

**Paper Code : OMB-201 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Organic Mechanisms in Biology**

**Lecture period : 42L**

- 1. Common Mechanisms in Biological Chemistry** – Overview of Digestion, Absorption, Metabolism (Anabolism & Catabolism), Nutrition, Photosynthesis, Respiration, Excretion. **(4 Periods)**
- 2. Biomolecules** – Carbohydrates (Anomeric carbon, Mutarotation, Simple Chemical reactions of Glucose, Reducing & Non-reducing Sucrose, Maltose & Lactose, Elementary idea of structure of Starch & Cellulose); Proteins (Denaturation of proteins, Enzyme Kinetics), Nucleic acids (Mechanisms of Replication, Transcription & Protein synthesis, Genetic code); Hormones (classification, structural features & functions in bio-systems); Vitamins (classification, functions of vitamins in bio-systems). **(10 Periods)**
- 3. Lipid Metabolism** – Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, ketone bodies. **(6 Periods)**
- 4. Carbohydrate Metabolism** – Aerobic & Anaerobic glycolysis, sequence of reactions in glycolysis, regulation in glycolysis, citric acid cycle, glycogenesis, glycogenolysis (sequence of reactions & regulation), Pentose-phosphate pathway (sequence of reactions & regulation), extraction of energy from food sources. **(8 Periods)**
- 5. Amino acid Metabolism** – Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, serotonin, GABA, histamin, glutathione); biosynthesis of essential & non-essential amino acids. **(8 Periods)**
- 6. Nucleotide Metabolism** – biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine. **(6 Periods)**

**Paper Code : PTG-202 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Principles of Transmission Genetics**

**Lecture period : 42L**

- 1. Science of Genetics** – an overview of modern history of Genetics before 1860, 1860-1900, 1900-1944, 1944-Present, about 3 general areas of Genetics (Classical, Molecular & Evolutionary). **(3 Periods)**
- 2. Mendelism & Chromosome Theory** – Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked, Autosomal, Mitochondrial, Unifactorial, Multi-factorial). **(4 Periods)**



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- 3. Extension of Mendelism** – Deviation from Mendel's Dihybrid phenotype, Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson & Punnett's Coupling & Repulsion hypothesis.  
**(2 Periods)**
- 4. Linkage & Crossing over** - Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, kinds of Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.  
**(3 Periods)**
- 5. Allelic Variation & Gene function** – Multiple allele, Genetic interaction, Epistatic interactions, Non-Epistatic inter-allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes.  
**(3 Periods)**
- 6. Non-Mendelian inheritance** – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extra-nuclear inheritance (mitochondrial, chloroplast), non-chromosomal inheritance, maternal inheritance, uniparental inheritance.  
**(3 Periods)**
- 7. Chromosomal variation in Number & Structure** – Euploidy, Non-disjunction & Aneuploidy, Aneuploid segregation in plants, Aneuploidy in Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Polytene chromosome in Diptera, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations & evolution.  
**(4 Periods)**
- 8. Chromosome Mapping** - Haploid mapping (2 point & 3 point cross), Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.  
**(4 Periods)**
- 9. Human Cyto-Genetics** – Human karyotype, Banding techniques, classification, use of Human Cyto-genetics in Medical science, Chromosomal abnormalities in spontaneous abortions, viable monosomies & trisomies, chromosomal deletions & duplications, genetics of chromosomal inversions & translocations, human traits, Genomic position effects on Gene expression.  
**(4 Periods)**
- 10. Pedigree analysis** – Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance.  
**(4 Periods)**
- 11. Formulating & Testing Genetic Hypothesis** –problems of Sex-linkage, problems of genes with Multiple alleles, problems of gene interactions, Chi-square, t-test.  
**(8 Periods)**

**Paper Code : POM -203 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Principles of Microbiology**

**Lecture period : 42L**

- 1. Overview of history of Microbiology** - Biogenesis and abiogenesis Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming [Penicillin], Scope of Microbiology. **(4 Periods)**
- 2. Classification of Microbes** - Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms Systematics of

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bacteria, Nutritional types [Definition and examples]. Classification on the basis of oxygen requirement.  
**(6 Periods)**

**3. Concept of Sterilization** - Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant.  
**(6 Periods)**

**4. Stains and staining techniques** – Definition of auxochrome , chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

**(6 Periods)**

**5. Microbes in Extreme Environment** – Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space.  
**(6 Periods)**

**6. Pathogenic Microorganisms** – List of common bacterial, fungal and viral diseases of human beings [Name of the disease, causative pathogen, parts affected]

**(4 Periods)**

**7. Basic concepts of Virology** - General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Capsids, complex (Bacteriophage, and Virion size, enveloped (Herpes), helical (TMV) and icosahedral (Polyoma), Capsids.

**(10 Periods)**

**Paper Code : BMT -204 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Biomathematics -II**

**Lecture period : 42L**

**1. Algebra :**

Linear Algebra: - Rank of Matrix by Diagonalization method, Eigen value & eigen vector  
**(2 Periods)**

Vector Algebra: - Vector addition, Vector multiplication (dot & cross product), There geometrical meanings, Simple properties (without proof) with simple examples, Vector triple product with simple examples.  
**(4 Periods)**

Abstract Algebra: - Relation-definition, example, binary relation, construction of function from relation.

Mapping, Composite mapping, with simple examples.

Group- Definition with examples, Sub- group-- its definition & Examples, Necessary & Sufficient condition for a subgroup, characterization of a sub-group, order of a group – its definition, simple properties & examples.

**(5 Periods)**

**Geometry:** 3D Straight Line. **(3 Periods)**

**Calculus :**

Sequence: Its definition, Convergence, Types of sequences, Simple examples of finding limits of simple sequences.

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Series: - Logarithmic series, Exponential series, Convergence of series- Absolute convergence, Test of convergence- Comparison test, D' Alembert Ratio test, Raabe's test, Cauchy's Root test, P-series Test, Leibnitz test for alternating series (Only simple examples without proof).

Power Series - Its definition, Convergence, radius convergence.

**(8 Periods)**

Differentiation: Existence of differentiation, Expansion of function – Rolle's Theorem (Statement only), Langrange's mean value theorem (with proof), Cauchy's mean value theorem (Statement only), Verification of each by simple examples.

Integration- Improper integration, Beta & Gamma function-statement and only examples. Fourier series- Definition and simple problems assuming convergence condition, D statement of Dirichlet's condition.

**(12 Periods)**

Deferential equation – Linear ODE of second Order.

**(8 Periods)**

**Paper Code : CGT-205 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Cytogenetics Techniques**

**Practical period : 40**

1. Basic sterilization techniques required for Media preparation & Cytological techniques  
**(5 Periods)**
2. Media preparation technique **(6 Periods)**
3. Culture of Human, Plant & Animal cells **(8 Periods)**
4. Preparation of Slides **(5 Periods)**
5. Staining of Slides **(6 Periods)**
6. Image analysis & Karyotyping **(10 Periods)**

**Paper Code : MIC-206 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Microbiology**

**Practical period : 40**

1. Sampling and quantification of microorganisms in air, soil and water. **(6 Periods)**
2. Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution] **(6 Periods)**
3. Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, spore staining and motility] **(6 Periods)**
4. Observation of morphology - shape and arrangement of cells. **(6 Periods)**
5. Methods of inoculation of different microbes in selective media. **(6 Periods)**
6. Microscopic measurements, micrometer (ocular and stage), haemocytometer. **(6 Periods)**
7. Microscopic study of phytoplanktons & zooplanktons. **(2 Periods)**

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**THIRD SEMESTER**

**Paper Code : MCG -301 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Microbial Genetics**

**Lecture period : 42L**

1. **Prokaryotic Genomes** - Physical organization of bacterial genomes (Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome and Genome of Archaea).  
**(4 Periods)**
2. **Mechanism of genetic exchange** : Plasmid and bacterial sex, Types of plasmids (F Plasmid : a Conjugate plasmid, Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu-virus); Bacterial Genetics (Mutant phenotype, DNA mediated Transformation; Conjugation (Cointegrate Formation and Hfr Cells, Time-of-Entry Mapping, F' Plasmid); Transduction (Generalized transduction, Specialized Transduction)- gene mapping.  
**(12 Periods)**
4. **Molecular Mechanism of gene regulation in prokaryotes** - Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp, Ara operons. **(6 Periods)**
5. **Bacteriophages:** Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, E. coli Phage T4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Induction & Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, E.coli phage phiX174, filamentous DNA phages, Single stranded RNA phages, The lysogenic Cycle. **(15 Periods)**
6. **Bacteriophage Genetics** - Benzer's fine structure of gene in bacteriophage T4 : Plaque Formation and Phage Mutants, Genetic recombination in the lytic cycle, (concept of recon, muton, cistron).  
**(5 Periods)**

**Paper Code : POI -302 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Principles of Immunology**

**Lecture period : 42L**

1. **Immune Response** - an overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination. **(8 Periods)**
2. **Regulation of immunoglobulin gene expression** – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity, alternate pathways of transcript splicing, variable joining sites & somatic mutation, role of antibody (alone, in complement activation & with effector cells), monoclonal antibodies. **(8 Periods)**
3. **Major Histocompatibility complexes** – class I & class II MHC antigens, antigen processing. **(3 Periods)**
4. **Immunity to infection** – immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effector mechanisms. **(3 Periods)**

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5. **Immuno-techniques** - Blood grouping, Antigen-Antibody reactions : agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA. **(8 Periods)**
6. **Vaccines & Vaccination** – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles of vaccination, passive & active immunization, immunization programs & role of WHO in immunization programs. **(5 Periods)**
7. **Auto-immune diseases** – autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants, molecular mimicry, diagnosis & treatment of auto-immune diseases, replacement therapy, suppression of auto-immune processes, nature of auto-antigens, immunodeficiency, AIDS. **(5 Periods)**
8. **Immune Response of Plants.** **(2 Periods)**

**Paper Code : PAT-303 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Plant and Animal Tissue Culture**  
**Techniques and its application**

**Lecture period : 42L**

1. **Introduction to Techniques** - Introductory history, Laboratory organization, Media, Aseptic manipulation. **(3 Periods)**
2. **Basic concepts in cell culture** - cell culture, Cellular Totipotency, Somatic Embryogenesis. **(5 Periods)**
3. **In vitro culture : approaches & methodologies** - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture. **(5 Periods)**
4. **Tissue nutrition : Growth Hormones** - Plant cells (Composition of culture media, Growth hormones, Vitamins, Unidentified supplements, selection of media); Animal cells (substrate on which cells grow, Feeder layer on substrate, gas phase for tissue culture, media and supplements). **(6 Periods)**
5. **Tissue culture methodologies** - Plant cells (Callus Culture, Cell Suspension Culture, Organ Micro-culture, plant micro-propagation, Somatic Embryogenesis); Animal cells (Source of tissue, primary culture, differentiation of cells, growth kinetics, animal cell lines and their origin and characterization). **(6 Periods)**
6. **Cloning & Selection of specific cell types** – cloning, somatic cell fusion and HAT selection, Medium suspension fusion, selection of Hybrid clone, production of monoclonal antibodies. **(6 Periods)**
7. **Organ Culture** - Culture of embryonic organs, whole embryo culture, culture of adult organs. **(7 Periods)**

**Paper Code : PBT- 304 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Plant Biotechnology**

**Lecture period : 42L**

1. **Plant Tissue Culture applications** – micropropagation, from Callus to plant, somatic embryogenesis, somaclonal variation, valuable germplasm, chemicals from plants, genetically engineered plants. **(10 Periods)**

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2. **Applications of Plant Genetic Engineering** – crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. **(8 Periods)**
3. **Genetic modification in Agriculture** – transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants. **(8 Periods)**
4. **Genetically modified foods** – organic foods, types of organic foods, identifying organic foods, organic food & preservatives. **(8 Periods)**
5. **Genetic modification in Food industry** – background, history, controversies over risks, application, future applications. **(8 Periods)**

**Paper Code : IMN–305 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Immunology**

**Practical period : 40**

1. Antigen-Antibody reactions – Agglutination (Blood grouping testing). **(6 Periods)**
2. Antibody titration (Ouchterlony Double Diffusion). **(6 Periods)**
3. Antigen-Antibody reactions – Immuno-electrophoresis, Rocket immuno-electrophoresis. **(10 Periods)**
4. Antigen-Antibody reactions – Coomb's test. **(8 Periods)**
5. Antigen-Antibody reactions – ELISA. **(10 Periods)**

**Paper Code : TCT–306 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Tissue Culture Techniques**

**Practical period : 40**

1. **In vitro Culture** - Washing & Sterilization, Preparatory steps for tissue culture, surface sterilization of plant material, basic procedures for Aseptic tissue transfer, incubation of culture. **(8 Periods)**
2. **Preparation of Culture media & Reagents** - Media composition, Nutrition, Hormones. **(8 Periods)**
3. **Tissue Culture** – Callus culture, Cell suspension. **(8 Periods)**
4. **Organ Micro-culture** - Shoot tip, excised root, Leaf culture. **(8 Periods)**
5. **Plant micro-propagation** – micro-culture of plants. **(8 Periods)**

**FOURTH SEMESTER**

**Paper Code : MOG-401 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Molecular Genetics**

**Lecture period : 42L**

1. **How to clone a gene** - What is clone, Overview of the procedure, Gene library, Hybridization. **(4 Periods)**
2. **Purification and Separation of nucleic acids** – Extraction and Purification of nucleic acids, Detection and Quantitation of Nucleic acids, Gel Electrophoresis.

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**(8 Periods)**

3. **Cutting and Joining DNA** – Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules.  
**(6 Periods)**
4. **Vectors** – Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors : YACs and BACs.  
**(8 Periods)**
5. **Amplifying DNA : PCR and Cell based DNA Cloning** – The importance of DNA Cloning, PCR : basic features and application, Principles of Cell-based DNA Cloning, Cloning System for amplifying different sized fragments, Cloning System for producing single-stranded and mutagenized DNA.  
**(8 Periods)**
6. **Nucleic Acid Hybridization : Principle and application** - Preparation of nucleic probes, Principle of Nucleic acid hybridization, Nucleic acid hybridization assays, and microarrays.  
**(8 Periods)**

**Paper Code : CBB-402 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Computational Biology & Bio-informatics**

**Lecture period : 42L**

1. **Introduction to Genomics** - information flow in biology, DNA sequence data, Experimental approach to genome sequence data, genome information resources.  
**(8 Periods)**
2. **Functional Proteomics** - protein sequence and structural data, protein information resources and secondary data bases.  
**(8 Periods)**
3. **Computational Genomics** - Internet basics, biological data analysis and application, sequence data bases, NCBI model, file format.  
**(8 Periods)**
4. **Sequence alignment & data base search** - Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA.  
**(10 Periods)**
5. **Structural data bases** - Small molecules data bases, protein information resources, protein data bank.  
**(8 Periods)**

**Paper Code : BDT-403 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Biodiversity & Taxonomy**

**Lecture period : 42L**

1. **Basic concept of Biodiversity** – What is Biodiversity, Why should we conserve it, Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity, Patterns of Species Diversity.  
**(4 Periods)**
2. **Global patterns of Biodiversity** – measuring biodiversity, Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis.  
**(5 Periods)**
3. **Biodiversity & Conservation** – Overexploitation threatening living species, International Trade, Animals threatened by International trade, Problems in

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Controlling International Trade (Enforcement, Reservations, Illegal Trade), Free Trade & the Environment, Free Trade & Conservation, Common patterns of Overexploitation.

**(5 Periods)**

- 1. Exotic Species** – Plants, Invertebrates, Fishes, Amphibians, Reptiles, Birds, Mammals, Detrimental Effects of Exotic Species. **(3 Periods)**
  
- 2. Endangered Species Conservation** – The US Endangered Species Act, State Endangered Species Acts Successes and Failures of the Endangered Species Act Role of ESA in Habitat Protection, Critical Habitat, Problems with the Endangered Species Act, Habitat Conservation Plans. **(5 Periods)**
  
- 6. Ethics of Conservation** – Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits & criticism), Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues. **(4 Periods)**

**Taxonomy**

- 7. Basic concept of Taxonomy** – Classification, Construction of Phylogenetic tree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature. **(5 Periods)**
  
- 8. Taxonomy in relation to Chromosomal morphology & Evolution** – Chromosomal evolution, why location of genes matter, evolutionary oddities about chromosomes, evolutionary effect of rearrangements of chromosomes, karyotypic orthoselection, chromosomal evolution & speciation. **(5 Periods)**
  
- 9. Molecular Taxonomy in relation to DNA characteristics & Protein sequences** – modes of molecular evolution, Neutral theory of Molecular evolution, genetic markers for taxonomic purposes, comparing total genome by DNA-DNA hybridization, comparing DNA sequences, Cladistics, biological identification through DNA barcodes, chromosome painting, establishing molecular homology using protein sequences. **(6 Periods)**

**Paper Code : ABT-404 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Animal Biotechnology**

**Lecture period : 42L**

- 1. Gene transfer methods in Animals** – Microinjection, Embryonic Stem cell gene transfer, Retrovirus & Gene transfer. **(8 Periods)**
  
- 2. Transgenic Animals** – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. **(8 Periods)**
  
- 3. Animal diseases need help of Biotechnology** – Foot-and-mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis. **(6 Periods)**
  
- 4. Animal propagation** – Artificial insemination, Animal Clones. **(6 Periods)**
  
- 5. Conservation Biology** – Embryo transfer techniques. **(4 Periods)**
  
- 6. Genetic modification in Medicine** - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics. **(10 Periods)**

**Paper Code : MBT-405 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Molecular Biology Techniques**

**Practical period : 40**



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1. **DNA isolation** - from Plant cell (leaf of cabbage / mustard), Animal cell (goat liver), Human Blood (Fresh / Stored / Frozen) & Microbes **(12 Periods)**
2. **Plasmid DNA isolation** **(6 Periods)**
3. **Gel electrophoresis** **(10 Periods)**
4. **Polymerase Chain Reaction** **(8 Periods)**
5. **Gel documentation & photography** **(4 Periods)**

**Paper Code : BIN-406 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Bio-informatics**

**Practical period : 40**

1. Internet basics **(10 Periods)**
2. Introduction to NCBI Web sites **(15 Periods)**
3. Introduction to Data bases **(15 Periods)**

**FIFTH SEMESTER**

**Paper Code : DPB-501 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : DNA Typing, Proteomics & Beyond**

**Lecture period : 42L**

1. **DNA Typing** : DNA polymorphisms: the basis of DNA typing, Minisatellite analysis, Polymerase chain reaction based analysis, Short tandem repeat analysis, Mitochondrial DNA analysis, Y chromosome analysis, Randomly amplified polymorphic DNA (RAPD) analysis. **(10 Periods)**
2. **Proteomics and beyond** : Analysis of the transcriptome, Proteomics-Expression analysis & Characterization of proteins, Metabolomics & global biochemical networks. **(12 Periods)**
3. **High-throughput analysis of gene function** - DNA microarrays, Protein arrays, Mass spectrometry. **(10 Periods)**
4. **Single Nucleotide Polymorphisms** - The nucleolar proteome, Mapping disease-associated SNPs : Alzheimer's disease. **(10 Periods)**

**Paper Code : RDT-502 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Recombinant DNA Technology**

**Lecture period : 42L**

1. **Gene Recombination and Gene transfer** : Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser. **(8 Periods)**
2. **Changing genes: site-directed mutagenesis and Protein engineering**: Primer extension is a simple method for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene

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shuffling, production of chimeric proteins. **(10 Periods)**

3. **Genetic engineering in animals:** Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Using Yeast to study Eukaryotic gene function, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, Transgenic animals, Production of proteins of Pharmaceutical value.

**(12 Periods)**

4. **Genetic engineering in plants:** Use of *Agrobacterium tumefaciens* and *Arhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

**(12 Periods)**

**Paper Code : EVB-503 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Environmental Biotechnology**

**Lecture period : 42L**

1. **Components of Environment** – Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment; Environmental Studies as a multidisciplinary subject. **(4 periods)**

2. **Global Environmental Problems** – Green House Effect, Acid rain, El Nino, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards. **(4 periods)**

3. **Environmental pollution and degradation** – Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas. Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals, Nutrient pollution. **(10 periods)**

4. **Environmental Management** – Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases, health hazards due to pesticide and metal pollution, waste treatment, solid waste management, environmental standards and quality monitoring. **(6 periods)**

5. **Environmental Protection Act** – Environmental Laws, national movements, sustainable development, environmental policies, environmental economics, environmental ethics – holistic approach of environmental protection and conservation, IUCN – role in environmental protection. Concept with reference to UN – declaration, aim and objectives of human right policies with reference to India, recent north-south debate on the priorities of implementation, Environmental Protection Agency (EPA). **(10 periods)**

6. **Bioremediation** – Oil spills, Wastewater treatment, chemical degradation, heavy Metals. **(8 periods)**

**Paper Code : IBT-504 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Industrial Biotechnology**

**Lecture period : 42L**

1. **Commercial Production of Microorganisms** – Industrial Fermenters, Single-cell Protein. **(2 Periods)**

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2. **Bioconversions** – Biomining and bioleaching of ores (Use of thermophilic microorganisms in industrial microbiology Bio-gas, Bio-leaching, Bio-diesel. **(3 Periods)**
3. **Microorganisms & Agriculture** – Microorganisms in Agricultural Waste water treatment, Vermiculture, Microbial pesticides. **(2 Periods)**
4. **Products from Microorganisms** – Metabolites, Enzymes, Antibiotics. **(2 Periods)**
5. **Bioremediation** – Petroleum prospecting and formation of oil spills,, Wastewater treatment, chemical degradation, heavy Metals. **(2 Periods)**
6. **Principles of Microbial growth** – introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics). **(2 Periods)**
7. **Bioreactor / Fermenter** – types & operation of Bioreactors, physico-chemical standards used in bioreactors, limitations of bioreactors, stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations. **(8 Periods)**
8. **Technology of Microbial cell maintenance** – steps to maintain microbial culture in an aseptic & sterile environment (how to inoculate, preserve & maintain), Strain preservation, maintenance and strain improvement by mutation of gene transfer processes **(2 Periods)**
9. **Downstream processing** – extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, Metabolites), Industrial production of Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid,  $\alpha$ -amylase, protease penicillin, tetracycline and vitamin B<sub>12</sub>, with reference to easily available raw materials, Production of herbal drugs. **(4 Periods)**
10. **Enzyme technology** – nature of enzymes, application of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, genetic engineering & protein engineering of enzymes, cloning strategy for enzymes, technology of enzyme production, use of immobilized cells and enzymes (Ca-alginate beads, polyacrylamide), industrial applications of immobilized enzymes. **(5 Periods)**
11. **Biological fuel generation** – photosynthesis, sources of biomass, ethanol from biomass, methane from biomass, hydrogen, microbial recovery of petroleum. **(2 Periods)**
12. **Biotechnology in specific medical & industrial applications** - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants, Microbial culture selection with high yield potential. **(4 Periods)**

**Paper Code : GET-505 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Genetic Engineering Techniques**

**Practical period : 40**

1. Transformation in E. coli DH5 $\alpha$

**(5 Periods)**

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- |   |                    |
|---|--------------------|
| 2. Bacterial conjugation                                  | <b>(4 Periods)</b> |
| 3. Phage Titration  | <b>(5 Periods)</b> |
| 4. Plasmid preparation                                    | <b>(4 Periods)</b> |
| 5. Restriction enzyme digestion                           | <b>(4 Periods)</b> |
| 6. Ligation   | <b>(4 Periods)</b> |
| 7. Genomic DNA extraction                                 | <b>(3 Periods)</b> |
| 8. DNA molecular size determination                       | <b>(3 Periods)</b> |
| 9. Bacterial Antibiotic sensitivity                       | <b>(4 Periods)</b> |
| 10. Bacterial gene expression (using Lac promoter system) | <b>(4 Periods)</b> |

**Paper Code : BFT-506 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Basic Fermentation Techniques**

**Practical period : 40**

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|---|---------------------|
| 1. Preparation of Baker's Yeast from molasses         | <b>(10 Periods)</b> |
| 2. Production of Biodiesel                            | <b>(10 Periods)</b> |
| 3. Production of Enzymes & Antibiotics                | <b>(10 Periods)</b> |
| 4. Bioleaching of Chalcopyrites (CuFeS <sub>2</sub> ) | <b>(10 Periods)</b> |

**SIXTH SEMESTER**

**Paper Code : MHG-601 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Model Organisms in Human Genome Project**

**Lecture period : 42L**

1. **Genome** – about genomes of model organisms (*E. coli*, Yeast, *Arabidopsis thaliana*, *C. elegans*, *Drosophila melanogaster*, laboratory mouse, Zebra fish, Human), types of genomes, genomes & genetic variation, comparison of different genomes, genome evolution.  
**(8 Periods)**
2. **Genomics** – about the genomics, history, comparative genomics, comparative genomic hybridization, functional genomics.  
**(5 Periods)**
3. **Genome projects** – an overview of genome projects of human and other model organisms of Human Genome Project.  
**(5 Periods)**
4. **Human Genome Project (HGP)** – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, expected scientific & medical benefits of this project, about the organizations behind this project.  
**(8 Periods)**
5. **How Human genome was mapped** – physical mapping, genetic mapping, gene ontology, gene annotation.  
**(8 Periods)**
6. **Technologies used in HGP** – RFLP, microsatellite markers, STS, EST, DNA sequencing, DNA microarray.  
**(8 Periods)**

**Paper Code : EME-602 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Elements of management & introduction to Entrepreneurship**

**Lecture period : 42L**

**Elements of Management**

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1. **Principles of management** - Concept and managerial functions, planning, organizing, staffing, directing and controlling. **(6 Periods)**
2. **Brief knowledge of organizational behavior and industrial relation** - concept of organization, motivation, leadership, introduction to organization structure, basic knowledge of IR. **(8 Periods)**
3. **Concept of Marketing** - Marketing concepts and functions, market research, marketing mix; product planning, PLC, advertising and promotion, principles of sales management, concept of direct sales and CRM. **(8 Periods)**

**Entrepreneurship**

4. **Concept, nature, scope and philosophy of entrepreneurship** - Distinction between self-employment and entrepreneurship. Importance of entrepreneurship and self-employment in India. Context, entrepreneurial traits, Small business strategic planning, Pricing and promotion, Franchising.  
**(10 Periods)**
5. **Concept of various Types of business organization** - sole proprietorship, partnership, cooperation society, private and public limited companies, institutions support for establishment of self-employment and entrepreneurial ventures, role of various agencies. **(10 Periods)**

**Paper Code : MBT -603 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Medical Biotechnology**

**Lecture period : 42L**

1. **Gene therapy** – background, types of gene therapy (ex vivo & in vivo), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. **(6 Periods)**
2. **Gene Delivery methods** – Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering. **(6 Periods)**
3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **(6 Periods)**
4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **(4 Periods)**
6. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **(4 Periods)**
7. **Tissue Engineering** – Skin, Liver, Pancreas. **(3 Periods)**
8. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **(4 Periods)**
8. **Cell Adhesion-based therapy** – integrins, inflammation, cancer & metastasis. **(5 Periods)**
10. **Drug delivery** – conventional & new approaches to drug delivery. **(4 Periods)**

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**Paper Code : BTL-604 (Theoretical)**

**Full Marks : 100**

**Credit : 4 (3+1)**

**Paper Name : Biotechnology : Social, Legal  
& Ethical Issues**

**Lecture period : 42L**

- 1. Molecular technologies** – an overview of Genetic screening for any predisposition symptoms, Cancer screening, Cloning, Gene therapy, DNA fingerprinting, (Paternity and Forensics) in vitro fertilization, surrogate motherhood, PGD, transgenic organisms, xenotransplantation, GMOs. **(10 Periods)**
- 2. Social issues** - public opinions against the molecular technologies. **(6 Periods)**
- 3. Legal issues** – legal actions taken by countries for use of the molecular technologies. **(6 Periods)**
- 4. Ethical issues** – ethical issues against the molecular technologies. **(6 Periods)**
- 5. Bioethics** – Necessity of Bioethics, different paradigms of Bioethics – National & International. **(6 Periods)**
- 6. Intellectual Property Rights** – Why IPR is necessary, TRIPS & IPR, IPR – national & international scenario, IPR protection of life forms. **(8 Periods)**

**Paper Code : PRO-605 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Project on Biodiversity**

**Tour : 3-5 days (40 hrs)**

A project work should be done individually or in a group under the guidance of one faculty of IGE on any topic related to the subject after one Educational tour to any place of India.  
The duration of tour will be at least 3-5 days at the spot depending upon the information/sample collection of project work.  
The work will be documented & also presented by the candidate in front of externals in a seminar.

**Paper Code : DSS-606 (Practical)**

**Full Marks : 100**

**Credit : 2**

**Paper Name : Dissertation on Biotechnology**

**Lab. work : 40 hrs**

A project work should be done individually under the guidance of one faculty of IGE on any topic related to the subject & can be recorded as dissertation & also be presented by the candidate in front of externals in a seminar.

**B.Sc**

**CHEMISTRY SYLLABUS (PASS)**

**1<sup>st</sup> Semester**

**Theory Paper Code: CH-101**

**Full Marks: 100**

**1. Atomic Structure :**

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- Bohr's atomic model & limitation. Idea of de Broglie matter waves. Heisenberg's uncertainty principle. Schrödinger's wave equation. Significance of wave function. Quantum numbers. Multielectron system-Pauli's exclusion principle, Hund's rules of maximum multiplicity. Stability of half filled full field orbitals, Aufbau principle & its limitation. Electronic configuration of atoms.
2. **Units & dimension :** (SI units to be used & encouraged).  
Kinetic Theory of Gases : Distribution of molecular velocities root-mean-square velocity, elementary kinetic molecular theory of ideal gases, deduction of kinetic gas equation.  $P = \frac{1}{3} m n c^2$ , deduction of gas laws.
  3. **Bonding in organic compounds :**  
Classification, trivial names and IUPAC system of nomenclature of organic compounds. Nature of covalent bond and its orbital representation. Hybridization, bond energy, polarity of bond & dipole moment of molecules, inductive effect, hydrogen bond, conjugation, resonance.  
Homolytic & heterolytic fission of bonds electrophiles & nucleophiles, carbonation, carbon ions and radicals- their stability, geometry & generation.
  4. **Stereochemistry:**  
Dissymmetric Molecules: Different types of Isomerism, Structural Isomers, Geometrical, Stereoisomerism, Configurational Isomers, Conformational Isomers, Concept of asymmetric carbon atom, Enantiomers, Diastereoisomers, Stereogenic atom / center, Chirotopic / Achirotopic Centre, Protostereoisomerism, Concept of Topicity of Ligands and Faces (Homotopic, Enantiotopic, Diastereotopic atoms and groups; Prochiral, Homotopic, Enantiotopic, Diastereotopic Faces), Projection Structures of Stereoisomers (Fischer, Sawhorse, Newman, Flying-Wedge projection and Interconversion of these projections formulas) of simple molecules containing one or two asymmetric carbon atom, Optical isomerism, Optical activity, Element of symmetry and chirality, Meso compounds, Chiral centers and the number of stereoisomers, Racemic mixtures, Racemic mixture or (+/-)-Conglomerate, Racemic Compounds or racemate, Stereochemical nomenclature of Stereoisomers containing chiral centers (R/S and E/Z or cis-trans or sec cis- sec trans of C=C system); D,L system of designation; *Pro-R*, *Pro-S*, *Re*, *Si*, *Erythro*, *threo*, *Pruf* and *Pruf* designation of enantiotopic groups and atoms; Chirality of Organic molecules without chiral center and concept of chiral axis.
  5. **Reaction Mechanism:**  
SN1 & SN2 reaction, E1 & E2 reaction (elementary treatment) of aliphatic hydrocarbon. Saytzeff & Hofmann elimination. Nucleophilic and electrophilic aromatic substitution.
  6. **Electrolytic conductance :**  
specific, equivalent and molar conduction, their variation with concentration in case of strong and weak electrolytes, measurement of conduction, Kohlrausch law of independent migration of ions, ionic mobility and conductance, transference number, conductometric titration.
  7. **Phase Rule:**  
Phase, component, system, degrees of freedom. The phase rule. Phase diagram of one component system: water.  
Heterogeneous systems: Raoult distribution law, miscibility and distillation of binary liquid mixture, azeotropic mixtures, critical solution temperature (elementary idea).
  8. **Radioactivity and Nuclear Structure of Atoms:**  
Radioactive disintegration series, group displacement law, law of radioactive decay, half-life and average life of radio elements, radioactive equilibrium, measurement of radioactivity. Stability of atomic nucleus, n/p ratio.  
Radioisotopes and their application: Determination of age of earth, radio carbon dating, Medicinal and agriculture use of isotopes, hazards of radio activity.

**9. Chemical analysis :**

**Gravimetric Analysis-** Solubility product and common ion effect, requirement of gravimetry, Techniques of Precipitations, filtration, washing, drying, igniting and weighing precipitates. Gravimetric estimation of chloride & nickel.

**Volumetric analysis** – primary and secondary standard substance/(solution). Principles of acid-base, oxidation- reduction and complexometric titration. Acid-Base, redox and metal ion indicators.

**Analysis of real samples:** Sampling techniques, methods of dissolution of solid samples for chemical analysis. Determination of hardness water. Estimation of glucose & phenol. Accuracy and precision in quantitative analysis, errors, standard deviations.

**Practical Paper code : CH-193**

**Full Marks: 100**

**Detection of elements & functional groups:**

Detection of elements (N,S,Cl,Br,I), unsaturation & all the functional groups (alcoholic & phenolic hydroxyl/ aldehydic & ketonic carbonyl / carboxylic acid & aromatic amino, anilide and nitro) present in a supplied mono- or bi- functional organic compounds.

**2<sup>nd</sup> Semester**

**Theory Paper Code : CH-201**

**Full Marks: 100**

**1. Chemical Bonding and Structure:**

**(a) Ionic Bonding:**

General characteristics of ionic compounds: ionization energy, electron affinity etc. Sizes of ions, radius ratio rule and its limitation. Lattice energy, Born-Haber cycle.

**(b) Covalent Bonding:**

General characteristics of covalent compounds, valence bond approach, directional character of covalent bond, hybridization involving s-, p- and d- orbitals. Valence State Electron Pair Repulsion (VSEPR) concept, shapes of simple molecules and ions.

Fajan's Rules. Hydrogen bonding and its effect of physical and chemical properties. Other types of molecular interaction.

**2. Double & complex salt:**

Werner's theory of coordination compounds. Chelates. Polydentate ligands including naturally occurring ones. Electronic interpretation of compounds formation. Stepwise and overall stability constants. (elementary idea only) Geometrical & optical isomerism. Nomenclature of coordination compounds.

**3. The noble gases:**

Occurrence, general properties, electronic structure & position in the periodic table. Elementary Xenon compounds (bonding and structures excluded).

**4. Real gases:**

Deviations from ideal behavior van der Waal's equation. Andrews experiment, critical phenomena in light of van der Waal's equation of state, critical constants.

**5. First law of thermodynamics:**

Cyclic process, Reversible & irreversible process, internal energy, enthalpy, work done in isothermal & adiabatic process, heat capacities,  $C_p - C_v = R$  for an ideal gas.

**6. Viscosity:**

Definition & determination of Oswald's viscometers, variation with temperature for liquid and gases.



**7. Alkanes, Alkenes, Alkynes:**

Isomerism, synthesis, chemical reactivity of alkanes, Mechanism of free radical halogenation of alkanes, sulphonation of alkanes. Chemical reactivity, hydrogenation, heat of hydrogenation and stability of alkanes, electrophilic addition reaction & mechanism, halogenation, hydrohalogenation, hydration, hydroboration, Markownikoffs rule, peroxide effect, 1-3 dipolar addition. (only formation no details mechanism is required). Alkyne synthesis hydration, substitution reactions, polymerization.

**8. Aromatics Hydrocarbons Aromatic substitution reactions :**

Isomerism of aromatic compounds, their nomenclature, structure of benzene ring. General mechanism of aromatic electrophilic substitution (elementary treatment)  
Methods of synthesis, nitration, Sulphonation, halogenation.  
Friedel-crafts alkylation and acylation, reaction, nuclear and side chain halogenation.

**9. Stereochemistry:**

Conformation of Acyclic organic molecules: Strain in molecules, Bond stretching and compression, Bond angle bending: Bond angle strain, Bond torsion: Torsional strain, Steric repulsion: van der Waals strain, Nomenclature for distinguishing conformations of organic molecules, Dihedral angle and Torsion angle, Torsional curves of a few simple acyclic compounds (ethane, propane, n-butane), Butane-gauche interaction, calculation of % of anti and gauche forms n-butane at 298<sup>0</sup>K, Conformation of some H-bonded acyclic molecules.  
Conformation of cyclic organic molecules mainly Cyclohexane: Chair and Boat Form, Topomerisation of Chair form of cyclohexane; The Conformational preference of substituent in chair cyclohexane, Conformations of a few substituted chair form of cyclohexane (1, 2- or 1,3- or 1,4- dimethylcyclohexane), Conformations of cyclohexane-1,4-dione, 2-alkyl and 3-alkyl ketone effect,  $\alpha$ -haloketone effect, Conformations of cyclohexene: A<sup>1,2</sup> strain, Concept of I-strain.

**10. Solubility and solubility product:**

Common ion effect. Principal and reaction involved in the group separation and identification of cations and anion in the Qualitative inorganic analysis.

**Practical Paper code : CH –293**

**Full Marks: 100**

Systematic semi micro quantitative analysis of simple mixture containing not more than two basic radical and one acid radical from the following list (Spot test are to be applied whenever possible)

Silver, lead, mercury, bismuth, copper, cadmium, arsenic, antimony, tin, iron, aluminum, chromium, zinc, manganese, cobalt, nickel, calcium, strontium, barium, magnesium, sodium, potassium, ammonium, & other oxides, chlorides, bromides, iodides, sulphides, sulphites, sulphates, nitrites, nitrates, nitrites, & phosphates, (Acid insoluble compounds & phosphate separation omitted)

**3rd Semester**

**Theory Paper Code : CH-301**

**Full Marks: 100**

**1. i) Comparative study of the following groups of elements:**

- |                         |                       |
|-------------------------|-----------------------|
| a) B, Al;               | b) C, Si, Ge, Sn, Pb; |
| c) N, P, S, As, Sb, Bi; | d) O, S, Se, Te       |
| e) F, Cl, Br, I         |                       |

in respect of electronic configuration, elements states, oxidation states, hydrides, halides oxides, and oxyacides.

**ii) Bonding in diborene**

**2. Second law of thermodynamics :**

- Carnot cycle, Elementary treatment of entropy, free energy, work function & criterion of equilibrium. Gibbs Helmholtz equation, Clausius Clapeyron equation and its application.
- 3. Homogeneous chemical equilibrium :**  
Law of mass action and equilibrium constant  $K_p, K_c, K_x$  and their relationship.  
Le-chatelier principle- effect of temperature, pressure and addition of products of reaction and inert gases. Van't Hoff equation (derivation not required) and its application.
  - 4. Alcohols & Ethers:**  
Methods of synthesis, physical properties, distinction of primary, secondary and tertiary alcohols. Chemical reactivity. Ethers, methods of synthesis, Chemical reactivity.
  - 5. Phenols:**  
Synthesis, physical properties acidic character of phenols, chemical reaction – Reimer-Tiemann reaction, Fries rearrangement, Kolbe's reaction, phenol formaldehyde resins (Lederer-Manasse reaction) Cresols nitro and amino phenols.(Synthesis only).
  - 6. Aldehydes and ketones:**  
Methods of synthesis of aldehydes and ketones, chemical reactivity of carbonyl group, Cannizzaro reaction and aldol condensation, relative reactivities of aldehyde and ketones. Perkin reaction, benzoin condensation, Claisen condensation.
  - 7. Carboxylic acid and their derivatives:**  
Methods of synthesis, acidity of aliphatic and aromatic acid, effects of substituents on acidity (simple cases). Chemical reactivity. Mechanism of esterification ( $A_{AC}2$ ): methods of synthesis and reaction of acid halides, amides, esters and anhydrides.
  - 8. Organic compounds containing nitrogen:**  
Aromatic nitro compounds their synthesis, reduction under different conditions. Methods of synthesis of aliphatic amines, Hinsberg's method of separation, Hofmann degradation, Gabriel's phthalimide synthesis, distinction between primary secondary & tertiary amines. Methods of synthesis of aromatic amines. Diazotizations and its mechanism. Synthetic application of aromatic diazonium salts.
  - 9. Acids-Bases and Solvents:**  
Modern concepts of acids and bases: Arrhenius theory, theory of solvent system, Bronsted and Lowry's concept, Lewis concept with typical examples, applications and limitations. Strengths of acids and bases (elementary idea). Ionization of weak acids and bases in aqueous solution, ionization constants, ionic product of water, pH-scale.
  - 10. Ionic Equilibrium:**  
Strong and weak electrolytes degree of dissociation. Ostwald's dilution law. Hydrolysis, buffer, calculation of pH, salt effect, elementary idea of activity & activity coefficient of electrolytes, ionic strength, buffer reaction of blood.
  - 11. EMF :**  
Electro chemical cells, half-cell, electrodes potential standard electrode potential, Nernst equation, redox potential, reference electrode, standard cell, measurement of emf, determination of pH, potentiometric titration, storage battery, corrosion.

**Practical Paper Code : CH-393**

**Full Marks: 100**

Quantitative analysis through titrations:

Preparation of standard solution of oxalic acid and standardization of (a) NaOH solution and (b)  $KMnO_4$  solution.

Preparation and standardization Mohr's solution by  $\text{KMnO}_4$  solution.

Preparation of standard  $\text{K}_2\text{Cr}_2\text{O}_7$  solution and standardization  
Mohr's Salt solution.  
Sodium thiosulphate solution.

Estimation of Fe(II) +Fe (III) mixture using standard solution of  $\text{K}_2\text{Cr}_2\text{O}_7$   
Determination of Cu (II) using standard sodium thiosulphate solution

#### Fourth Semester

**Theory Paper Code: CH-401**

**Full Marks: 100**

**1. Interhalogen compounds:**

Basic properties of iodine, pseudo halogens.

**2. Dilute solution:**

Rault's law, ideal solution, non- ideal solution, and qualitative treatment of colligative properties relative lowering of vapour pressure, elevation of boiling point, and osmotic pressure-their application in finding molecular weight. Van't Hoff 'i' factor, plasmolysis, haemolysis, isotonic solution, normal saline, role of osmosis in living organism.

**3. Some Reaction of Synthetic Importance: (Mechanism and Importance)**

Aldol Condensation, Arndt-Eistert Synthesis, Bayer-Villiger Reaction, Bischler-Napieralski Synthesis, Cannizzaro Reaction, Claisen Condensation, Claisen-Schmidt or Claisen Reaction, Dakin Reaction, Dieckmann Reaction, Diel's-Alder Reaction-Diene Synthesis, Elbs Persulphate Oxidation, Fischer-Indole Synthesis, Fitting-Reaction, Friedal Craft Reaction, Knoevenagel Reaction, Leuckart Reaction, Mannich Reaction, Meerwein-Ponndorf-verley Reduction, Michael Reaction, Oppenauer Oxidation, Peehmann Reaction, Perkin Reaction, Reformatsky Reaction, Reimer-Tiemann Reaction, Sommelet Reaction, Ullmann Reaction, Willgerdot Reaction, Witting Reaction, Wolf-Kishner Reduction.

**4. Some Reagent of Synthetic Importance:**

Alluminium isopropoxide, Alluminium-t-butoxide, Anhydrous alluminium chloride, Boron trifluoride, N- Bromosuccinimide(NBS), Diazoacetic ester, Diazomethane, Dicyclohexylcarbodiimide(DCC), Girard Reagents, Lead tetraacetate, Liquid ammonia, Lithium alluminium hydride, Osmium tetraoxide, Ozone, Perbenzoic acid, Periodic acid, Platinum and Palladium catalyst, Polyphosphoric acid, Raney nickel, Selenium, Selenium dioxide, Sodamide, Sodium borohydride, Trifluoroacetic acid.

**5. Molecular Rearrangements:**

Introduction, Rearrangements to electron deficient atoms(C, N, O)( Pinacol-pinacolone Rearrangement, Wagner-Meerwein Rearrangement, Wolf Rearrangement, Allylic Rearrangement, Sommelet-Hauser Rearrangement, Hofmann Rearrangement, Curtius Rearrangement, Schmidt Rearrangement, Lossen Rearrangement, Beckmann Rearrangement, Neber Rearrangement, Baeyer-Villiger Reaction, Cumene-Hydroperoxide Rearrangement, Dakin Rearrangement); Intermolecular aromatic rearrangement ( Orton Rearrangement, Hoofmann-Martius Rearrangement); Intramolecular aromatic rearrangement ( Claisen Rearrangement, Benzidine Rearrangement); Mixed types of aromatic rearrangement, Fries Rearrangement.

**6. Organometallic Compounds:**

Organomagnesium Compounds, Organozinc Compounds, Organolead Compounds, Organocadmium Compounds.

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**7. Amino acids, Peptides and Proteins:**

Amino acids (Preparative Methods, dipolar Nature, Chemical reaction, Detection and Configuration); Peptides (The Peptide Linkage, Peptide Synthesis, Structure of Polypeptides); Proteins (General Characteristics, Classification, Structure).

**8. Carbohydrate:**

Introduction, occurrence, classification, constitution of glucose, osazone formation. Reaction of glucose and fructose, mutaration, cyclic structure- pyranose and furanose form. Epimerisation, Chain lengthening and shortening in aioses.

**9. Chemicals Kinetics:**

Rate, order and molecularity of a reaction, rate constants of first and second order reactions, half life period, influence of temperature on reaction rate, activation energy, determination of order of a reaction.

**10. Homogeneous catalysis:**

Criterion of catalysis, mechanism of catalytic action, enzyme catalysis, industrial catalyst.

**Practical Paper Code : CH-493**

**Full Marks: 100**

To determine the percentage composition of given mixture from viscosity measurement.

To determine the percentage composition of given mixture by surface tension method.

To determine the percentage composition of given mixture using abbe's refractrometer.

To verify the law of refraction of mixtures such as glycerol or water using abbe's refractrometer.

To determine the specific rotation of a given optically active compound.

To determine the percentage composition of a substance in its aqueous solution using polarimeter.

To determine the solubility of benzoic acid in water at room temperature

To study the adsorption of acetic acid/ oxalic acid on activated charcoal and verify the freundlich's adsorption isotherm.

To study the distribution of acetic acid between benzoic acid/ CCl<sub>4</sub> CHCl<sub>3</sub> & water.

To study the specific reaction rate of the acid-catalyzed hydrolysis of methyl acetate at room temperature.

To determine the pH of a given solution using bromocresol green/ methyl red indicator.

**B.Sc**

**COMPUTER APPLICATION SYLLABUS (PASS)**

**1<sup>st</sup> Semester**

**Theory Paper Code : CA-101**

**Full Marks: 100**

**INTRODUCTION TO COMPUTER**

**Generation of computer:-**

**in**  
**Biotechnology**

1<sup>st</sup> to 4<sup>th</sup> generation with their characteristics .

**Basic concept of computer :-**

Introduction , different components of computer, basic design of computer.

**Introduction to operating system**

Introduction to OS ,different management ( processor ,memory ,device ,file),

Processor management-Process concept ,Threads ,CPU Scheduling

Process scheduling, Deadlocks ,Process synchronization.

Memory management –Memory allocation rule ,Swapping, Overlay, Paging ,Demand paging ,segmentation ,virtual memory.

Device management ,File management.

**Practical Paper Code : CA-194**

**Full Marks: 100**

**INTRODUCTION TO COMPUTER**

**Usage of MS DOS commands:**

basic concept of internal & external commands ,directory &file commands, copying, erasing ,renaming ,displaying files ,introduction to pipes & filters ,concept of batch file.

**Windows operation :**

Customizing the interface , windows explorer, computer upkeep & utilities

**Office operation**

**Microsoft word:-** concept of toolbar ,character ,paragraph& document formatting, drawing tool bar , header ,footer ,document editing ,page setup, short cut keys, text & graphics.

**Microsoft excel:-** concept of spread sheets, creating worksheet ,well formatted documents, concept of row , column ,cell &formula bar, using function ,using shortcuts ,chart, conditional formatting, goal seek ,validation rule.

**Microsoft power point :-** slide presentation, slide layout & design , custom animation, image importing ,slide transition

**2<sup>nd</sup> Semester**

**Theory Paper Code : CA-201**

**Full Marks: 100**

**INTRODUCTION TO C-PROGRAMMING & DIGITAL LOGIC**

**C Programming**

Introduction , data type, operators & expression, program control, case control structure, function, array, structure & union, character & string, pointer, file handling, preprocessor & library function .

**Digital logic**

Number systems (binary, octal, hexadecimal),logic gates, Boolean algebra, logic diagram.

**Practical Paper Code : CA-294**

**Full Marks: 100**

**INTRODUCTION TO C-PROGRAMMING & DIGITAL LOGIC**

**Assignments for lab:**

1. If a five digit number is input through the keyboard, write a program to calculate the sum of its digits.
2. Write a program which will find out the bill amount on the basis of

following condition

Bill amount = 590 when no of call  $\leq 255$

Bill amount =  $590 + 2 * (\text{call} - 250)$  when no of call  $> 250$  and  $\leq 550$

Bill amount =  $590 + 3 * (\text{call} - 250)$  when no of call  $> 550$

3. write a program to produce the following out put:

```
A B C D E F G F E D C B A
A B C D E F F E D C B A
A B C D E E D C B A
A B C D D C B A
A B C C B A
A B B A
A A
```

4. Write a program to add first seven terms of the following series

$1/1! + 2/2! + 3/3! + \dots$

5. Write a program to display following.

a)

```
*
* *
* * *
* * * *
* * * * *
```

b)

```
      *
     * *
    * * *
   * * * *
  * * * * *
```

c)

```
      1
     2 1
    3 2 1
   4 3 2 1
```

6. Write a program to solve the quadratic equation and find its root.

7. Write a program, which will take marks of five subject of a student and will give the output as sum & percentage of marks.

8. Write a menu driven program which has following options;

1. Factorial of a number.
2. Prime or not.
3. Odd or even
4. exit.

9. Write a recursive function to obtain the first 25 numbers of a fibonacci series.

10. Write a program to obtain transpose of a 4x4 matrix. the transpose of a matrix is obtained by exchanging the elements of each row with the elements of the corresponding column.

11. Write a program, which will take a word as input and reverse it.

12. Write a program ,which will take a word as input and test whether it is palindrome or not.

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13. Write a program, which will produce a output to show student details (home address ,phone number, department) from an institution.
14. Find out the sum of the following series.
  - a)  $\text{Sum}=(1/1^1) + (2/2^2) + (3/3^3) + (4/4^4) + \dots \text{nth}$
  - b)  $\text{Sum}=(1/1!) + (2/2!) + (3/3!) + (4/4!) + \dots \text{nth}$
15. Write a simple program for demonstrating function of a pointer.
16. Write a program for demonstrating function (like factorial etc).
17. Write a program to calculate the number of character , blank , tabs & lines in a given text file.
18. Write a program to copy the content of a given text file into a newly created file.

**3<sup>rd</sup> Semester**

**Theory Paper Code : CA-301**

**Full Marks: 100**

**INTRODUCTION TO DATA STRUCTURE & COMPUTER ORGANIZATION**

**Introduction to data structure**

Stack, queue, linked list, introduction of graph theory, sorting (bubble, selection), searching (binary),

**Computer organization**

Memory organization (RAM, cache memory, auxiliary memory, ROM), I/O organization (DMA, programmed i/o, interrupted i/o), ALU & floating point arithmetic.

**Practical Paper Code : CA-394**

**Full Marks: 100**

**INTRODUCTION TO DATA STRUCTURE & COMPUTER ORGANIZATION**

1. Write a program to perform stack operation using array.
2. Write a program to perform queue operation using array.
3. Write a program to perform link list operation (insertion , deletion , updation , modification and searching).
4. Write a program to search an element in an array using binary search.
5. Write a program to sort the element in an array using binary search.

**4<sup>th</sup> Semester**

**Theory Paper Code : CA-401**

**Full Marks: 100**

**INTRODUCTION TO DBMS, COMPUTER NETWORK & NUMERICAL ANALYSIS**

**Introduction to database management system**

ER Model

Various models of DBMS-Hierarchical, Network, Relational, File organization

Architecture of DBMS

Concept of SQL

Client server DBMS

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Normalization (up to 3NF)  
Concept of Transaction management and log based recovery.

**Introduction to computer network**

Network model :

Layered tasks ,internet model(peer- to -peer process ,function of layers),OSI model.

Signal : analog & digital, transmission impairment ( attenuation, distortion, noise )

Transmission media :

Guided, unguided.

Connecting device:

Repeaters , hubs, bridges ,two layers switch ,router & three layer switches.

Internet address: classful address , classless address ,subnetting.

**Introduction to numerical analysis**

Bisection method, Forward and backward method, Rung Kutta method etc.

**Practical Paper Code : CA-494**

**Full Marks: 100**

**INTRODUCTION TO DBMS, COMPUTER NETWORK & NUMERICAL ANALYSIS**

**DBMS lab (MS-Access)**

Table creation , from creation , concept of SQL, report generation , case study on MS-Access .

**Web Technology lab**

Creation of web page using HTML tags ( b ,u, I, br ,no br ,p ,marquee ,imgsrc ,a href ,font ,pre ,list tags etc) ,creation of table, creation of forms ,usage of frame set.

**Numerical analysis using C**

Bisection method, Forward and backward method, Rung Kutta methodetc.