Syllabus for three-year
B.Sc DEGREE COURSE (Hons)
in
Molecular Biology

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

| 4 credit (Theory) means 3 lecture hours & 1 Tutorial per week
| or 42 lectures per semester per paper
| 2 credit (Lab.) means at least 40 hours of lab work per semester per paper

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 30.

3. The fee structure should be on no grant basis as applicable to technical courses.

BSc : Molecular Biology (Hons) Syllabus

FIRST SEMESTER

Paper (Theoretical) :

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

Paper (Practical) :

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
</tr>
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<tbody>
<tr>
<td>BMI–192</td>
<td>Basic Microscopy &amp; Instrumentation</td>
<td>100</td>
<td>2</td>
<td>40</td>
</tr>
</tbody>
</table>
## Syllabus for three-year B.Sc DEGREE COURSE (Hons) in Molecular Biology

### FIRST SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
</tr>
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<tbody>
<tr>
<td>BCH–191</td>
<td>Biochemistry</td>
<td>100</td>
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<tr>
<td>CH-191</td>
<td>Chemistry (Pass)</td>
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<tr>
<td>CA-191</td>
<td>Introduction to Computer (Pass)</td>
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### SECOND SEMESTER

#### Paper (Theoretical) :

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
</tr>
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<tbody>
<tr>
<td>OMB-201</td>
<td>Organic Mechanisms in Biology</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
</tr>
<tr>
<td>PTG-202</td>
<td>Principles of Transmission Genetics</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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<tr>
<td>POM-203</td>
<td>Principles of Microbiology</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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<tr>
<td>GGR-204</td>
<td>Gene Expression and Gene Regulation</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>CH-201</td>
<td>Chemistry (Pass)</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>CA-201</td>
<td>Introduction to C-Programming &amp; Digital Logic (Pass)</td>
<td>100</td>
<td>3+1</td>
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#### Paper (Practical) :

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
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<tbody>
<tr>
<td>CGT–292</td>
<td>Cyto-genetic Techniques</td>
<td>100</td>
<td>2</td>
<td>40</td>
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<tr>
<td>MIC–293</td>
<td>Microbiology</td>
<td>100</td>
<td>2</td>
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<tr>
<td>CH-291</td>
<td>Chemistry (Pass)</td>
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<tr>
<td>CA-291</td>
<td>Introduction to C-Programming &amp; Digital Logic (Pass)</td>
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### THIRD SEMESTER

#### Paper (Theoretical) :

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>MCG-301</td>
<td>Microbial Genetics</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>POI-302</td>
<td>Principles of Immunology</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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<tr>
<td>PAT-303</td>
<td>Plant and Animal Tissue Culture Techniques and applications</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>GNO-304</td>
<td>Genome Organization</td>
<td>100</td>
<td>3+1</td>
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<td>CH-301</td>
<td>Chemistry (Pass)</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>CA-301</td>
<td>Introduction to Data Structure &amp; Computer Organization (Pass)</td>
<td>100</td>
<td>3+1</td>
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#### Paper (Practical) :

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
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<tbody>
<tr>
<td>IMN–392</td>
<td>Immunology</td>
<td>100</td>
<td>2</td>
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</table>
**SYLLABUS FOR THREE-YEAR B.Sc DEGREE COURSE (Hons) IN MOLECULAR BIOLOGY**

<table>
<thead>
<tr>
<th>Paper Code</th>
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<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
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<tbody>
<tr>
<td>TCT–393</td>
<td>Tissue Culture Techniques</td>
<td>100</td>
<td>2</td>
<td>40</td>
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<tr>
<td>CH-391</td>
<td>Chemistry (Pass)</td>
<td>100</td>
<td>2</td>
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<td>CA-391</td>
<td>Introduction to Data Structure &amp; Computer Organization (Pass)</td>
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**FOURTH SEMESTER**

**Paper (Theoretical) :**

<table>
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<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
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<tbody>
<tr>
<td>MOG-401</td>
<td>Molecular Genetics</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>CBB-402</td>
<td>Computational Biology &amp; Bio-informatics</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
</tr>
<tr>
<td>BDT-403</td>
<td>Biodiversity &amp; Taxonomy</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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<tr>
<td>TGE-404</td>
<td>Tools for analyzing Gene Expression</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>CH-401</td>
<td>Chemistry (Pass)</td>
<td>100</td>
<td>3+1</td>
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<tr>
<td>CA-401</td>
<td>Introduction to DBMS, Computer Network &amp; Numerical Analysis (Pass)</td>
<td>100</td>
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**Paper (Practical) :**

<table>
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<tr>
<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
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<tbody>
<tr>
<td>MBT–491</td>
<td>Molecular Biology Techniques</td>
<td>100</td>
<td>2</td>
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<tr>
<td>BIN–492</td>
<td>Bio-informatics</td>
<td>100</td>
<td>2</td>
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<td>CH-493</td>
<td>Chemistry (Pass)</td>
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<td>CA-494</td>
<td>Introduction to DBMS, Computer Network &amp; Numerical Analysis (Pass)</td>
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**FIFTH SEMESTER**

**Paper (Theoretical) :**

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<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
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<tbody>
<tr>
<td>DPB-501</td>
<td>DNA Typing, Proteomics &amp; Beyond</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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<tr>
<td>RDT-502</td>
<td>Recombinant DNA Technology</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
</tr>
<tr>
<td>EVB-503</td>
<td>Environmental Biotechnology</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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<tr>
<td>GEM-504</td>
<td>Genetic Modification in Agriculture, Food &amp; Industry</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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</table>

**Paper (Practical) :**

<table>
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<tr>
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<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
</tr>
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<tbody>
<tr>
<td>GET-591</td>
<td>Genetic Engineering Techniques</td>
<td>100</td>
<td>2</td>
<td>40</td>
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<tr>
<td>AGE–592</td>
<td>Analysis of Gene Expression</td>
<td>100</td>
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SIXTH SEMESTER

Paper (Theoretical) :

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit hrs</th>
<th>Classes / Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHG-601</td>
<td>Model Organisms in Human Genome Project</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
</tr>
<tr>
<td>MMB-602</td>
<td>Medical Molecular Biology</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
</tr>
<tr>
<td>MLG-603</td>
<td>Molecular Human Genetics</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
</tr>
<tr>
<td>MTI-604</td>
<td>Molecular Technology : Social, Legal &amp; Ethical Issues</td>
<td>100</td>
<td>3+1</td>
<td>42</td>
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</table>

Paper (Practical) :

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Name of the Paper</th>
<th>Marks</th>
<th>Credit</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRO–691</td>
<td>Project on Biodiversity</td>
<td>100</td>
<td>2</td>
<td>40</td>
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<tr>
<td>DSS–692</td>
<td>Dissertation on Molecular Biology</td>
<td>100</td>
<td>2</td>
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</tbody>
</table>

BSc (H) Syllabus in
Molecular Biology

FIRST SEMESTER

Paper Code : MSA –101 (Theoretical)    Full Marks : 100
Credit : 4 (3+1)  Lecture period : 42L

Paper Name : Macromolecular Structure & Analysis

   (4 Periods)

2. **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)

3. **Proteins** : Structural aspects – General introduction, Classification & General characteristics, Structure of Primary, Secondary, Tertiary & Quaternary proteins (elementary idea), & & -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)

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

*Full Marks : 100*

*Credit : 4 (3+1)*

**Paper Name : Cell Structure & Dynamics**

**Lecture period : 42L**

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Syllabus for three-year B.Sc DEGREE COURSE (Hons) in Molecular Biology


(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, Gilding 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**

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]
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Partial Differentiation including Euler’s theorem and its 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)

SECOND SEMESTER

Paper Code: OMB-201 (Theoretical)  
Full Marks: 100  
Credit: 4 (3+1)
Paper Name: Organic Mechanisms in Biology  
Lecture period: 42L

2. Biomolecules – Carbohydrates (Anomaric 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
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)
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Molecular Biology
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)


(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
Paper Name : Principles of Microbiology    Credit : 4 (3+1)
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)


(6 Periods)


(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 : GGR -204 (Theoretical)    Full Marks : 100
Credit : 4 (3+1)

Paper Name : Gene expression and Gene Regulation    Lecture period : 42L

1. Transcription: Enzymatic Synthesis of RNA Basic features of RNA synthesis, E.coli RNA polymerase, Classes of RNA molecules, processing of tRNA and rRNA in E.coli, Transcription in Eukaryotes, Eukaryotic rRNA genes, formation of eukaryotic tRNA molecules, RNA Polymerases of eukaryotes, RNA polymerase II Promoters, Eukaryotic Promoters for RNA polymerase III, Hypersensitive sites, Upstream activation sites and enhancers, Splicing mechanisms, Splicing of tRNA precursors, Splicing of rRNA precursors, Splicing without a protein enzyme. (8 Periods)

2. Translation: Outline of Translation, The Genetic Code, The Decoding System, Codon Anticodon interaction, The special properties of the prokaryotic Initiator tRNA \( f \text{Met} \), Transfer RNA genes, suppressors, Ribosomes, Protein Synthesis, Complex Translation units, Some numerical parameters of Protein synthesis, Inhibitors and Modifiers of protein synthesis, Protein Synthesis in Eukaryotes. (12 Periods)


4. Regulation in Eukaryotes: Regulatory strategies in Eukaryotes, Gene alteration (Gene loss, Gene amplification, Gene rearrangement: the joining of coding sequences in the immune system) Transcriptional Control by hormones, Regulation mediate through Transcription factors, Regulation of enhancer activity, Methylation, Regulation of processing, Translational control, Regulation of gene expression in plant cells by light. (14 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)
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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)

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 (Coincetranscription 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 PhageT4, 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)


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
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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)

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)


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 : GNO- 304 (Theoretical)    Full Marks : 100
Credit : 4 (3+1)
Paper Name : Genome Organization    Lecture period : 42L

1. The content of the genome : Genomes can be mapped by linkage, restriction cleavage or DNA sequence, RFLPs and SNPs for genetic mapping, Eukaryotic genomes contain both non repetitive and repetitive DNA sequences, Human genome has fewer genes than expected, Organelles have DNA, Mitochondrial DNA organization is variable, Mitochondria evolved by endosymbiosis, Chloroplast genome codes for many proteins and RNAs. (10 Periods)


4. Transposable Elements: An Overview of Transposition, Insertion sequences, Detection of Transposition in Bacteria, Types of bacterial Transposons, Transposition, Replication of a transposon in the course of transposition between two plasmids, The Cointegrate as an Intermediate in transposition of Tn3, Deletions and Inversions Caused by Transposons, Role of IS elements in Hfr Formation, Transposable Elements in Eukaryotes, Retroposons, Limitation of Transposition. (10 Periods)

5. Mutagenesis, Mutations, and Mutants– Terminology,Types of Mutations and their Notation, Biochemical Basis of Mutants, Mutagenesis, Mutational Hot Spots, Reversion. (6 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)
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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. (8 Periods)
3. Cutting and Joining DNA – Restriction Enonucleases, 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)

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)

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**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)

   (5 Periods)

4. **Exotic Species** – Plants, Invertebrates, Fishes, Amphibians, Reptiles, Birds, Mammals, Detrimental Effects of Exotic Species.  
   (3 Periods)

   (5 Periods)

   (4 Periods)

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**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
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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: TGE-404 (Theoretical)    Full Marks: 100
Paper Name: Tools for analyzing Gene Expression    Credit: 4 (3+1)
Lecture period : 42L

1. **Reporter Genes** – Commonly used reporter genes, Analysis of gene regulation Purification and
detection tags. (6 Periods)

2. **Analysis at the level of gene transcription** – Northern blot, In situ hybridization, Rnase protection
   assay, RT-PCR. (6 Periods)

3. **Analysis at the level of Translation** – Western blot, In situ analysis, ELISA, protein gel
electrophoresis, Antibody production. (6 Periods)

4. **Antisense technology** - Antisense oligonucleotides, RNA interference (RNAi), RNAi therapies.
   (6 Periods)

5. **Analysis of DNA protein interactions**: Electrophoretic mobility shift assay (EMSA), Dnase I
   footprinting, Chromatin immuno-precipitation assay. (10 Periods)

6. **Analysis of protein-protein interactions** - Pull-down assay, Yeast two hybrid assay,
   Coimmunoprecipitation assay, Fluorescence resonance energy transfer (FRET). (8 Periods)

Paper Code: MBT–405 (Practical)    Full Marks: 100
Paper Name: Molecular Biology Techniques    Credit: 2
Practical period : 40

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
Paper Name: Bio-informatics    Credit: 2
Practical period : 40

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


3. High-throughput analysis of gene function - DNA microarrays, Protein arrays, Mass spectrometry. (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 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
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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)

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

**Full Marks : 100**

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

**Paper Name : Genetic Modification in Agriculture, Food Industry and Medicine**

**Lecture period : 42L**

1. **Genetic modification** – terminology, methods of genetic modification, genetic modification of bacteria, plant & animal, controversies over genetic modification, policy around the world (USA, European Union, EU regulation, Japan, China & other developing countries).
   
   (12 Periods)

2. **Genetic modification in Agriculture** – transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants.
   
   (10 Periods)

   
   (6 Periods)

4. **Genetic modification in Food industry** – background, history, controversies over risks, application, future applications.
   
   (6 Periods)

   
   (8 Periods)

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**Paper Code : GET–505 (Practical)**

**Full Marks : 100**

**Credit : 2**
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Paper Name: Genetic Engineering Techniques  Practical period: 40

1. Transformation in E. coli DH5α (5 Periods)
2. Bacterial conjugation (4 Periods)
3. Phage Titration (5 Periods)
4. Plasmid preparation (4 Periods)
5. Restriction enzyme digestion (4 Periods)
6. Ligation (4 Periods)
7. Genomic DNA extraction (3 Periods)
8. DNA molecular size determination (3 Periods)
9. Bacterial Antibiotic sensitivity (4 Periods)
10. Bacterial gene expression (using Lac promoter system) (4 Periods)

Paper Code: AGE-506 (Practical)  Full Marks: 100  Credit: 2
Paper Name: Analysis of Gene Expression  Practical period: 40

1. Screening & Analysis:
   a) GFP Cloning
   b) Bacterial Gene Expression
   c) Southern Hybridization. (12 Periods)
2. PCR Application: Single Nucleotide Polymorphism (SNP) (10 Periods)
3. DNA Fingerprinting:
   a) DNA Fingerprinting (Using RAPD techniques)
   b) Rice variety identification by RAPD analysis
   c) Genotyping Analysis in Human (18 Periods)

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)
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6. Technologies used in HGP – RFLP, microsatellite markers, STS, EST, DNA sequencing, DNA microarray. (8 Periods)

Paper Code : MMB-602 (Theoretical)  Full Marks : 100
Credit : 4 (3+1)
Paper Name : Medical Molecular Biology  Lecture period : 42L


3. Genes and Human behavior - Aggressive, impulsive, and violent behavior, Schizophrenia susceptibility loci. (10 Periods)

4. Stem cells & therapeutic cloning - Embryonic stem cells and therapeutic cloning, multi-potent adult stem cells, pluripotent adult stem cells, transgenic stem cells, Regeneration therapy. (10 Periods)

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Paper Code : MLG -603 (Theoretical)  Full Marks : 100
Credit : 4 (3+1)
Paper Name : Molecular Human Genetics  Lecture period : 42L

1. Genetic mapping of Mendelian characters: Recombinants, Non-recombinants, Genetic markers, Two point mapping, Multipoint mapping, Fine mapping using extended pedigrees and ancestral haplotypes. (10 Periods)

2. Identifying Human disease genes: Principles and strategies in identifying disease genes, Positional cloning, Use of chromosomal abnormalities, confirming a candidate gene, various ways of identifying disease genes. (10 Periods)

3. Mapping and identifying genes conferring susceptibility to complex diseases: Deciding whether a non-Mendelian character is genetic: the role of family, twin and adoption studies, Linkage analysis of complex characters, Association studies and linkage disequilibrium, Identifying the susceptibility alleles, Examples that illustrate the varying success of genetic dissection of complex diseases. (12 Periods)

4. Molecular Pathology: Rules for nomenclature of mutations & databases of mutations, Loss of function mutations, Gain of function mutations, Molecular pathology from gene to disease, Molecular pathology from disease to gene, Molecular pathology of chromosomal disorders. (10 Periods)

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Paper Code : MTI-604 (Theoretical)  Full Marks : 100
Credit : 4 (3+1)
Paper Name : Molecular Technology : 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,
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(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 Molecular Biology
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)

1st Semester

Theory Paper Code: CH-101
Full Marks: 100

1. Atomic Structure:

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. \( P = \frac{1}{3} m n v^2 \), deduction of gases laws.

3. Bonding in organic compounds:
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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, Prototereoisomerism, Concept of Topicity of Ligands and Faces (Homotopic, Enantiotopic, Diastereotopic atoms and groups; Prochiral, Homotopic, Enantiotopic, Diastereotopic Faces), Projection Structures of Streoisomers (Fischer, Swahorse, 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 modifications, Racemic mixture or (+/-)-Conglomerate, Racemic Compounds or racenate, 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, threeo, Pref and Praf designations of enantiotropic 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, transferrance number, conduct metric titration.

7. Phase Rule:
Phase, component, system, degrees of freedom. The phase rule. Phase diagram of one component system: water. Heterogeneous systems: Nerast distribution law, miscibility and distillation of binary liquid mixture, aziotroic mixtures, critical solution temperature (elementary idea).

8. Radioactivity and Nuclear Structure of Atoms:

9. Chemical analysis:
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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.

2nd 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:

2. Double & complex salt:
   Werner’s theory of co ordination compounds. Chalets. Polydentate ligands including naturally occurring ones. Electronic interpretation of compounds formation. Stepwise and overall stability constants. (elementary idea only) Geometrical & optical isomerism. Nomenclature of co or dination compounds.

3. The noble gases:
   Occurrence, general properties, electronic structure 7 position in the periodic table. Elementary Xenon compounds (bonding and structures excluded).

4. Real gases:
   Deviations from ideal behavior vander Waal’s equation. Andrews exprment, critical phenomena in light in Vander wal’s equation state, community of state.

5. First law of thermodynamics:
   Cyclic process, Reversible & irreversible process, internal energy, enthalapy, work done an isothermal & adiabatic pricess, heat capacities, Cp-Cv =R for an ideal gas.

6. Viscosity:
   Definition & determination of Oswald’s viscomers, variation with temperature for liquid and gases.

7. Alkanes, Alkenes, Alkynes:
   Isomerism, synthesis, chemical reactivity of alkanes, Mechanism of free radical helogination of alkanes, sulphonation of alkanes. Chemical reactivity, hydrogenation, heat of hydrogenation and stability of alkanes, electrophilic addition reaction & mechanism, helogination, hydrohelogination, hydration, hydroboration, Markownikoffs rule, peroxide effect, 1-3 dipolar addition. 9only 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)
Syllabus for three-year
B.Sc DEGREE COURSE (Hons)
in
Molecular Biology

Methods of synthesis, nitration, Sulphonation, halogenation.
Friedel-crafts alkylation and acylation, reaction, nuclear and side chain helogination.

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 298ºK, 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 subsituent 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, α - haloketone effect, Conformations of cyclohexane: A12 strain, Concept of 1- 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, magnesiun, sodium, potassium, ammonium, & other oxides, chlorides, bromides, iodides, sulphides, sulphites, sulphates, nitrates, nitrites, nitrates, & 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 entry, work function & criterion of equilibrium. Gibbs Helmohltz equation, Clasious clapeyron equation and its application.

3. Homogeneous chemical equilibrium:
Law of mass action and equilibrium constant Kp,Kc,Kx and their relationship. Le-chatelier principal- effect of temperature, pressure and addition of products of relation and inert gases. Vant’s 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:
Syllabus for three-year
B.Sc DEGREE COURSE (Hons)
in
Molecular Biology

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, cannizero reaction and adol condensation, relative reactivities of aldehyde and
ketones. Perking reaction, benzoine condensation, Claisen condensation.

7. Carboxylic acid and their derivatives:
Methods of synthesis, acidity of aliphatic and aromatic acid, effects of substitutents
on acidity (simple cases). Chemical reactivity. Mechanism of esterification (A_{CH}^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, Gabrie’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, elementary idea of activity
& activity co-efficient 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, standered 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 KMnO_4 solution.

Preparation of standard K_2Cr_2O_7 solution and standardization
Mohr’s Salt solution.
Sodium thiosulphate solution.

Estimation of Fe(II) +Fe (III) mixture using standard solution of K_2Cr_2O_7
Determination of Cu (II) using standard sodium thiosulphate solution
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)**

4. **Some Reagent of Synthetic Importance:**
   Alluminium isopropoxide, Alluminium-t-butoxide, Anhydrous alluminium chloride, Boron trifluoride, N- Bromosuccinimide(NBS), Diazomethylcarboximide(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, 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, Curtiuss 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.

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, mutation, cyclic structure—pyranose and furanose form. Epimerisation, Chain lengthening and shortening in aidoses.

9. **Chemicals Kinetics:**
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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 refractometer.
To verify the law of refraction of mixtures such as glycerol or water using abbe’s refractometer.
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 an activated charcoal and verify the freundlich’s adsorption isotherm.
To study the distribution of acetic acid between benzoic acid/ CCl4 CHCl3& 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)

1st Semester

Theory Paper Code: CA-101 Full Marks: 100

INTRODUCTION TO COMPUTER

Generation of computer:::-
1st to 4th 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 Excel: Concept of spreadsheets, creating worksheet, well formatted documents, concept of row, column, cell, formula bar, using function, using shortcuts, chart, conditional formatting, goal seek, validation rule.
- Microsoft PowerPoint: Slide presentation, slide layout & design, custom animation, image importing, slide transition.

2nd 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 the following condition:
   - Bill amount = 590 when no of call <= 255
   - Bill amount = 590 + 2*(call-250) when no of call > 250 and <= 550
   - Bill amount = 590 + 3*(call-250) when no of call > 550

3. Write a program to produce the following output:
   
   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 D C B A
   A B C D C B A
   A B C B A
   A B A
   A
4. Write a program to add first seven terms of the following series
\[ \frac{1}{1!}+\frac{2}{2!}+\frac{3}{3!}+\cdots \]

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.

13. Write a program, which will produce an output to show student details (home address, phone number, department) from an institution.

14. Find out the sum of the following series.
   a) \( \text{Sum} = \frac{1}{1^1} + \frac{2}{2^2} + \frac{3}{3^3} + \frac{4}{4^4} + \cdots \)  
   b) \( \text{Sum} = \frac{1}{1!} + \frac{2}{2!} + \frac{3}{3!} + \frac{4}{4!} + \cdots \)  

15. Write a simple program for demonstrating function of a pointer.

16. Write a program for demonstrating function (like factorial etc).
Syllabus for three-year B.Sc DEGREE COURSE (Hons) in Molecular Biology

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.

3rd 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.

4th 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
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 method etc.