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## B.Sc Part-I

## Bio-technology

Main Subject: Biotechnology (Summary of the Course Structure)  
Compulsory Subjects: Behavioural Science and Entrepreneurship Development

### B.Sc. - I (At the end of First Year)

Examinations	Total Marks
1. Four Theory paper (I - IV) of 75 marks each	300
2. Practical based on papers I - IV	100
3. Behavioural Science	50
4. Internal Assessment	50
On-the-job-training (30 days-duration summer) Report	

### B.Sc. - II (At the end of Second Years)

5. Four Theory papers (V-VIII) of 75 marks each	300
6. Practical based on papers V - VIII	100
7. Internal Assessment	100
On-the-job-training (30 days-duration summer) Report	

### B. Sc. - III (At the end of Third Year)

8. Five Theory papers (IX-XIII) of 75 marks each.	375
9. Practical based on papers IX - XIII	100
10. Entrepreneurship Development	75
11. Project work	150
12. Internal Assessment	100
Project work of 6 month duration under supervision of a chosen faculty	

**Total** 1800

- Note:**
1. Each theory paper shall be of three-hour duration
  2. Each practical examination shall be of six hour duration.
  3. 20% of the marks in each practical examination shall be reserved for class records.
  4. Internal assessment shall be based on training report, oral presentation and term paper.

## Paper I: Biochemistry and Biophysics

**Nature of Biological materials:** Polymeric reaction, carbohydrates, lipids, proteins, nucleotide, nucleic acid, oxidation-reduction properties. pH, pK and buffering, isomerism, types of chemical bonds, and hydrophilic

hydrophobic group in biomolecules, neurotransmitters, hormones and growth factors, high energy biomolecules (ATP, GTP & Creatine phosphate)

**Perspectives of biological macromolecules:** The repeating units in nucleic acids and proteins, helicity, bending, looping pleats, salt bridges, etc. and their determinants, basis for intermolecular interactions with example, enzyme-substrate and antigen-antibody reactions, salient features of biochemical reactions involved in the biosynthesis of amino acids, fatty acids and nucleotides.

**Enzymes, Protein and non-protein enzymes:** Classification and nomenclature of enzymes, regulation of enzyme activity, coenzymes structure and function of Coenzyme I and Coenzyme A; kinetics of enzyme catalysed reactions; isolation and purification of enzymes; enzymes in food processing, medicines, and production of chemical compounds.

**Bio-energetics:** Laws of thermodynamics (1<sup>st</sup> & 2<sup>nd</sup> laws), electrical properties of biological compartments, electrochemical gradients, membrane potential, chemiosmotic hypothesis.

**Energetics of a living body:** Sources of heat limit to temperature, heat dissipation and conservation; Lambert-Beer law, spectrophotometry and colorimetry, primary events in photosynthesis, strategies of high reception in microbes, plants and animals, correction of vision bulb generation and reception of sonic vibrations, hearing aids

**Electrical properties of biological compartments:** Electricity as a potential signal.

**Intra and intermolecular interactions in biological system:** Space and charge compatibility as determinant of such interactions.

## Paper II: Maths, Biostatistics, Computers and Bioinformatics

**Maths:** The set theory properties of sub sets; linear geometric functions, the binomial theorem of integer, limits of functions (basic idea of limits of function without analytic definition), derivatives of functions, logarithm (definition & laws of logarithm, use of logarithm table), differentiation, integration (general introduction, significance and application for simple algebraic and trigonometric functions).

**Biostatistics:** Probability calculation (classical & axiomatic definition of probability, theorem on total and compound probability), standard

- \* Estimation of sugar in given solution.

#### Cell Biology

- \* Cytological preparations
  - Fixation, dehydration and staining

#### Biostatistics

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#### Computers

- \* Handling of computer and Data analysis

## B.Sc. in Biotechnology Behavioural Science (Compulsory Subject)

### Syllabus for Behavioural Science

50 Marks: 3 Hours

#### (a) Psychology

1. Nature and Methods of Psychology
2. Attention and perception
3. Motivation
4. Emotion
5. Learning and Memory
6. Thinking
7. Intelligence
8. Personality its nature and assessment

#### (b) Anthropology

##### Cultural basis of behaviour-Nature and Natures.

Process of Socialization  
Enculturation  
Value Orientation  
Culture and Society  
Nature of Culture and its Development  
Society-its characteristics  
Types and organization

##### Genetic basis of behaviour-Primate and Human

Evolution of behaviour

Genetic and deviant behaviour  
Mechanism and development of behaviour phenotypes.

## Inorganic and Physical Chemistry

(40 Hours)

### Unit-I

#### Inorganic

**Chemical bonds and molecules:** Shapes of simple molecules, bond energy, bond length, resonance and Hydrogen bond.

**Radioactivity:** Natural and artificial, group displacement law, half life period, binding energy, nuclear reaction equations, isotopes, tracers, radiodating, Application of radioactivity.

**Periodic table:** Modern periodic table, periodicity in properties of element, atomic radii, ionic and covalent radii, ionization energies, electron affinity, electron-negativity.

**Ores and Minerals:** Principles involved in the extraction of metals from ores, including their refining and purification. General trends in the Chemistry of S-block elements (Group IA & IIA).

### Unit-II

(20 Hours)

#### Physical

**Gases:** Kinetic theory of gases, van der Waal's equation, critical constants, Liquefaction of gases.

**Chemical Kinetics:** Velocity of a reaction, Law of mass action; determination of rate constant for first and second order reactions, collision theory of bimolecular reactions.

**Catalysis:** Promoters and Poisons, Enzyme catalysis.

## Paper II-Organic and Physical

### Unit-I

#### Organic

Organic chemistry is Chemistry of carbon compounds. Methods of purification, tests of purity; qualitative and quantitative elemental analysis, determination of molecular formula. Tetrahedral concept in carbon compounds, functional groups, nomenclature and isomerism.

\* General methods of preparation and properties of alkanes, alkenes, alkynes, halogen substituted alkanes ( $\text{CH}_2$ ,  $\text{Cl}_2$ ,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{ClH}_2$ ) and others.

\* **Grignard reagent:** Its preparation and synthetic uses Ethyl alcohol, Propanol; glycol, glycerol, aldehydes, ketones, formaldehyde, acetaldehyde, and acetone. Monocarboxylic acids and their simple derivatives, Descriptive studies of dicarboxylic acids, viz malic, oxalic, tartaric, malic, fumaric acids. Tri-carboxylic acid, citric acid and urea stereoisomerism; geometrical and optical.

✓ Keto-enol tautomerism; aceto-acetic ester and malonic ester Petroleum; Fractionation, cracking and synthetic petrol.

**Unit-II** (20 Hours)  
**Physical**

**Chemical equilibrium:** Reversible reactions, equilibrium law equilibrium constant factors influencing equilibrium states.

**Electrochemistry:** Electrolysis, laws of electrolysis, ionization specific, equivalent and molecular conductance, ionization constant common ion effect; Hydrogen ion concentration. pH value. Theory of acid base indicators, buffer solutions, hydrolysis of salts and solubility product simple calculations based on these concepts.

**Practicals**

**Inorganic**

1. **Volumetric analysis:** Oxidation-reduction titration using  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$ .
2. **Iodometry titrations:** Estimation of sodium thiosulphate, potassium dichromate, and copper sulphate.
3. **Preparation of the following inorganic compounds:** Prussian blue from iron filings, chrome alum, cuprammonium sulphate, cuprous chloride and potassium trioxide atochromate.

**Physical**

- (1) Determination of surface tension and viscosity of liquid.
- (2) Heat of neutralization of a strong acid and a strong base.
- (3) Solubility curve,  $\text{KNO}_3$  or benzoic acid.

## B. Sc. in Biotechnology Botany (Subsidiary Subject)

**B. Sc. Part-I (At the end of First year)**

There shall be Examination in two theory papers and a practical		Duration (Hours)	Max Marks
Paper I	Algae, Fungi, Bryophytes and Pteridophytes	3	50
Paper II	Gymnosperms & Taxonomy of Angiosperms	3	50
Practical examination based paper I & II		4	50

20% of the Marks in the Practical examination shall be reserved for the class and field records.

## B.Sc. Part-II (At the end of Second year)

There shall be Examination in two theory papers and a practical		Duration (Hours)	Max. Marks
Paper III	Plant Physiology, Ecology and Plant Anatomy	3	50
Paper IV	Embryology, Plant Pathology, Plant Breeding & Economic Botany	3	50
Practical examination based on Paper I and II		4	50

20% of the Marks in the Practical examination shall be reserved for the class records.

### Paper - I (Algae, Fungi, Bryophytes and Pteridophytes)

**Unit-I** (15 Hrs)

Classification, occurrence, structure, systematic position of mode of reproduction and economic importance of the following general; Chlamydomonas, Volvox, Oedoponium, Vaucheria, Chara, Saragassum Polysiphonia Nostoc.

**Unit-II****(15 Hrs.)**

1. Outlines of classification of fungi.
2. Systematic position, occurrence, structure and mode of reproduction in fungi, based on the following representatives: Synchytrium, Eurotium, Morchella, Agaricus and Alternaria.
3. Economic importance of fungi.
4. Lichens: Classification, occurrence, systematic position, mode of nutrition, reproduction and economic importance of Lichens.

**Unit-III****(15 Hrs.)**

1. Outlines of classification and importance of bryophytes.
2. Systematic position occurrence, morphology, anatomy and reproductive structure in Riccia, Marchantia, Anthoceros (Development of Sporophyte only)

**Unit-IV****(15 Hrs.)**

1. Systematic position, occurrence, morphology, anatomy and development of reproductives of the following taxa-Rhynia, Selaginella, Equisetum and Marsilea.
2. Stele system and its evolution in Pteridophytes.
3. Heterospory and seed habit.

**Practicals**

**Algae** Study of Algal types with the help of permanent slides and also by preparation suitable slide as presented in the theory course.

**Fungi** Study of Fungal types with the help of permanent slides and also by preparing suitable slide and also by preparing suitable slide as prescribed as the theory course.

Study of the following types with the help of permanent slides and also by cutting sections and making suitable preparations.

**Bryophytes** : Riccia, Marchantia, Anthoceros.

**Pteridophytes** : Rhynia, Selaginella, Equisetum and Marsilea

**Practicals****Paper - 2****(Gymnosperms & Taxonomy of Angiosperms)****Unit - 1****(20 Hrs.)**

1. General characteristics, affinities and classification of Gymnosperms.
2. Distribution of Gymnosperms in India.
3. Systematic position, occurrence, morphology and development, of reproductive structures of the following taxa-Cycas, Pinus, Ephedra
4. Economic importance of Gymnosperms.

**Unit - 2****(10 Hrs.)**

1. Classification as proposed by Bentham and Hooker and Hutchison.
2. Important Herbaria and Botanical gardens of India.
3. Binomial Nomenclature and elementary knowledge of international Code of Botanical Nomenclature.

**Unit - 3****(30Hrs.)**

1. Systematic position, distinguishing character and economic importance of the following families.
2. Dicotyledons:
  - (a) Polypetalae: Ranunculaceae, papaveraceae, Caryophyllaceae, Rutaceae, Cucurbitaceae, Rosaceae, Apiaceae.
  - (b) Gamopetalae, Rubiaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Verbenaceae.
  - (c) Monochlamydeae Euphorbiaceae.
3. Monocotyledons: Araceae, Poaceae.

**PRACTICALS**

Study of the following types with the help of permanent slides and also by cutting sections and making suitable preparations

Gymnosperms : Cycas, Pinus, and Ephedra

Taxonomy : Detailed description and identification of locally available plants of the families as prescribed in theory course.

distribution with important properties, simple problems involving binomial, poisson and normal variables, methods of sampling collection of data; primary & secondary data, classification & tabulation, confidence level, statistics, idea of sampling, distribution and standard error, large samples; normal tests, measurement of dispersion (measures of location and dispersion).

**Computers:** General introduction (characteristics, capabilities, generations), software, hardware; organic ion of hardware (input devices memory, control unit arithmetic logic unit, output devices); software; application software, languages-low level, high level). interpreter, compiler, data processing; batch, on-line, real time (example from bio-industries, e.g. application of computers in co-ordination of solute concentration, pH, temperature, etc., of a fermenter in operation); internet application.

**Bioinformatics:** Application of computers in biotechnology, genome analysis, sequence, primer designing, phylogenetic analysis.

### Paper III: Cell Biology

**Cell as a basic unit of living systems:** The cell theory precellular evolution; artificial creation of "cell"; broad classification cell type, PPLOS, bacteria, eukaryotic microbes, plant and animal cells a details classification cell types within an organism, cell, tissue, organ and organism at different levels of organisation of otherwise genetically similar cells, ecological amplitude of cells in high altitude, sediments, aeries, hot spring, arid, brackish and freshwater environments; biochemical composition of cells (proteins, lipids, carbohydrates, nucleic acids and the metabolic pool).

**Ultra structure of the cell membrane and cell organelles:** Structure and function of cell organelles; ultrastructure of cell membrane, cytolcol golgi bodies, endoplasmic reticulum (rough and smooth), mitochondria. Chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane nucleoplasm, nucleolus).

**Chromosomes:** Chemical composition; structural organic atoms of chromatids, centromeres, telomeres, chromatin, nucleosome organisation eu- and heterochromatin; special chromosomes (e.g., polytene and lampbrush chromosomes); banding patterns in human chromosomes.

**Cell division and cell cycle:** mitosis and meiosis interphase and mitosis comparisin of mitosis and meiosis

**Cell-Cell interaction.** Cell locomotion (amoeboid, flagellar, and ciliar) muscle and nerve cells, cell senescence and death.

**Cell differentiation:** Plants and animals difference between normal and cancer cells.

### Paper IV: Instrumentation & Bio-analytical Techniques

**Microscopy:** Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM)

**Instruments, basis principles and usage:** pH meter, absorption and emission spectroscopy, principle and law of absorption and radiation, use of densitometry, fluorimetry, colorimetry, spectrophotometry (visible, uv, infrared), manometry, polarography, centrifugation, atomic absorption, IR, NMR, X-ray crystallography.

**Chromatography techniques:** Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, affinity chromatography, gel filtration, chromatography, ion exchange (paper gel etc.)

**Electrophoresis:** SDS polyacrylamide electrophoresis, immunoelectrophoriss, isoelectric focussing.

**Fermentaton:** Different type of fermenters: principle operating, characteristics of fermenters, computer control of fermentation process.

**Radioisotope tracer techniques and autoradiography.**

### Practicals

#### Practical Examination

##### Biochemistry

- \* Preparation of buffer
- \* Colour reactions of Carolydrates
- \* Colour reactions of amino acids
- \* Extraction of lipids
- \* Estimation of protein by Bradford method
- \* Estimation of DNA
- \* Estimation of RNA