FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc. (Honour School) Biotechnology (Semester System)
&
M.Sc. (Honour School) Biotechnology (Semester System)

Examinations 2011-2012

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# SYLLABUS – 2011-12: B.Sc. (Hons. School) Semester System

## B.Sc. (Hons. School) 1st year (1st Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Biomaths / Life Sciences</td>
<td>BHS(I)Sem-I-I/T</td>
<td>50</td>
</tr>
<tr>
<td>2.</td>
<td>Chemistry</td>
<td>BHS(I)Sem-I-II/T</td>
<td>75</td>
</tr>
<tr>
<td>3.</td>
<td>English</td>
<td>BHS(I)Sem-I-III/T</td>
<td>100</td>
</tr>
<tr>
<td>4.</td>
<td>Introduction to Microbial World</td>
<td>BHS(I)Sem-I-IV/T</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Physics</td>
<td>BHS(I)Sem-I-V/T</td>
<td>75</td>
</tr>
</tbody>
</table>

Total Credits=20 Total Marks = 500 (Including subsidiaries)

## Semester – II

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Bio Stats.</td>
<td>BHS(I)Sem-II-I/T</td>
<td>50</td>
</tr>
<tr>
<td>2.</td>
<td>Cell Biology</td>
<td>BHS(I)Sem-II-II/T</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>Chemistry</td>
<td>BHS(I)Sem-II-III/T</td>
<td>75</td>
</tr>
<tr>
<td>4.</td>
<td>English</td>
<td>BHS(I)Sem-II-IV/T</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Physics</td>
<td>BHS(I)Sem-II-V/T</td>
<td>75</td>
</tr>
</tbody>
</table>

Total Credits=20 Total Marks = 500 (Including subsidiaries)

## Semester – III

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Biophysical Chemistry</td>
<td>BHS(II)Sem-III-I/T</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Biophysics</td>
<td>BHS(II)Sem-III-II/T</td>
<td>100</td>
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</tbody>
</table>

Total Credits=20 Total Marks = 500

## Semester – IV

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Cellular Biochemistry</td>
<td>BHS(II)Sem-IV-I/T</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Enzymology and Enzyme Technology</td>
<td>BHS(II)Sem-IV-II/T</td>
<td>100</td>
</tr>
<tr>
<td>4.</td>
<td>Tools in Biotechnology</td>
<td>BHS(II)Sem-IV-IV/T</td>
<td>100</td>
</tr>
</tbody>
</table>

Total Credits=20 Total Marks = 500
Semester – V

B.Sc. (Hons. School) Semester System 3rd year (5th Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Theory</th>
<th>Practical</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Immunology – I</td>
<td>BHS(III)Sem-V-I/T</td>
<td>100</td>
<td>BHS(III)Sem-V-I/P</td>
<td>25</td>
</tr>
<tr>
<td>2.</td>
<td>Plant Tissue Culture and Biotechnology</td>
<td>BHS(III)Sem-V-II/T</td>
<td>100</td>
<td>BHS(III)Sem-V-II/P</td>
<td>25</td>
</tr>
<tr>
<td>3.</td>
<td>Molecular Human Genetics</td>
<td>BHS(III)Sem-V-III/T</td>
<td>100</td>
<td>BHS(III)Sem-V-III/P</td>
<td>25</td>
</tr>
<tr>
<td>4.</td>
<td>Environmental Biotechnology</td>
<td>BHS(III)Sem-V-IV/T</td>
<td>100</td>
<td>BHS(III)Sem-V-IV/P</td>
<td>25</td>
</tr>
</tbody>
</table>

Total Credits=20    Total Marks = 500

Semester – VI

B.Sc. (Hons. School) Semester System 3rd year (6th Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Theory</th>
<th>Practical</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
<td>Course No.</td>
<td>Marks</td>
</tr>
<tr>
<td>1.</td>
<td>Fermentation Technology</td>
<td>BHS(III)Sem-VI-I/T</td>
<td>100</td>
<td>BHS(III)Sem-VI-I/P</td>
<td>25</td>
</tr>
<tr>
<td>2.</td>
<td>Genetic Engineering</td>
<td>BHS(III)Sem-VI-II/T</td>
<td>100</td>
<td>BHS(III)Sem-VI-II/P</td>
<td>25</td>
</tr>
<tr>
<td>3.</td>
<td>Tools in Biotechnology-II</td>
<td>BHS(III)Sem-VI-III/T</td>
<td>100</td>
<td>BHS(III)Sem-VI-III/P</td>
<td>25</td>
</tr>
<tr>
<td>4.</td>
<td>Scientific Writing &amp; Project Management</td>
<td>BHS(III)Sem-VI-IV/T</td>
<td>100</td>
<td>BHS(III)Sem-VI-IV/P</td>
<td>25</td>
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</table>

Total Credits=20    Total Marks = 500

The students of B.Sc (Hons. School) have also to study the subject of “Environment Education”. This is a compulsory qualifying paper which the students are required to qualify in the 1st/2nd/3rd year of the course. The examination will be conducted by the University.
# SYLLABUS – 2011-12 : M.Sc. (Hons. School) Semester System

## M.Sc. 1st Year (1st Semester)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course/Paper</th>
<th>Theory</th>
<th>Practicals</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
<td>Course No.</td>
</tr>
<tr>
<td>1.</td>
<td>Advanced Molecular Biology</td>
<td>MHS(I)Sem-I-I/T</td>
<td>100</td>
<td>MHS(I)Sem-I-I/P</td>
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<tr>
<td>2.</td>
<td>Advanced Immunology</td>
<td>MHS(I)Sem-I-II/T</td>
<td>100</td>
<td>MHS(I)Sem-I-II/P</td>
</tr>
<tr>
<td>3.</td>
<td>Advanced rDNA Technology</td>
<td>MHS(I)Sem-I-III/T</td>
<td>100</td>
<td>MHS(I)Sem-I-III/P</td>
</tr>
</tbody>
</table>

Total Credit = 20
Total Marks = 500

## M.Sc. 1st Year (2nd Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Theory</th>
<th>Practicals</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
<td>Course No.</td>
</tr>
<tr>
<td>1.</td>
<td>Plant Biotechnology</td>
<td>MHS(I)Sem-II-I/T</td>
<td>100</td>
<td>MHS(I)Sem-II-I/P</td>
</tr>
<tr>
<td>2.</td>
<td>Microbial Biotechnology</td>
<td>MHS(I)Sem-II-II/T</td>
<td>100</td>
<td>MHS(I)Sem-II-II/P</td>
</tr>
<tr>
<td>3.</td>
<td>Food Biotechnology</td>
<td>MHS(I)Sem-II-III/T</td>
<td>100</td>
<td>MHS(I)Sem-II-III/P</td>
</tr>
<tr>
<td>4.</td>
<td>Bioethics &amp; Biosafety</td>
<td>MHS(I)Sem-II-IV/T</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

Total Credit = 20
Total Marks = 500

## M.Sc. 2nd Year (3rd Semester)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course/Paper</th>
<th>Theory</th>
<th>Practicals</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Course No.</td>
<td>Marks</td>
<td>Course No.</td>
</tr>
<tr>
<td>1.</td>
<td>Bioinformatics</td>
<td>MHS(I)Sem-III-I/T</td>
<td>100</td>
<td>MHS(I)Sem-III-I/P</td>
</tr>
<tr>
<td>2.</td>
<td>Advanced Animal Biotechnology</td>
<td>MHS(I)Sem-III-II/T</td>
<td>100</td>
<td>MHS(I)Sem-III-II/P</td>
</tr>
<tr>
<td>3.</td>
<td>Emerging Technologies</td>
<td>MHS(I)Sem-III-III/T</td>
<td>100</td>
<td>MHS(I)Sem-III-III/P</td>
</tr>
<tr>
<td>4.</td>
<td>Trends in Biotechnology (Seminar)</td>
<td>MHS(I)Sem-III-IV</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

Total Credit =20
Total Marks = 500

## M.Sc. 2nd Year (4th Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Research Project</td>
<td>MHS(I)Sem-IV-I</td>
<td>20</td>
</tr>
<tr>
<td>a)</td>
<td>Thesis</td>
<td>MHS(I)Sem-IV-I</td>
<td>250</td>
</tr>
<tr>
<td>b)</td>
<td>Presentation &amp; Viva</td>
<td>MHS(I)Sem-IV-I</td>
<td>150</td>
</tr>
<tr>
<td>c)</td>
<td>Internal Assessment</td>
<td>MHS(I)Sem-IV-I</td>
<td>100</td>
</tr>
</tbody>
</table>

Total Credit =20
Total Marks = 500
Semester – I

B.Sc. (Hons. School) 1st year (1st Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Theory Course No.</th>
<th>Marks</th>
<th>Practical Course No.</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Biomaths / Life Sciences</td>
<td>BHS(I)Sem-I-I/T</td>
<td>50</td>
<td>BHS(I)Sem-I-I/P</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Chemistry</td>
<td>BHS(I)Sem-I-II/T</td>
<td>75</td>
<td>BHS(I)Sem-I-II/P</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>English</td>
<td>BHS(I)Sem-I-III/T</td>
<td>50</td>
<td>BHS(I)Sem-I-III/P</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>Introduction to Microbial World</td>
<td>BHS(I)Sem-I-IV/T</td>
<td>100</td>
<td>BHS(I)Sem-I-III/P</td>
<td>50</td>
<td>6</td>
</tr>
<tr>
<td>5.</td>
<td>Physics</td>
<td>BHS(I)Sem-I-V/T</td>
<td>75</td>
<td>BHS(I)Sem-I-IV/P</td>
<td>25</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Credits=20 Total Marks = 500 (Including subsidiaries)

Instructions for paper setters and candidates

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two question from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.
- The students of B.Sc. (Hons. School) have also to study the subject of “Environment Education”. This is a compulsory qualifying paper which the students are required to qualify in the 1st/2nd/3rd year of the course. The examination will be conducted by the University.
Course No. BHS(I)Sem-I-I/T

Paper: Biomaths / Life Sciences

Objectives: -

Biomaths
- To study the different concepts of limits, differentiation, integration and calculus so as to apply these concepts in chemistry and biology.
- To learn solutions to quadratic, cubic equations, differential equation, linear equation and thus study the applications in chemistry.

Life Sciences
- To increase scientific vocabulary and understanding of a variety of life science concepts.
- To learn about the anatomy and physiology of animals and animal systems.
- To study ecology and ecosystems.

Paper: Biomaths

Concept of limit, differentiation from first principles, Differential and integral calculus, derivate and its physical significance, basis rules for differentiation (without derivation) maxima and minima, their applications in chemistry, exact and inexact differentiation with specific emphasis on thermodynamic properties, partial differentiation, curve sketching. Basis rules for integration without derivations, definite and definite integrals, geometric meaning of integration, applications in biology and chemistry. Solutions to quadratic and cubic equations. Differential equations, separable variables, homogeneous, exact and linear equation, equations of second order, applications or differential equations in Chemistry.

Paper: Life Sciences

Unit-I

An introduction to life on earth.
Plant Anatomy and Physiology:-
Structure of land plants.
Nutrition and Transport phenomena in plants.
Plant reproduction and development.
Plant responses to the environment.

Unit-II

Ecology:- Community interactions.
Ecosystems:- Definition and components.
Food chain and food web.
Habitat.
Ecological succession.
Types of succession.
Animal behaviour:- Definition and learning.

Unit-III

Animal Anatomy and Physiology:-
Homeostasis and organization of animal body.
Circulation.
Respiration.
Nutrition and digestion.
Urinary system and homeostasis.
The immune response.
Unit-IV

Animal Anatomy and Physiology:
- The endocrine system.
- Nervous system.
- The senses.
- Action and support by the muscles and skeleton system.
- Reproduction.

Suggested Readings:

Course No. BHS(I)Sem-I-II/T

Paper: Chemistry

Objectives:
- To learn the concepts of chemical thermodynamics, chemical equilibrium and their applications.
- To learn about compounds of carbon, their sources, mechanism of reactions and utility in daily life
- To study concepts of stereochemistry and spectra of organic molecules.

CHS-116 GENERAL CHEMISTRY (Physical & Organic Chemistry) (60 Hrs.)

UNIT-I
CHEMICAL THERMODYNAMICS AND CHEMICAL EQUILIBRIUM (15Hrs)

Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy.
Third law of thermodynamics: Absolute entropies.

UNIT-II
Chemical Equilibrium: (15Hrs)
General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van’t Hoff reaction isotherm. Relation between $K_p$, $K_c$ and $K_v$. Temperature dependence of equilibrium constant-Van’t Hoff equation, homogeneous & heterogeneous equilibria, Le Chetaler’s principle.
COMPOUNDS OF CARBON (10 Hrs.)
Differences in chemical and physical behaviour as consequences of structure. Discussion (with mechanism) of reactions of hydrocarbons’ ranging from saturated acyclic and alicyclic, unsaturated dienes and aromatic systems. Huckel rule; as applied to 4n+2 systems. Industrial sources and utility of such compounds in daily life for medicine clothing and shelter.

UNIT-III
STEREOCHEMISTRY (15 Hrs.)

UNIT-IV
SPECTRA OF ORGANIC MOLECULES (15 Hrs.)

Suggested Books
ESSENTIAL:

FURTHER READING:

B.Sc. (Hons. School) First Year CHEMISTRY (SUBSIDIARY) PRACTICALS (Semester I)
(Subsidiary for the students of Physics, Botany, Zoology, Geology, Biotechnology, Biophysics, Biochemistry and Microbiology, (for both one year and two year chemistry subsidiary course)

Total lecture: 45 Max. Marks: 25
1. Analysis of the given mixture containing six radicals with at least one interfering (PO₄³⁻ Oxalate, Tartarate).
2. Volumetric Analysis:
   (i) Acid-Alkali/Base: Involving use of one of one indicator and two indicators.
   (ii) Oxidation-Reduction : KMnO₄/K₂Cr₂O₇ Titrations.
Course No. BHS(I)Sem-I-III/T  
Paper: English  

Objective:
- To study English so as to create fluency so that the student is killed to express creatively.
- To learn about writing and grammar so that student can express freely in writing.

SECTION A

1. Fluency in English     20 Marks  
   Units-I, II,III,IV

2. Shorts Stories     10 Marks  
   Unit I to VI

3. Poems     20 Marks  
   Unit I to IX

SECTION B

Writing and Grammar

1. Paragraph Writing     12 marks
2. Formal Letters and E-mails     10 marks  8 marks
3. Applied Grammar:     20 marks  
   -Types of Sentences  
   -Sentence Linkers  
   - Correction of Sentences

TEXTS PRESCRIBED:

1. Fluency in English Eds. Mukti Sanyal & Tulika Prasad  
   Macmillan Publishers
2. Twelve Contemporary Shorts Stories O.U.P.
3. The Silver Lute  
   Macmillam Publishers

NOTE:

1. The book ‘Twelve contemporary Short Stories’ is meant for discussion and evaluation purposes.
2. Mode of Testing: All the questions of Section A would have Internal choice. Question 1 and 2 Essay type. Question 3 and 4 from poems based on central idea or summary.

RECOMMENDED READING:

Course No. BHS(I)Sem-I-IV/T
Paper: Introduction to Microbial World

Objectives:
This course will enlighten the students with the world of microbes i.e organisms invisible to human eye. It is a basic course in which students will learn the a) history of microbiology, b) types of microbes, c) metabolic processes of energy generation and utilization d) mutations in microbes and natural ways of genetic recombination, e) important microbial diseases and the agents used to control the growth of microbes.

Unit-I
1. Scope and Relevance of Microbiology as a field of Biotechnology
2. Historical aspects / Spontaneous Generation / Koch Postulates.
3. Cell structures and functions of a industrially important prokaryotic (E.coli) and eukaryotic (Saccharomyces sp.) cell.
4. Microbial taxonomy (in brief) of Archaea, Bacteria, Algae, Fungi, Viruses

Unit-II
5. Microbial nutrition, culture media, isolation of pure culture, growth curves and kinetics
6. Transport mechanisms of nutrients in microbes
7. Control of microorganisms: Physical agents, chemical agents, antibiotics.

Unit III
8. Microbial metabolism: Energy production, energy utilization and biosynthesis (major emphasis on unique carbohydrate metabolic pathways, cell wall synthesis and photosynthesis).
9. Microbial genetics: DNA structure, Mutations, transformations, transduction, conjugation, transposons, plasmids.

Unit-IV
11. Microbial diseases of humans : (causative agent, transmission, symptoms, diagnosis, prevention)
   Bacterial : Cholera, Typhoid, Plague, Diphtheria, Pertusis, Tetanus, Tuberculosis, Leprosy, Botulism, Anthrax, Food poisoning.
   Viral : Measles, Mumps, Rubella, Small pox, Chicken pox, Rabies, Influenza, Common cold, Herpes, Hepatitis, AIDS
   Fungal : Superficial mycosis, Cutaneous and Sub-cutaneous Mycosis, Systemic mycosis and opportunistic mycosis
   Protozoa : Malaria, Amoebiasis, Giardiasis

Suggested Readings:

Course No. BHS(I)Sem-I-V/T

Paper: Physics

Objectives:

- To get sufficient exposure in Physics so as to enable students to understand the working of electronic equipment used in their field of specialization.
- To learn about the different concepts of electricity and magnetism like electrostatics, dielectrics, current electricity, magnetic field, Maxwell equation and their applications.
- To study the concepts of electronics like conduction in semiconductors, diode characteristics, transistor and their applications.

PHYS 113S: ELECTRICITY, MAGNETISM AND ELECTRONICS Max Marks : 75

Objective: This course has been designed for the students of basic medical sciences so that after learning the basic features of electricity and magnetism, they get sufficient exposure to the electronics that can enable them to understand the working of electronic equipment used in their fields of specialization.

Note
1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt five questions in all, selecting two questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION A: Electricity and Magnetism

Vector Analysis: Review of vector algebra, vector differentiation, vector integration, Gauss’s divergence and Stoke’s theorems and their physical significance. (1.1-1.5 of Book1)

Electrostatics: Coulomb’s law, superposition principle, field concept, scalar potential, Energy considerations, relation between field and potential, use of Gauss’s law to calculate electric field, electric field due to a uniform line charge, surface charge, spherical shell of charge, the electric dipole. (Book 1)

Dielectrics: Polarization density, polarization charge density, \( \mathbf{D} = \mathbf{\nabla} \cdot \mathbf{E} + \mathbf{P} \) (Book 1)

Current Electricity: Current as moving charge, The Biot-Savart law, some properties of \( \mathbf{B} \), Ampere’s law, the magnetic dipole, the solenoid, magnetic vector and scalar potential, charged particle in magnetic field, charged particle in electric and magnetic fields, Faraday’s law of electromagnetic induction, different mechanisms for change of flux, motional emf, mutual inductance, self inductance. (Book 1)

Magnetic field in material media: Types of magnetic substances, magnetization, \( \mathbf{B} = \mathbf{\mu}_0 (\mathbf{M} + \mathbf{H}) \), Boundary conditions on \( \mathbf{B} \) and \( \mathbf{H} \), Hysteresis curve. (Book 1)

Maxwell’s equations: Displacement current, Maxwell’s equations, Poynting vector. (Book 1)

Some applications: Electrostatic deflection in a cathode ray tube, Cathode ray oscilloscope, G M counter. (Book 1)
SECTION B: Electronics

Conduction in semiconductors: Electrons and holes in an semiconductor, carrier concentration, donor and acceptor impurities, charge densities, Fermi level in semiconductors, diffusion, carrier lifetimes, continuity equation. (Book 2)

Diode characteristics: qualitative theory of p-n junction, p-n diode, band structure of an open circuit diode, current components, quantitative theory of diode currents, V-I characteristics, transition capacitance, diffusion capacitance. (Book 2)

Transistor: Junction transistor, transistor current components, transistor as an amplifier, C B and C E configurations. (Book 2)

Low frequency transistor model: The port device and hybrid model, transistor hybrid model, transistor as amplifier using h-parameters, comparison of transistor amplifier configurations. (Book 2)

Applications: Half wave rectifier, ripple factor, full wave rectifier, inductor and capacitor filters, regulated power supply, oscillators (introduction only), photoconductivity, photodiode. (Book 3)

Books:

PHYS 114 S PHYSICS LABORATORY (45 hrs.) Max. Marks: 25

Objective: The exercises included in this laboratory course are aimed at training the students to handle different type of equipment for verification of some of the laws studied in theory and for carrying out precise measurements so that they develop confidence to use later the sophisticated instruments in their respective fields.

Note:
1. Examination time will be 3 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester. Exercises (i) and (ii) are compulsory for all students in first semester.

(i) Analysis of experimental data by Fitting of given data to a straight line.
(ii) Calculation of probable error. Use of vernier calipers, screw gauge and spherometer and other measuring instruments, Barometer.

1. Determination of wavelength of laser light by a plane diffraction grating.
3. Determination of specific rotation of sugar by Polarimeter.
4. Determination of refractive index of prism for different wave lengths using spectrometer.
5. Self-inductance by Anderson's bridge.
6. Capacitance by de Sauty method.
7. Verification of laws of electromagnetic induction.
8. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
9. To find half-life period of a given radio-active substance using GM counter/ Characterisitics of GM Counter
10. Study of C.R.O. as display and measuring device, Study of Sine-wave, square wave signals ( half wave and full wave rectification)
13. Determination of Stefan's constant.
15. Study of one dimensional Collision.
17. Determination of $E_g$ in Si and Ge.
18. Study of Ge, Si, LED, diode characteristics.
19. To study the variation of the resistance of filament of bulb with its temperature.
20. Study of common base transistor characteristics.
21. Study of common emitter transistor characteristics
22. Determination of 'e' or '(e/m)' of an electron.
23. Study of Solar-Cell characteristics
24. Determination of Planck's constant using photocell.
25. Determination of velocity of ultrasonic waves in a given liquid
26. Study of vacuum triode characteristics.
## Semester – II

### B.Sc. (Hons. School) 1st year (2nd Semester)

<table>
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<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
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<td>2.</td>
<td>Cell Biology</td>
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<td>3.</td>
<td>Chemistry</td>
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<td>4.</td>
<td>English</td>
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<td>5.</td>
<td>Physics</td>
<td>BHS(I)Sem-II-V/T</td>
<td>75</td>
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</table>

Total Credits=20 Total Marks = 500 (Including subsidiaries)

**Instructions for paper setters and candidates**
- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two question from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.
Course No. BHS(I)Sem-II-I/T

Objectives: -
- To learn applications of statistics in the field of biology.
- To study concepts of probability, averages, distributions, tests of deviations, correlation and linear regression.
- To learn to design experiments and analysis of results by tests of significance or analysis of variance.

Statistical population, sample from population, random sample.
Tabular and graphical presentation, mean and standard deviation of grouped and ungrouped data, probability, relative frequency, probability, distribution, binomial, poison and normal distributions. Tests of deviations, F and Z residuals, precision, measure of precision, probable error of function, rejection of observations. Methods of averages and least squares. Correlations and linear regression, associated test of significance. Analysis of variance for one and two way clarification. Design of experiments, randomization, replication, local control, completely randomized and randomized block design. Determinant evaluations of 3x determinants, matrices manipulations, simultaneous and inversion.

Interpolation and polynomial filling. Introduction of curve smoothening, derivative curves, numerical integration, fourier transformation.

Suggested Reading:

Course No. BHS(I)Sem-II-II/T
Paper: Cell Biology

Objectives: -
- To study in detail about the cell which encompasses the cell structure, structure and functions of organelles, locomotion, life cycle and division.
- To impart knowledge to students about the basics of stem cells and their applications as well as to introduce them to the world of cellular differentiation and cloning.

Unit-I

Cell :-
Cell as a basic unit of living systems.
Pre-cellular evolution.
The cell theory.
Ultrastructure of the cell membrane.
Cytosol.

Structure and function of cell organelles :-
- a. Golgi bodies.
- b. Endoplasmic reticulum (rough and smooth).

Unit-II

Structure and function of cell organelles:-
- a. Ribosomes.
- b. Cytoskeletal structures (actin, microtubules etc.)
- c. Mitochondria,
- d. Chloroplasts,
- e. Lysosomes,
Unit-III

Structure and function of cell organelles:-
  a. Microbodies (peroxysomes, glyoxysomes, vacuoles etc.)
  b. Nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

Cell division : -
  Mitosis.
  Meiosis.
  Basic aspects of cell cycle.

Unit-IV

Cell locomotion :-
  Amoeboid, flagellar and ciliar.
  Muscle and nerves cells.

Basics of stem cells:-
  Properties.
  Potency.
  Types.
  Applications

  Introduction to cellular differentiation.
  Introduction to cloning.

Suggested Readings:

Course No. BHS(I)Sem-II-III/T
Paper: Chemistry

Objectives: -
  (Physical & Inorganic Chemistry)
  • To study the concepts of chemical kinetics and catalysis.
  • To study concepts of electrochemistry and electrochemical cells.
  • To gain information about ionic solids, coordination chemistry and elements of the periodic table.

  (Physical & Inorganic Chemistry)

UNIT-I

CHEMICAL KINETICS AND CATALYSIS (10 Hrs)
Rates of reactions, rate constant, order and molecularity of reactions.
Catalysis: Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis. Unimolecular surface reactions.
ELECTRO-CHEMISTRY  

Specific conductance, molar conductance and their dependence on electrolyte concentration.

UNIT II  

Electrochemical cells:  
Distinction between electrolytic and electrochemical cells. Standard EMF and electrode potential. Types of electrodes. Reference electrode.
Calculation of $\frac{G}{n}$ and $S$ and equilibrium constant from EMF data. Potentiometric determination of pH. Potentiometric titrations.

Covalent Bond:  
Various types of hybridization and shapes of simple inorganic molecules and ions (BeF$_2$, BF$_3$, CH$_4$, PF$_5$, SF$_6$, IF$_7$, SnCl$_2$, XeF$_4$, ClF$_3$, SF$_4$, ClO$_4^-$, ClO$_3^-$, NO$_3^-$).
Concept of molecular orbitals. Molecular orbital theory of homonuclear (Li$_2$ to Ne$_2$) molecules and ions and heteronuclear diatomic molecules (CO, CO$^+$, NO, NO$^+$). Concept of electronegativity, polarity of bonds and dipole moments.

UNIT III  

Ionic Solids  
Factors affecting the formation of ionic solids, concept of close packing, radius ratio rule and coordination number. Calculation of limiting radius ratio for tetrahedral and octahedral sites.
Structures of some common ionic solids NaCl, ZnS (zinc blende and wurtzite), CsCl and CaF$_2$.
Lattice energy. Born-Hable cycle and its applications.

s and p Block of Elements  
variation in size effects, ionization energy, electron affinity, electro negativity, polarizability and metallic character. Variation in the properties of oxides, hydrides and halides. Some special characteristics.

UNIT IV  

Coordination Chemistry/Compounds:  
Coordinate Bond. Werner’s coordination theory, ligands, chelates. Nomenclature of coordination compounds. Stereochemistry of different coordination numbers, isomerism. Valence-bond and crystal-field theories of bonding in complexes. Explanation of properties such as geometry colour and magnetism.

d and f-Block of Elements:  
position in periodic Table, electronic configuration, variation in size, ionization energy, magnetic behaviour. Complex formation. Bonding in metal carbonyls and metal olefins. Lanthanide contraction, Comparison of d-and f-block elements.
Suggested Books

ESSENTIAL:

FURTHER READING:

B.Sc. (Hons.School) First Year CHEMISTRY (SUBSIDIARY) PRACTICALS (Semester II)

Total Lectures(45hrs.)
Max. Marks: 25

1. Analysis of the given organic compounds (solid) (Elemental Analysis, Detection of functional groups and (m.pt.). The compounds to be given are acids, phenols, carbohydrates, amides, amines and Thiourea etc.).

2. Iodimetry/Iodometry: Volumetric titrations

3. Gravimetric Determinations
  
  **Ba**<sup>2+</sup> (as BaSO<sub>4</sub>), Ag<sup>+</sup> (as AgCl), Ni<sup>2+</sup> (as DMG)
Course No. BHS(I)Sem-II-IV/T
Paper: English

Objectives: -

- To study short stories, poems and book of fluency in English so that student is skilled to express.
- To learn about writing resume, précis and reports as well as applied grammar so that student can improve his/her writing skills.

SECOND SEMESTER

SECTION A

1. Fluency in English 20 Marks
   Units-VIII, IX, XIV, XVI

2. Short Stories 10 Marks
   Unit to VII to XII

3. Poem 20 Marks
   Unit X to XVIII

SECTION B

Writing and Grammar

1. Resume Writing 10 Marks
2. Précis Writing 8 Marks
3. Report Writing 12 Marks
4. Applied Grammar 20 Marks
   - same word as different part of speech
   - Formation of words
   - One Word substitution
   - Idioms & Phrases

Texts Prescribed:
1. Fluency in English Eds. Mukti Sanyal & Tulika Prasad MacMillan Publishers
2. Twelve Contemporary Short Stories O.U.P
3. The Silver Lute Macmillan Publishers

Note:
1. The book ‘Twelve Contemporary Short Stories’ is meant for Discussion and evaluation purposes.
2. Mode of Testing: All the questions of Section A Would have Internal choice. Question 1 and 2 Essay type. Question 3 and 4 poems based on central idea or summary.

Recommended Reading:
Course No. BHS(I)Sem-II-V/T
Paper: Physics

Objectives:

• To study the concepts of physical optics like interference, diffraction, polarization and laser so as to understand their utility in the different branches of basic medical sciences.

• To study the concepts of quantum mechanics like wave function and wave equation, steady state forms etc and their applications in biosciences.

PHYS 123S : OPTICS AND MODERN PHYSICS Max Marks : 75

Objective:
This course has been framed keeping in mind the requirements of the students with respect to the concepts of physical optics and quantum mechanics as used in different branches of basic medical sciences.

Note
1. The question paper for the final examination will consist of three sections. Sections A and B of the paper will have three questions each from the corresponding sections of the syllabi and section C will have one compulsory question covering the whole syllabus. There will be no choice in the compulsory question. The candidate will attempt five questions in all, selecting two questions each from sections A and B and compulsory question from section C. All Questions will carry equal marks viz. 12.
2. The question paper is expected to contain problems with a weightage of 25 to 40%.
3. The books indicated as recommended books are suggestive of the level of coverage. However, other books may be followed.

SECTION A: Optics

Interference : Young's experiment, coherent sources, phase and path differences, Theory of interference fringes, Fresnel's biprism, sheet thickness determination, interference in thin films due to reflected and transmitted lights, Maxima and minima in intensities, Colours of thin films, Newton's rings and its various aspects. (Book 1).


Polarization : Introduction, Polarization by reflection and refraction, Brewester's law, Malus's law, Double retraction, Nicol Prism and its use, elliptically and circularly polarized light, quarter and half-wave plates, production and detection of plane, circularly and elliptically polarized light, optical activity, specific rotation, Half-shade polarimeter. (Book 1).

Laser and Holography: Brief features of laser, holography and fibre optics. (Book 1).

SECTION B: MODERN PHYSICS

Particle Properties of Waves: Quantum theory of light, X-ray diffraction, Compton effect, pair production, Photons and gravity, black holes. (Book2).

Wave Properties of Particles : de Broglie waves, waves of probability, the wave equation, phase and group velocities, particle diffraction, electron microscope, uncertainty principle. (Book2).

Quantum Mechanics: Wave function and wave equation, Schrodinger equation -time-dependent and steady state forms, expectation value. Particle in a box, Schrodinger's equation for hydrogen atom, separation of variables, quantum numbers. (Book 2).


**Books:**

**PHYS 124 S   PHYSICS LABORATORY   (45 hrs.)   Max. Marks: 25**

**Objective:**
The exercises included in this laboratory course are aimed at training the students to handle different type of equipment for verification of some of the laws studied in theory and for carrying out precise measurements so that they develop confidence to use later the sophisticated instruments in their respective fields.

**Note :**
1. Examination time will be 3 hours. Internal assessment will be based on day to day performance of the students in the laboratory, viva voice of each experiment, regularity in the class, number of experiments performed etc.
2. Eight to ten experiments are to be performed in each Semester. Experiments performed in odd semester can not be repeated in even semester Exercises (i) and (ii) are compulsory for all students in first semester.

(iii) **Analysis of experimental data by** Fitting of given data to a straight line.
(iv) **Calculation of probable error.** Use of vernier calipers, screw gauge and spherometer and other measuring instruments, Barometer.

1. Determination of wavelength of laser light by a plane diffraction grating.
3. Determination of specific rotation of sugar by Polarimeter.
4. Determination of refractive index of prism for different wave lengths using spectrometer.
5. Self-inductance by Anderson's bridge.
6. Capacitance by de Sauty method.
7. Verification of laws of electromagnetic induction.
8. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
9. To find half-life period of a given radio-active substance using GM counter/ Characteristics of GM Counter
10. Study of C.R.O. as display and measuring device, Study of Sine-wave, square wave signals (half wave and full wave rectification).
13. Determination of Stefan's constant.
15. Study of one dimensional Collision.
17. Determination of $E_g$ in Si and Ge.
18. Study of Ge, Si, LED, diode characteristics.
19. To study the variation of the resistance of filament of bulb with its temperature.
20. Study of common base transistor characteristics.
21. Study of common emitter transistor characteristics.
22. Determination of ‘e’ or ‘(e/m)’ of an electron.
23. Study of Solar-Cell characteristics
24. Determination of Planck's constant using photocell.
25. Determination of velocity of ultrasonic waves in a given liquid
26. Study of vacuum triode characteristics.
## Semester – III

**B.Sc. (Hons. School) 2nd year (3rd Semester)**

<table>
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<td>Biophysical Chemistry</td>
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<td>BHS(II)Sem-III-I/P</td>
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<td>2.</td>
<td>Biophysics</td>
<td>BHS(II)Sem-III-II/T</td>
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<td>BHS(II)Sem-III-IV/P</td>
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<td>BHS(II)Sem-III-IV/T</td>
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</table>

Total Credits=20  Total Marks = 500
Course No. BHS(II)Sem-III-I/T  
**Paper: Biophysical Chemistry**

**Objective:**  
To introduce the laws of physical chemistry and their application on biological macromolecules like proteins and nucleic acid with emphasis on thermodynamics principles used in biochemistry.

**Unit-I**  
Fundamental principles of macro-molecules.  
Macromolecular interactions: Level of structure in biomolecules, different kinds of interactions of macromolecules (van-der-waals to covalent). Hydrogen bonding: in subunits, between the C-G, A-T, helices in DNA etc. Effects of IR spectra. Hydrophobic interactions, definitions and illustrations, ionic interactions (salt bridges etc.)

**Unit-II**  
Thermodynamics and bioenergetics: Review of principles of thermodynamics, free energy, enthalpy and entropy, energy yielding and energy requiring reactions, coupled reactions. Organisations of metabolism, acquiring energy, from the environment, the food cycle, calculation of equilibrium constant.

**Unit-III**  
Acid base chemistry: review of aqueous solutions, pH, Biochemists standard, state for pH, acid and bases, neutralization, buffers, ionization, equilibria in proteins.

**Unit-IV**  
Statistical thermodynamics: Binding of ligands by macromolecules, binding of proteins, titration of proteins, analysis of the titration results for an amino-acid say glycine, Conformational equilibria of poly-peptides and proteins; helix coil transition, molecular mechanisms, thermodynamic treatment, partition functions for conformational equilibria of simple linear chains, reversible folding of proteins, status of research in protein folding.

**Suggested Readings:**  
1. Biophysical Chemistry (2011) by Alan Cooper RSC Publisher  
3. Physical Chemistry with Applications to Life Sciences (1979) by Eisenberg, D and Brothers, D., Benjamin-Cumming, California, USA  

Course No. BHS(II)Sem-III-II/T  
**Paper: Biophysics**

**Objective:**  
To understand the link between biology and physics with explanation of physical principles applied to biological systems.

**Unit-I**  
The structure of biological macromolecules; physics of nuclear medicine.  
Methods for structural elucidation; Conformation of biological system; polyelectrolytes, Debye-Huckel theory

**Unit-II**  
Photochemical and photobiological phenomena; mechanism of photosynthesis; vision, absorption and fluorescence;
Biological energy conservation; concept of membrane potential and proton flux; Ion pumps, muscle contraction

Unit-II
The biophysics of locomotion
Generation and propagation of the nerve impulse;
Biophysics of chemoreception; Cybernetics and information theory

Unit-IV
Evolution of life, low temperature biology and medicine.
Tracer Techniques: - Use of radioisotope detection and measurement of radioactivity, specific activity, applications in Biological systems, autoradiography.

Suggested Readings:

Course No. BHS(II)Sem-III-III/T
Paper: Ecological Interaction & Biodiversity

Objective: -
To understand the ecological interactions of plant, microbial, animal systems and ecosystems at local and regional scales.

Unit-I
Microbial Ecology:
1. Introduction and terminology
2. Historical Development
3. Microbial Diversity
4. Microbial Interactions:-
5. Positive and negative interactions, neutralism, commensalism, synergism, mutualism, competition, amensalism.
7. Quantitative microbial ecology: Sample collection and processing, Detection of microbial populations, determination of microbial numbers and biomass.
8. Environment and microbial adaptation: various determinants.
9. Role of microbes in geochemical cycles

Unit-II
Plant Ecology:
1. Basic concepts, definitions, ecosystem
2. Weed Ecology and Biology, weed characteristics and classification, harmful effects of weeds, weed competition, methods of weed management.
3. Plant-plant interactions: allelopathy, factors affecting allelopathy, weed allelopathy, types of allelochemicals, applied aspects of allelopathy i.e. role of allelopathy in weed management.
5. Phytochemistry: Plant phenolics and their ecological roles.
6. Plant communities: Qualitative and quantitative characteristics, analysis of plant communities.
Unit-III

Animal Ecology:
1. Introduction: Definition, subdivisions and scope of ecology.
2. Abiotic factors: Temperature, Light as ecological factors.
4. Community: Ecological succession, types of succession, changes in animal communities during
   hydrack, ecological niche, ecotone & edge effect.
5. Ecosystem: Definition, components, food chain and food web, flow of energy through an ecosystem.

Unit-IV

Animal Ecology:
1. Habitat: Adaptations of animals in different types of habitats. Aquatic adaptations, desert adaptations
   and aereal adaptations.
2. Productivity: Concept of productivity.
3. Animal associations: Inter specific relationships.
4. Parental care line animals.
5. Migrations: Fish migration & bird migration.
6. Ecology in the welfare of Man: Environmental pollution, wildlife management, management of fresh
   water, marine coastal, estuarine and reservoir, biology & ecology of reservoirs.

Suggested Readings:
1. Ecology with special reference to animals and man (1930) Kendiegh, S.C., New Jersey, Prentice Hall,
   Science Publishing, California.
   K.M.M. and C.L. foy, C.R.C. Press

Course No. BHS(II)Sem-III-IV/T
Paper: Genetics & Molecular Biology

Objective:
This course is aimed at understanding the basic concepts of genetics at molecular level to develop analytical and
quantitative skills from classical to molecular genetics.

Unit-I
Mendalian laws of inheritance, gene interaction,
Sex determination in drosophila, plants and animals, sex linkage
Non-disjunction as a proof of chromosomal theory of inheritance.

Unit-II
Structural and numerical aberrations involving chromosomes
Hereditary defects, extranuclear inheritance
Recombination, linkage, gene mapping, interference, coincidence, recombination frequencies
Population genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies.
Unit-III

DNA as a genetic material: The Genetic significance of nucleic acids, structural properties of DNA
DNA Replication: Mechanism of DNA replication, Enzymes and accessory proteins involved in DNA replication, DNA mutagenesis and repair.
Prokaryotic and Eukaryotic transcription: General and specific transcription factors, Regulatory elements and mechanism of transcription regulation, Modifications of RNA

Unit-IV

Genetic code: deciphering the genetic code, nature of the code
Prokaryotic and Eukaryotic translation: The translation machinery- tRNA, Ribosomes, mRNA, aminoacyl-tRNA synthases and aminoacylation of tRNA; Mechanisms of initiation, elongation and termination, Regulation of translation, post translational modifications of proteins, protein localization, protein degradation
Gene expression: Lac and Trp operon- induction, repression and attenuation mechanism.

Suggested Readings:

## Semester – IV

**B.Sc. (Hons. School) Semester System 2\(^{nd}\) year (4\(^{th}\) Semester)**

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<th>S. No.</th>
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<td>Cellular Biochemistry</td>
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<td>BHS(II)Sem-IV-I/P 25</td>
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<td>Enzymology and Enzyme Technology</td>
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<td>BHS(II)Sem-IV-II/P 25</td>
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<td>4.</td>
<td>Tools in Biotechnology</td>
<td>BHS(II)Sem-IV-IV/T 100</td>
<td>BHS(II)Sem-IV-IV/P 25</td>
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Total Credits=20  
Total Marks = 500
Course No. BHS(II)Sem-IV-I/T  
Paper: Cellular Biochemistry  

Objective:  
To introduce the concepts underlying the cellular biochemistry, understanding how these processes are integrated to carry out highly coordinated cellular functions.

Unit-I  
**Carbohydrates:** Structure of important mono, di-, oligo- and polysaccharides, glycoproteins, peptidoglycan, glycolipids and lipopolysaccharides. Reaction of monosaccharides.  
**Lipids:** Classification of lipids and fatty acids, general functions of major lipid subclasses, acyglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpenes, sterols,  
**Steroids:** Prostaglandins,  
**Proteins:** Structure of amino acids, nonprotein and rare amino acids and their chemical reactions. Structural organization (primary, secondary, Tertiary and quaternary domain structure), classification and function of proteins.

Unit-II  
Structural components of nucleic acids: Sugar (Ribose and Deoxyribose), purines, pyrimidines, nucleoside and nucleotide; DNA: Structure of DNA (Watson and Crick Model), types (A, B, Z), Chargaff’s rule; RNA: Structure and significance of mRNA, tRNA and rRNA  
Vitamins and Hormones: Types of vitamins – structure of water soluble vitamins and their coenzyme derivatives, Fat soluble vitamins Deficiency symptoms and dietary sources. Steroid Hormones: structure and importance, Peptide Hormones: structure and function of important peptide hormones.

Unit-III  
**Metabolism:** Metabolic pathways, biochemical reaction mechanism, energy rich metabolites.  
**Carbohydrate metabolism:** Biosynthesis and degradation of carbohydrates; feed pathways for glycolysis; Kreb’s cycle, enzymes of Kreb’s cycle, amphibolic nature of the Kreb’s cycle; Kreb’s cycle regulation of carbohydrate metabolism.  
**Lipid Metabolism:** Biosynthesis and degradation of fatty acids; metabolism of triacylglycerols; cholesterol metabolism, complex lipids.

Unit-IV  
**Nitrogen Metabolism:** Reduction and assimilation of atmospheric nitrogen, Biosynthesis and degradation of amino acids; amino acids as precursors of heme; biogenic amines; biosynthesis and degradation of nucleic acids. Nucleic acid biosynthesis and degradation. Mitochondrial electron transport chain, oxidative phosphorylation; regulation of ATP synthesis.

Suggested Reading:  
Course No. BHS(II)Sem-IV-II/T
Paper: Enzymology and Enzyme Technology

Objective:
To learn the basic principles of enzymology to know how enzymes functions in the biological systems and strategies/applications of enzyme technology in industries.

Unit-I
1. Introduction to Enzymes
   Definition, historical perspectives, systematic nomenclature & classification, significance of numbering system, coenzyme, cofactors.

2. Specificity of enzyme action
   Types of specificity, hypothesis (lock-and-key, induced fit, strain or transition-state stabilization), investigation of active site structure, Mechanism of action of serine protease, lysozyme and chymotrypsin.

Unit-II
3. Enzyme kinetics
   Factors affecting enzyme activity (Enzyme concentration, substrate concentration, pH, temperature and reaction time etc.).
   Derivation of Michaelis-Menten equation for uni-substrate reactions, $K_m$ and its significance. Lineweaver-Burk plot, Eadie-Hofstee and Hanes-Woolf equation and $y$ value. Importance of $K_{cat}/K_m$.
   Bi-substrate reactions- brief introduction of sequential and ping-pong mechanisms with examples.
   Reversible (competitive, non-competitive, uncompetitive inhibitions and mixed inhibition) and irreversible inhibition. Determination of $K_m$ & $V_{max}$ in the presence and absence of inhibitor.

Unit-III
4. Regulation of enzyme activity
   General mechanisms of enzyme regulation, Feedback inhibition and feed forward stimulation. Reversible (phosphorylation, disulphide reduction, adenylation) and irreversible (proteases) covalent modifications of enzymes.
   Isoenzymes: Properties, measurement and significance.
   Multienzyme system: Occurrence, isolation & their properties; Mechanism of action and regulation of pyruvate dehydrogenase & fatty acid synthase complexes.
   Measurement and expression of enzyme activity: Extraction, enzyme assay, enzyme units, enzyme turnover number and specific activity.

Unit-IV
5. Enzyme immobilization/modification/applications
   Enzyme engineering-Strategies, artificial enzymes, degradation of unnatural substrates and catalytic antibodies.
   Clinical and industrial applications of enzymes– Detergent, food, leather, dairy and medicine industries.

Suggested Reading:

Course No. BHS(II)Sem-IV-III/T
Paper: Plant Taxonomy and Metabolism

Objective: Initiating with basic concepts and definitions, the course would traverse through various processes such as plant taxonomy, water relations, mineral nutrition, photosynthesis, respiration, nitrogen metabolism and end up with growth control by hormones and plant adaptation to various stresses.

Unit-I
1. Plant Taxonomy: Classification of divisions of plant kingdom.
2. Biological membranes: structure; membrane transport- carriers and channels.

Unit-II
3. Plant-Water Relations: Water transport processes; diffusion and osmosis; water potential and chemical potential; absorption of water, water transport through tracheids and xylem.

Unit-III
5. Photosynthesis: Historical background and significance; structure and photosynthetic apparatus; photosynthetic pigments; accessory pigments and the photoprotective carotenoids; reaction center complexes; photochemical reactions; electron transport pathways in chloroplast membranes; photophosphorylation; the Calvin cycle; the C4 carbon cycle; crassulacean acid metabolism; photorespiration, factors affecting photosynthesis, Blackman’s Law of limiting factors.
6. Nitrogen Metabolism: Biological nitrogen fixation; nitrate and ammonium assimilation, role of leghaemoglobin and signaling.

Unit-IV
7. Growth and Development: General aspects – definitions; regions of growth; phases of growth; discovery; chemical nature; distribution; physiological effects of phytohormones (auxins, cytokinins, gibberellins, abscisic acid and ethylene).
8. Stress Physiology: Introduction, water deficit and drought resistance; salt stress; temperature stress (heat stress and chilling injury); plant adaptation/resistance to stresses.

Practical Work
9. The practicals will include the experiments related to the course work
Suggested Reading


Course No. BHS(II)Sem-IV-IV/T

Paper: Tools in Biotechnology – I

Objective: -

To understand the principles and instrumentations to investigate the biological properties and functions of the biomolecules/macromolecules.

**Unit-I**

2. Spectrophotometry: Colorimetry (Lambert & Beer Law, measurement of extinction, absorption spectra), components of UV and visible spectrophotometer: Light source, monocrometry, sample chamber, detector.

**Unit-II**

3. Light Microscope: Definition, magnification, resolution, Numerical Aperture. Study with respect to principle, working and applications of light microscopes.

**Unit-III**

5. Centrifugation: Theory and its applications to biological systems, centrifuges, rotors, angle/swing out/vertical, buoyant density centrifugation.

**Unit-IV**

8. Protein Purification: Development of an Assay, Selection of a Source from which Macromolecule may be isolated, Method of solubilization, Stabilization, Isolation and Concentration, criteria of purity.
9. Chromatography (Principle and applications): Affinity chromatography, ion exchange chromatography, hydrophophobic interaction chromatography, size exclusion chromatography, GLC, TLC.

Suggested Readings:

1. Techniques used in Bioproduct analysis-BIOTOL Series (I-IV), (1992), Buterworth Heineman, UK.
### Semester – V

**B.Sc. (Hons. School) 3\textsuperscript{rd} year (5\textsuperscript{th} Semester)**

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<td>2.</td>
<td>Plant Tissue Culture and Biotechnology</td>
<td>BHS(III)Sem-V-II/T</td>
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<td>3.</td>
<td>Molecular Human Genetics</td>
<td>BHS(III)Sem-V-III/T</td>
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<td>Environmental Biotechnology</td>
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Total Credits=20    Total Marks = 500
Course No. BHS(III)Sem-V-I/T
Paper: Immunology – I

Objectives:
To learn the fundamental working knowledge of the basic principles of immunology and immunological techniques in prognosis/diagnosis.

Unit-I
1. Introduction
   i) Overview of immune system – Historical perspectives
   ii) Innate and acquired immunity
   iii) Clonal nature of immune response.
2. Cells of the immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocytes, T-lymphocytes, macrophages, dendritic cells, Natural killer cells and lymphocyte activated killer cells, eosinophils, neutrophils & mast cells.

Unit-II
3. Organs of the immune system: Primary and secondary lymphoid organs, systemic function of immune system.
4. Immunoglobulins: Structure of antibody, antibody mediated effects function, antibody classes and biological activities, antigens determinants on Immunoglobulins, Immunoglobulins superfamilies.

Unit-III
6. Antigen – Immunogenecity Vs. antigenecity, factors effecting immunogeneticity, nature of immunogen, epitopes, heptans and antigenecity, pattern recognition receptors.
7. Antigen – Antibody interactions: Strength of interaction, cross reactivity, precipitate, reaction, agglutination reactions, enzyme linked immunosorbent assay, western blot, immunofluorescence, flow cytometry and Fluorescence, alternative to Antigen – Antibody interaction.

Unit-IV
8. Major histocompatibility complex: General organization and inheritance, MHC molecules and genes, genetic map, cellular distribution, regulation of MHC expression and disease susceptibility.
9. Antigen processing and presentation: Self MHC restriction of T Cells, role of Antigen – processing cells, endogenous antigens, exogenous antigens, presentation of non-peptide antigens.
10. Production and applications of polyclonal and monoclonal antibodies.

Suggested readings:

Course No. BHS(III)Sem-V-II/T
Paper: Plant Tissue Culture and Biotechnology

Objectives:
The aim is to teach set of in vitro techniques, methods and strategies related to plant biotechnology. Students will learn how to create genetic variability for the improvement of crops, to improve the state of health of planted material and to increase the number of desirable germplasms for conservation and breeding experiments.

Unit-I
2. Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids.
3. Tissue culture media (composition and preparation)
Unit-II
5. Initiation and maintenance of callus and suspension culture; single cell clones.
6. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil.
7. Shoot-tip culture; rapid clonal propagation and production of virus-free plants.
8. Embryo culture, embryo rescue and synthetic seeds.

Unit-III
9. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.
10. Anther, pollen and ovary culture for production of haploid plants and homozygous lines.
11. Soma clonal variations and triploid production.

Unit-IV
13. Cryopreservation, slow growth and DNA banking for germ plasm conservation.
15. Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

Suggested Readings:

Course No. BHS(III)Sem-V-III/T
Paper: Molecular Human Genetics

Objectives:
To gather knowledge in areas which are not covered in the Basic and Clinical Genetics Courses. To develop basic skills in eliciting a genetic history, constructing a pedigree, examining, genetic evaluation and genetic counseling and to develop attitudes required for managing genetic diseases and birth defects and for genetic counseling.

Unit-I
1. Introduction to human genetics:
2. Human chromosomes: Structure and function in normal and diseased state.

Unit-II
3. Human genome Molecular mapping of the genome: Chromosome dissection, Genetic and physical maps, physical map and map based cloning, Molecular markers in genome analysis. Molecular markers linked to disease resistance genes.: Human Genome Project, Mitochondrial, nuclear genome, Analysis of DNA, Variation and expression. Application of sequence information for identification of defecting genes.

Unit-III
5. Transcriptosmics & proteomics:Definitions, Methods to understand Transcriptosmics & proteomics & their application.

Unit-IV
6. Genome variations in normal and diseased state. Role of genome in molecular medicine: Diagnosis therapeutics & prediction medicine.

Suggested Readings:
2. Human Molecular Genetics, Tom Strachan Andrew P. Read, Bio. Publications, USA

Course No. BHS(III)Sem-V-IV/T
Paper: Environmental Biotechnology

Objectives:
To understand the importance and types of environmental pollution, detection of mutagens. Biotechnological approaches to tackle environmental pollution

Unit-I
1. Introduction : Historical importance.
2. Environment pollution and its types.
3. Impact of pollution on health

Unit-II
4. Introduction to toxicology including genetic toxicology, common assays to detect genetic toxicology, mutagenesis, carcinogenesis
5. Use of genetic engineering techniques in genetic toxicology.
6. Waste water treatment
7. Volatile toxic gases and biofiltration

Unit-III
8. Methanogenesis
9. Composting
10. Biodegradation of organic compounds
11. Bioremediation

Unit-IV
12. Biosorption of heavy metals
13. Biomining and bioleaching
15. Biosafety levels

Suggested Readings:
### Semester – VI

**B.Sc. (Hons. School) 3rd year (6th Semester)**

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<td>Tools in Biotechnology-II</td>
<td>BHS(III)Sem-VI-III/T</td>
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<td>4.</td>
<td>Scientific Writing &amp; Project Management</td>
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Total Credits=20 Total Marks = 500
Course No. BHS(III)Sem-VI-I/T
Paper: Fermentation Technology

Objectives:
The students will be exposed to the industrial importance of various microbes, types of fermentations, design of fermenters and the energetics of microbial growth in fermenters, Upstream and downstream processes of important microbial compounds and immobilization techniques for continuous production of metabolites.

Unit-I
1. Isolation and screening of microbes of industrial importance.
2. Strain improvement: mutation and genetic manipulations.
3. Culture preservation techniques
4. Primary metabolites

Unit-II
5. Secondary metabolites
6. Feedback inhibition
7. Feedback repression
8. Fermentative processes:
   a. Sub-merged
   b. Solid state,
   c. Fed Batch
   d. Continuous etc.

Unit-III
9. Inoculum development, fermentation media
10. Types of industrial fermenters, Fermentation equipment:
    Design of fermenters, tank construction materials, control panels, antifoam, autoclaving
11. Energetics of microbial growth in fermenters:
    Reaction rates, heat and mass transfer, transport phenomenon in reactors, macroscopic balances of energy and energy flow etc.
12. Upstream and downstream processing of industrial fermentations.

Unit-IV
13. Cell disruptions, Flocculation, Filterations, Ultrafiltration, ultracentrifugation, gel filtration, chromatographic methods, two phase aqueous separations. Cells and enzyme immobilizations Fermentation of :
    a. Antibiotics (Penicillin, Streptomycin)
    b. Organic acids (Citric acid, Lactic acid)
    c. Enzymes (Penicillin G Acylase, Streptokinase) d. ethanol.
15. Hygiene and safety in fermentation laboratory

Suggested Readings:
Course No. BHS(III)Sem-VI-II/T
Paper: Genetic Engineering

Objectives:
Genetic engineering or genetic modification refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics. The students will learn how the genes can be cut and pasted from one organism to another and what are its implications.

Unit-I
1. Introduction to genetic engineering. Why gene cloning and DNA analysis is important.

Unit-II
3. DNA modifying enzymes (RE, polymerase, kinases, ligase, alkaline phosphatase, exonuclease etc.)
4. Isolation and purification of DNA from bacteria, plants, animals and soil.
5. Transformation of E.coli, bacillus, yeast, plant and animal cells.

Unit-III

Unit-IV
10. Processing of recombinant proteins: Purification using affinity tags like His, GST, MBP and IMPACT etc. refolding and stabilization of proteins.
11. Safety measures and regulations for recombinant work.

Suggested readings:

Course No. BHS(III)Sem-VI-III/T
Paper: Tools in Biotechnology – II

Objectives:
To understand the various tools used in modern day biotechnological processes.

Unit-I

Unit-II
4. 2D Gel Electrophoresis : Principle and application.

Unit-III
5. MALDI –TOFF : Principle and application.

Unit-IV
8. Radioisotopy: Principles and applications of tracer techniques in biology; Radiation dosimetry; Radioactive isotopes and half life of isotopes; Effect of radiation on biological system; Autoradiography; Cerenkov radiation; Liquid scintillation spectrometry.

Suggested Readings:
1. Techniques used in Bioproduct analysis-Biotol Series (I-IV), 1992, Buterworth Heineman, UK.
6. The Tools of Biochemistry, Terrance G. Cooper, John Wiley & Sons, Inc. U.S.A.

Course No. BHS(III)Sem-VI-IV/T
Paper: Scientific Writing & Project Management

Objectives:
The aim is to develop good writing and communication skills among the students necessary for publishing research in high impact scientific journals. The students will get exposure about various funding agencies for scientific projects and how can they write and organize their projects.

Unit-I

Unit-II
2). Scientific literature: Gathering data using the Library/Internet (Abstracts and journals in biotechnology, e-Journals, and major libraries subscribing journals related to biotechnology in the region and country).

Unit-III
3). Funding agencies: National and international funding agencies for R & D projects.
4). Preparation of R & D projects for funding: Organization of a research project, identification of gap areas in the subject, aims and objectives of the projects, possible outcome of the project, funds requirements and justification(s).

Unit-IV
5). Project management in bioindustry: Basis and technology for starting a new project, cost estimation, marketing strategies for biotechnological products, evaluation and advertisements.

Books suggested:
Semester – I

M.Sc. (Hons. School) 1st year (1st Semester)

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<td>Advanced Immunology</td>
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<td>3.</td>
<td>Advanced rDNA Technology</td>
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<td>4.</td>
<td>Intellectual Property Rights</td>
<td>MHS(I)Sem-I-IV/T</td>
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Total Credit = 20 Total Marks = 500

Instructions for paper setters and candidates

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two question from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.
Course No. MHS(I)Sem-I-I/T
Paper: Advanced Molecular Biology

Objective:
To impart in depth knowledge of (a) structural DNA and Proteins (b) Cell cycle and Signal transduction, (c) Cancer biology and (d) Molecular basis of AIDS

Unit I
Protein structure: Primary structure determination, modifications
Three dimensional structures of proteins: Secondary structure; the peptide group, helical structure, Beta structure, non-repetitive structure
Quaternary structure and Protein folding
Fibrous and globular proteins,
Protein stability

Unit II
Different forms of DNA, supercoiling of DNA, DNA melting,
Repetitive sequences, cot and rot curves, C value paradox,
DNA protein interaction
Structural organization of chromatin, non-coding sequences, chromatin remodeling, CHIP assay
Regulation of eukaryotic gene expression

Unit III
Transposition and gene amplification
Antisense nucleic acid and its applications
Molecular basis of AIDS: infection, replication, functions of different genes therapy
Cell cycle: Overview and control of cell cycle

Unit IV
Cancer: biology, causes, genetics, oncongnes, tumour suppressor genes,
strategies for combating cancer.
Apoptosis: pathways and genes involved
Signal transduction, Types of signals, ligand and receptors, second messenger molecules
Signaling through
a. G-protein coupled cell surface receptors and small intracellular mediators,
b. Enzyme coupled cell surface receptors

Suggested Readings:
Course No. MHS(I)Sem-I-II/T
Paper: Advanced Immunology

Objective:
This course will expose the students (a) to the functioning/importance of immunomodulators (b) why our body do not produce immune response against our own components,(c) why certain individuals produce undesirable immune-related reactions (c) how our body responds to the invasion by microbes (d) How can we induce our body to accept foreign components (e) why normal cells become cancerous cells and (f) various vaccines prepared to combat infections

Unit-I
1. Cytokines: Nomenclature, properties, functions, families, regulations, diseases, therapeutic uses.
2. Immune response to infectious diseases: Bacteria, viruses, Intracellular parasites and helminthes.

Unit-II
3. AIDS & other immunodeficiencies: Primary & secondary immunodeficiencies.
4. Auto immunity: Organ specific, cellular damage, animal models, evidences implicating the CD4+, T cells, MHC & TCR in autoimmunity, induction & treatment of autoimmunity.

Unit-III
5. Hypersensitivity reactions: Type I, II, III and IV hypersensitivity.
7. Transplantation immunity: Immunological basis of graft rejection, clinical manifestations of graft rejection, immunosuppressive therapies, immune tolerance to allograft, clinical transplants.

Unit-IV
9. Vaccines: Designing vaccines for active immunization, purified macromolecules as vaccines, recombinant vaccines, DNA vaccines and multivalent vaccines.

Suggested Readings:

Course No. MHS(I)Sem-I-III/T
Paper: Advanced rDNA Technology

Objective:
This course introduces the students to the advancements made in the last two decades in the field of rDNA Technology. Unit one deals with the gene cloning strategies in eukaryotic system and DNA sequencing techniques. Unit two is basically about the amplification of DNA and its practical ramifications. Unit three deals with two technologies being used extensively in the field of Molecular Biology i.e. Phage display system and
Yeast two hybrid system. Last unit covers the techniques used in creating specific mutation in the genome, importance of T-DNA and the applications of rDNA.

**Unit I**

1. Cloning in Saccharomyces cerevisiae: vectors for yeast (2μ plasmids, YIp, YEp, YRp) yeast artificial chromosomes,
2. Vectors for animal cells and selection markers,
3. DNA sequencing (Maxum Gilbert, Sanger’s Method, PyroSequencing, Hierarchical shotgun sequencing and whole genome shotgun sequencing.

**Unit II**

5. DNA amplification techniques: PCR (long, inverse, real time PCR, RACE etc.) ligase chain reaction and helicase dependent amplification.
6. Application of PCR in rDNA Technology.

**Unit III**

7. Phage display system its types and applications.
8. Yeast hybrid system for protein-protein interaction and its variations (one, two, three hybrid and reverse hybrid

**Unit IV**

10. T-DNA and Transposon Tagging
   Role of gene tagging in gene analysis, identification and isolation of genes through T-DNA or transposon.
11. Applications of rDNA Technology.

**Suggested readings:**


**Course No. MHS(I)Sem-I-IV/T**

**Paper: Intellectual Property Rights**

**Objective:**
Since biological entities are patentable it is pertinent that students should have some knowledge of law pertaining to biotechnology, how to apply for national/international patent, Biotech agreements between various countries etc. This course gives a birds eye view to the legal aspect of biotechnology/biotech products.

**Unit I**

General Introduction to intellectual property rights and its different forms.
Farmers Rights, Animal and Plant breeders rights.
Development of patent system in India.
WTO agreement and TRIPS
Patent Cooperation treaty
Unit II
Ownership of Tangible and Intellectual Property. Basic requirements of patentability, patentable subject matter, novelty and the Public Domain; Non obviousness
Compulsory licensing, Patent infringements and revocation
Recent Development in Patent System and Patentability of Biotechnology invention, Budapest treaty

Suggested Readings:
Semester – II

M.Sc. (Hons. School) 1st year (2nd Semester)

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Total Credit = 20 Total Marks = 500

Instructions for paper setters and candidates

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two question from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.
Course No. MHS(I)Sem-II-I/T
Paper: Plant Biotechnology

Objective:
The course will make the students aware of the (a) techniques used for creating transgenic plants of industrial importance (b) Industrial applications of Plant biotech products (c) importance of secondary metabolism in plants (d) Diagnosis of plants based on molecular techniques

Unit I
1. Plant transformation technology: basis of tumor formation, hairy root, features of TI and RI plasmids, mechanisms of DNA transfer, role of virulence genes, use of TI and RI as vectors, binary vectors, use of 35S and other promoters, use of reporter genes, methods of nuclear transformation, viral vectors and their applications, multiple gene transfers, Vectors-less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots. Transgene stability and gene silencing.

Unit II
2. Application of Plant Transformation for productivity and performance: herbicide resistance, phosphinothricin, glyphosate, sulfonyl urea, atrazine, insect resistance, Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated nucleocapsid gene, disease resistance chitinase, 1-3 beta glucanase, RIP, antifungal proteins, PR proteins, nematode resistance, abiotic stress, post-harvest losses, long shelf life to fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems,

Unit III
4. Metabolic Engineering and industrial products: Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, terpenoids,
5. Industrial enzymes, Plantibodies, Edible vaccines,

Unit IV
6. Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism), AFLP, QTL

Suggested Readings:
Course No. MHS(I)Sem-II-II/T  
Paper: Microbial Biotechnology

Objective:
Unit one emphasizes the importance of microbial genomics, proteomics and metabolic engineering for the welfare of mankind. Unit two deals with the various approaches being adopted to discover new antimicrobial compounds, novel enzymes which can work in organic environment, and how recombinant proteins are secreted out in the environment by the host cells. Unit three comprises of (i) the ability of microbes to synthesize unique proteins without the involvement of ribosomal machinery, (ii) Reporter genes and their importance and © a brief introduction to microbial nano-biotechnology. The last unit i.e. Unit four discusses (a) the ability of microbial pathogens to cause various diseases at molecular level and (b) role of microbes in the production of energy rich compounds like bio-diesel/bio-hydrogen and as bio-fertilizers.

Unit-I
1. Applications of genomics in microbiology  
2. Applications of proteomics in microbiology  
3. Metabolic engineering for production of novel compounds

Unit-II
4. Novel strategies for development of new antimicrobial drugs  
5. Secretary mechanisms of recombinant proteins  
6. Microbial enzymes in organic synthesis

Unit-III
7. Biosynthesis of non-ribosomal proteins in microbes  
8. Applications of reporter genes in microbiology  

Unit-IV
10. Microbial pathogenesis at molecular level  
11. New Biofuels/Bioenergy:  
   a. Biodiesel  
   b. Biohydrogen  
   c. Microbes as Biofertilizers

Suggested Readings:
1. Trends in Biotechnology, Ann Rev. of Microbiology, Critical Reviews in Microbiology,  
2. Scientific American, Clinical Rev. in Microbiology etc.  
Course No. MHS(I)Sem-II-III/T
Paper: Food Biotechnology

Objective:
This course enlightens the students about the role of biotechnology in the Food Sector. The major emphasis is on a) the role of microbes in the preparation of traditional food, alcoholic beverages and single cell proteins; b) microbial diseases spread through foods and their detection techniques c) various strategies used for preservation of foods

Unit I
1. History background
2. Composition of food
3. Growth of microorganisms in food: Intrinsic and extrinsic factors
4. Traditional fermented foods: Bread, cocoa, coffee, tea, sauerkraut, cheese, butter, yoghurt, meat, fish, etc.

Unit II
1. Alcoholic beverages: Beer, wine and whisky
2. Value addition products: High fructose syrup, invert sugars etc.
3. Edible fungus: Mushrooms

Unit III
1. Single cell proteins: Spirulina, yeast etc. as food supplements
2. Improvement of food resources: Golden rice, Potato etc.
3. Food and water borne disease: Gastroenteritis, Diarrhea, Shigellosis, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis etc.

Unit IV
1. Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc.
2. Detection of food borne pathogens.
3. Food preservation and storage

Suggested Readings:
1. Food Sciences and Food Biotechnology (2003), G.F.P. Lopez, G, Canas, E.V. Nathan. CRC.
Course No. MHS(I)Sem-II-IV/T  
Paper: Bioethics & Biosafety  

Objective:  
This course will make the students aware of the (a) ethical issues concerned with the field of Biotechnology,(b) bioterrorism and (c) ways to handle/dispose-of biohazard material.

Unit I  
Public acceptance for biotechnology and biosafety issues  
The Cartagena protocol on biosafety  
Biosafety management: Key to the environmentally responsible use of biotechnology  
Environment protection act.

Unit II  
Ethical implications of biotechnological products and techniques.  
Bioterrorism, Social and ethical implication of biological weapons  
Biohazards: Concept of biohazards with cases highlighting importance.

Suggested Readings:  
Semester – III

M.Sc. (Hons. School) 2\textsuperscript{nd} year (3\textsuperscript{rd} Semester)

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<td>Bioinformatics</td>
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<td>2.</td>
<td>Advanced Animal Biotechnology</td>
<td>MHS(I)Sem-III-II/T</td>
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<td>3.</td>
<td>Emerging Technologies</td>
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<td>4.</td>
<td>Trends in Biotechnology (Seminar)</td>
<td>MHS(I)Sem-III-IV</td>
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Total Credit = 20  Total Marks = 500

\textit{Instructions for paper setters and candidates}

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two question from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.
Course No. MHS(I)Sem-III-I/T
Paper: Bioinformatics

Objective:
This course lays emphasis on the role of computational tools in the field of biotechnology. The students will be exposed to various data bases pertaining to DNA, RNA and protein sequences.

Section A
1. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.
2. Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.
3. Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment Phylogenetic Analysis.

Section B
5. Protein Structure: Protein structure classification, Structure Analysis, Secondary structure prediction methods, Comparative modeling

Suggested References:

Course No. MHS(I)Sem-III-II/T
Paper: Advanced Animal Biotechnology

Objective:
The major emphasis of this course is to introduce the students to the fields of Animal cell-culturing and Stem cell culturing and their importance to mankind. The students will also learn the techniques involved in in vitro fertilization, organ/animal cloning, biodiversity conservation.

Section A
1. Structure and organization of animal cell.
2. Equipments and materials for animal cell culture technology.
3. Primary and established cell line cultures.
4. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements.
5. Serum & protein free defined media and their application.
7. Biology and characterization of the cultured cells, measuring parameters of growth.
8. Basic techniques of mammalian cell culture in vitro; desegregation of tissue and primary culture; maintenance of cell culture; cell separation.
9. Scaling-up of animal cell culture

**Section B**
15. Cell culture based vaccines.
16. Organ and histotypic cultures.
17. Three dimensional culture and tissue engineering.
18. Transgenic animal and their applications.
19. Biotechnology in Pest control, Aquaculture and sericulture
20. Role of biotechnology in biodiversity conservation

**Suggested Readings:**

**Course No.** MHS(I)Sem-III-III/T

**Paper:** Emerging Technologies

**Objective:**
This course is meant to update the students with the state of art technologies in the areas of genomics, proteomics, metabolomics and pharmacogenomics and their impact on industry and mankind at large.

**Section A**

**Genomics:** Introduction to Genomics, Sequencing strategies for whole Genome Analysis, Sequence Data Analysis, Comparative Genomics, Genome Annotation, Structural and Functional Genomics, Global Analysis of Gene Expression, Transcriptomics & Microarray.


**Section B**

**Metabolomics:** Concept of Metabolomics, Metabolomic Engineering, Techniques for Metabolomics Engineering, Applications.

**Pharmacogenomics:** Introduction to Drug Design, Drug Design: In silico, automated, Structure based, High Throughput Screening, Technologies & Challenges of Pharmacogenomics.
Practical: - Visit to Biotech Institute / Industry and report submission.

Reference Books:


Course No. MHS(I)Sem-III-IV
Trends in Biotechnology (Seminar)
Objective:
The purpose of this course is to make the students know of the type of research going on all over the world in the field of biotechnology. Each student will be given a topic. He/she has to look up the literature and make a presentation in front to biotech faculty and students.
**Semester – IV**

**M.Sc. (Hons. School) 2\textsuperscript{nd} year (4\textsuperscript{th} Semester)**

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<td>d) Thesis</td>
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<td>e) Presentation &amp; Viva</td>
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<td>f) Internal Assessment</td>
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**Total Credit = 20** **Total Marks = 500**

**Instructions for paper setters and candidates**

- Set nine questions in all. All questions carry equal marks.
- Five questions to be attempted.
- Question number one will be compulsory having 7-10 short answer types covering the whole syllabus (Not objective type and no short notes).
- Set two question from each Unit, and each question should be further divided in two to three parts. Any one question to be attempted from each unit.

**Course No. MHS(I)Sem-IV-I**

**Research Project**

a) Thesis  
b) Presentation & Viva  
c) Internal Assessment

**Objective:**

The purpose of this course is to teach the students how to carry out research independently. Each student will be given a research project. He/she will work on a particular topic under the guidance of a faculty member. At the end of the experimental part each student will write the Thesis and defend his/her research work in front of faculty members of the department.

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