

**BIOTECHNOLOGY HONOURS**  
**PAPER [I]**  
**BIOCHEMISTRY**

**Nature of biological material** – Polymeric reactions, carbohydrates, lipids, proteins, nucleotides, nucleic acids, oxidation-reduction properties, pH, pK and buffering, isomerism, types of chemical bonds and hydrophilic and hydrophobic groups in biomolecules, the signal molecules-neurotransmitters, hormones and growth factors, c-AMP, 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. The basis for intermolecular interactions example (enzyme-substrate and antigen-antibody recognitions). Salient features of biochemical reactions involved in the biosynthesis of amino acids, fatty acids and nucleotides.

**Enzymes** – Classification and nomenclature of enzymes, Protein and non-protein enzymes, regulation of enzyme activity, coenzymes-Basic structure and function; kinetics of enzyme catalyzed reactions; isolation and purification of enzymes; enzymes in food processing, medicine and diagnostics

**Enzymes as research tools** – ELISA methods, Modification of biological compounds with the help of enzymes.

**Metabolism** – Glycolysis, TCA cycle, Electron Transport Chain and Oxidative phosphorylation, Gluconeogenesis and Glycogen metabolism,  $\beta$ -oxidation.

**PAPER [II]**  
**MATHS AND COMPUTER**

The Set theory-Set, types of sets, subsets and its properties.

Linear and geometric functions.

Limits of functions (basic idea without analytic definition).

Derivatives of functions.

The binomial theorem for positive index, formula for negative integral index and fractional index.

Logarithm (Definition, laws of logarithm and use of log table).

Differentiation of function of functions, Trigonometric, logarithmic exponential and inverse circular functions.

Integration (general introduction, significance and application for simple algebraic and trigonometric functions).

**Biostatistics** – Probability calculations

Methods of sampling, confidence level

Measurement of central tendencies-Mean, Median, Mode

Measurements of deviations and dispersion-Mean Deviation, Standard deviation.

**Computers** : General introduction (Characteristic, capabilities, generations), software, hardware : organization of hardware (input devices, memory, control unit, arithmetic and logic unit, output devices), Software : (system software, application software, languages- low level, high level), interpreter, compiler, data processing, batch, on-line, real time (examples from bio-industries, e.g. application of computers in coordination of solute concentration, pH, temperature, etc., of a fermentor in operation); internet application.

**Bioinformatics** : Application of computer in Biotechnology, genome analysis, sequence analysis, primer designer, phylogenetic analysis.

**PAPER [III]**  
**CELL BIOLOGY**

**Cell as a basic unit of living systems** : The cell theory, precellular evolution, broad classification of cell types : PLOs, bacteria, eukaryotic microbes, plant and animal cells a detailed classification of cell types within an organism, cell, tissue, organ and organism as different levels of organization of otherwise genetically similar cells, Biological 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 ; Ultra structure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum, ribosomes, cytoskeletal structures, mitochondria, chloroplasts, lysosomes, peroxisomes, nucleus, organization of chromosomes.

**Cell cycle and Cell division** (Including cell synchrony and its applications).

Cell-cell interaction, Cell attachment Cell locomotion (amoeboid, flagellar and ciliary), Muscle and nerve cells, Cell senescence and death.

Cell differentiation in Plants and animals; difference between normal and cancer cells.

**PAPER [IV]**  
**GENETICS**

Mendelian laws of inheritance, gene interactions.

**Linkage and crossing over** – mapping genes, interference; coincidence in pro and eukaryotes.

Sex determination in plants and animals, sex linkage, non-disjunction as a proof of chromosomal theory of inheritance.

**Chromosomes** : chemical composition, structural organization of chromatids, centromeres, telomeres, chromatin, nucleosome organization, eu – and heterochromatin, special chromosomes (eg. Polytene and lampbrush chromosomes), banding patterns in chromosomes.

Structural and numerical aberrations involving chromosomes, Evolution of wheat, cotton and rice, Hereditary defects in man – Klinefelter, Turner, Cri-du-chat and Down syndromes.

**Concept of gene** : Classical and modern gene concept, pseudoallelism, Position effect, intragenic crossing over and complementation (cistron, recon and muton), Benzer's work on rII locus in T4 phage.

**Mutations** : Spontaneous and induced, chemical and physical mutagens, induced mutations in plants, animals and microbes for economic benefit of man.

**Basic microbial genetics** : conjugation, transduction, transformation. Isolation of auxotrophs, replica plating techniques, analysis of mutation in biochemical pathways, one gene- one enzyme hypothesis.

Extra chromosomal inheritance, mitochondrial and chloroplast genetic systems.

**Population genetics**: - Hardy-Weinberg equilibrium, gene and genotypic frequencies.

## **PAPER [V] MICROBIOLOGY**

History and development of microbiology, scope of microbiology.

Development of Microscopy (Optical, Fluorescence TEM and SEM).

Pasteur's experiments disproving spontaneous generation.

The concept of sterilization methods of sterilization (dry heat, wet heat, radiation, chemical and filtration etc.)

Concept of microbial species and strains, serotypes.

Classification of microorganisms. Characteristics features of eubacteria, archaeobacteria, Cyanobacteria, protozoa and viruses.

The various forms of microorganisms – PPLOs, cocci, bacilli and spirilla.

Nature of microbial cell surfaces; Gram positive and Gram negative bacteria, kinds of flagella, Ultra structure of flagella.

Prokaryotic and eukaryotic microbial cells,

Nutritional classification of microorganisms.

Microbes in extreme environments – the thermophiles, psychrophiles and alkalophiles.

Pathogenesis and pathogenic microorganisms, defense mechanism against microorganisms.

Symbiosis and antibiosis among microbial populations.

N<sub>2</sub>- fixing microbes in agriculture, mechanisms of N<sub>2</sub> fixation in symbiotic and non symbiotic states.

Microbial metabolism, Fermentation products, A survey of products from microorganisms, Strain improvement by enrichment, selection and recombinant DNA methods, Production of heterologous proteins of interest in microorganisms.

## **PAPER [VI] BIOCHEMICAL TECHNIQUES**

Quantitative estimation of the following in biological samples.

Sugar in given solutions.

Sugar in biological samples.

Extractions and separation of lipids.

Estimation of proteins.

Estimation of DNA / RNA.

Isolation and purification of proteins.

Assay of enzyme activity.

Kinetic studies on enzymes.

Chromatographic methods for separation of macromolecules (Sugars, Amino acids, Plant pigments).

## **PAPER [VII] MICROBIOLOGICAL TECHNIQUES**

**Aseptic techniques** : Cleaning of glasswares, preparation of media, cotton plugging and sterilization.

Isolation of microorganisms from air, water and soil samples, personal hygiene (microbes from hands, tooth-scum and other body parts), dilution, pour plating & Colony purification.

Enumeration of microorganisms, Total vs viable count.

Identification of isolated bacteria, Gram staining, Metabolic, Characterisation (IMViC) test.

Growth curve of microorganisms.

Antibiotic sensitivity of microbes, use of antibiotic discs.

Testing of water quality (BOD, COD & E.coli Count)

Alcoholic and mixed –acid fermentation.

## **PAPER [VIII] ON THE JOB TRAINING**

The students should be assigned to assist a clinic ( in a hospital), a fermentation plant, brewery or bakery and watch the various stages in brewing and baking and post fermentation processing. Prior arrangement must be made of the mode of interaction of the educational institution with the clinic and the industry.

## PART II

### PAPER [IX]

#### BIOPHYSICS

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

**Energetics of a living body** : Sources of heat limits to temperature, heat dissipation and conservation, Lambert-Beer law. Spectrophotometry and colorimetry Primary events in photosynthesis, Correction of vision faults, Generation and reception of sonic vibrations. Hearing aids.

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

**Physical methods applied to find out molecular structure** : X-rays crystallography and NMR.

**General spectroscopy** : UV, Visible and infra red fluorescence, atomic absorption, IR, Raman spectra.

**Centrifugation** : Principles, instrumentation and applications.

**Electrophoresis** : Principles, instrumentation and applications (PAGE and Agarose).

**Chromatography** : Paper, TLC, Gel filtration and Affinity, Ion exchange, GLC and HPLC.

### PAPER [X]

#### MOLECULAR BIOLOGY

**Molecular basis of life** : Structure of DNA, DNA replication both in prokaryotes and eukaryotes, DNA recombination, molecular mechanism in prokaryotes and eukaryotes.

Insertion elements and transposons.

**Organization of genetic material** : silt genes, overlapping genes, pseudogenes, cryptic genes.

**Genetic code** : Properties of genetic code, codon assignments, chain initiation and chain termination codons, Wobble hypothesis.

Prokaryotic transcription, Prokaryotic translation, Prokaryotic gene expression (lac, his, trp, catabolic repression).

Eukaryotic transcription, Eukaryotic translation, Eukaryotic gene expression, transcription factors etc.

Gene expression in yeast.

Gene expression in protozoan parasites.

Gene organization and expression in mitochondria and chloroplasts.

Post translation regulation of gene expression.

Development and environmental regulation of gene expression.

### PAPER [XI]

#### IMMUNOLOGY

The immune system and immunity along with historical perspective.

Antigen-antibody and their structure.

The organs and the cells of the immune system and their function.

Antigen-antibody interaction.

Humoral and cell mediated immunity (role of MHC and genetic restrictions).

Origin of diversity in immune system.

Effector mechanisms.

Immunity to infectious diseases, vaccines.

### PAPER [XII]

#### RECOMBINANT DNA TECHNOLOGY

What is gene cloning and why do we need to clone a gene?

Tools and Techniques, Plasmids and other vehicles, genomic DNA, handling of DNA, RNA, cDNA, CRT enzymes and other reagents, laboratory requirements.

Safety measures and regulations for recombinant DNA work.

Choice and selection of the tools and the techniques.

**Vectors** : Plasmids and Bacteriophages, available phagemids, cosmids,

Viruses.

Purification of DNA from bacterial, plant and animal cells.

DNA amplification using PCR, DNA sequencing.

Cloning strategies : Construction of genomic libraries and cDNA libraries.

Probe construction, recombinant selection and screening.

Introduction of DNA into living cells.

Cloning vectors for *E. coli*.

Cloning vectors for organisms other than *E. coli*, yeast, fungi, plants-agrobacterium, plant virus, animal viruses.

**Application of r DNA technology**

➤ In studying gene structure and expression. Cloning in gene analysis.

- In medicine (insulin, recombinant vaccine, diagnostic reagents and other pharmaceutical compounds).
- In agriculture.

### PAPER [XIII] INDUSTRIAL BIOTECHNOLOGY

Isolation, Preservation and maintenance of industrial microorganisms.

**Fermentor :** Factor involved in fermentor design; fermentor configurations- batch fermentors, continuous stirred tank fermentor, solid state fermentor; operation & characteristics of fermentors.

**Down stream processing and product recovery :** Precipitation, filtration, centrifugation; cell disruption, liquid extraction, chromatography.

**Productions of pharmaceuticals :** Antibiotics (Penicillin), Vitamins (B<sub>12</sub>&C).

**Production of organic acids :** Citric acid, Acetic acid.

**Production of amino acids :** Lysine & Glutamic acid.

**Production of enzymes :** Proteases & Amylase.

**Production of solvents :** Ethanol, Acetone & Butanol.

**Production of single cell protein.**

**Production of edible mushrooms**

**Paper industry:** - production of raw materials and paper from savai grass, eucalyptus, semal and bamboo.

### PAPER [XIV] METHODS IN MOLECULAR AND CELLULAR BIOLOGY

Cytological Preparations :

- Fixation, dehydration and staining.
- Squash in stain.
- Embedding and sectioning.

Cell counting methods :

- The haemocytometer and other aids.

Measurements with the help of light microscope

- Calibration of ocular micrometer.
- Finding out average cell size.
- Chromosome lengths.

Identification of cell types in human blood.

Separation of cell organelles:

Methods for cell lysis: - rupture / osmotic / chemical / enzymatic lysis of cells followed by centrifugation. Monitoring cell lysis by release of cellular material and by change in light scattering etc.

- Mechanical rupture of cells : Ultrasonic vibrations,

Separation of the constituent molecules of the extract in aqueous buffer

- Gel filtration.
- Ion exchange chromatography.

Thin layer chromatography of extracted material.

Isolation of chromosomal and plasmid DNA from bacteria.

Restriction digestion of DNA and assigning restriction sites ( may be done as a demonstration).

Making competent *E. coli*.

Transfection of plasmid DNA and selection for transformants.

### PAPER [XV] IMMUNOLOGICAL METHODS

Purification of antigens.

Raising polyclonal antibodies

Purification of antibodies.

Enzyme-linked immunoassay.

Radial immunodiffusion analysis.

Diagnosis of an infectious disease by an immunoassay.

### PAPER [XVI]

## ON THE JOB TRAINING

This should be taken up during summer over a period of one month preferably in an immunology / veterinary / virology institute or a laboratory using recombinant DNA methods.

### PAPER [XVII] ANIMAL BIOTECHNOLOGY

History of development of cell cultures.

Stimulating natural condition for growing animal cells.

Primary cultures. Anchorage dependence of growth, non-anchorage dependent cells.

Secondary cultures. Transformed animal cells. Established / continuous cell lines.

Characterization of cell lines, commonly used animal cell lines-their origin and characteristics.

Preservation and maintenance of animal cell lines, Cryopreservation, and transport of animal germplasm (Semen, Ovum & Embryos).

Growth kinetics of cells in culture.

Organ culture, Transfection of animal cells : selectable markers, HAT selection, antibiotic resistance etc. Cell fusion

Transplantation of cultured cells. Differentiation of cells.

Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, IL-2, NGF, erythropoietin etc.) Bioreactors for large scale culture of cells. Special secondary metabolites/products (insulin, growth hormone, interferon, t-plasminogen activator, factor VII etc.)

Application of animals cell culture for studies on gene expression.

Expressing cloned proteins in animal cells. Over production and processing of chosen proteins, the need to express in animal cells.

Production of vaccines in animal cells.

Production of monoclonal antibodies.

Transplanting cultured cells.

Transgenic animals, *in vitro* fertilization and embryo transfer.

### PAPER [XVIII] PLANT BIOTECHNOLOGY

History of plant tissue culture: - Introduction to *in vitro* methods. Terms and definitions . Use of growth regulators. Introduction to the processes of embryogenesis and organogenesis and their practical applications. Single – cell suspension culture and their applications in selection of variants/mutants with or without mutagen treatment (of haploid cultures preferably).

Beginning of *in vitro* cultures in our country (ovary and ovule culture, *in vitro* pollination and fertilization) Embryo culture, embryo rescue after wide hybridization and its applications. Endosperm culture and production of triploids. Synthetic seeds.

Haploids and their applications.

Clonal multiplication of elite species (micropropagation) axillary bud, shoottip and meristem culture.

Somaclonal variations and application (treasure your exceptions)

Introduction to protoplast isolation : principles and applications. Testing of viability of isolated protoplasts. Various steps in the regeneration of protoplasts. Somatic hybridization – an introduction, Various methods for fusing protoplasts : Chemical , electrical. Use of markers for selection of hybrid cells. Practical application of somatic hybridization (hybrids vs cybrids). Use of plant cell, protoplast and tissue culture for genetic manipulation of plants.

Practical application of tissue and organ culture (summarizing the practical application of all the above mentioned techniques.

Introduction to *A. tumefaciens*, Tumor formation on plants using *A. tumefaciens* (Monocots vs Dicots). Root formation using *A. Rhizogenes*, Practical applications of genetic transformation.

Transgenic Plants : Herbicide, insect, pest resistance and stress tolerant.

### PAPER [XIX] ENVIRONMENTAL BIOTECHNOLOGY

Renewable and non-renewable resources of Energy.

What is renewable should be bioassimilable / biodegradable.

Major consumer items : food fuel, and fibers.

Conventional fuels and their environmental impacts :

- Firewood
- Plant and animal wastes
- Coal
- Gas
- Petroleum

Modern fuels and their environmental impacts :

- Methogenic bacteria and biogas
- Microbial hydrogen production
- Conversion of sugars to ethanol. The gasohol experiment
- Solar energy convertors-Hopes from the photosynthetic pigments
- Plant based petroleum industry
- Biomass production and Cellulose degradation for combustible fuel.

Microbiological quality of food and water, Environmental monitoring (Physical and Chemical) Biological analysis, Biosensors.

Treatment of municipal waste and industrial effluents (Solid & Liquid).

Degradation of pesticides and toxic chemicals by microorganisms.

Thuringiensis toxin as a natural pesticide.

Biological control of insects and pathogens.

Vermi Culture.

Enrichment of ores by microorganisms.

Biofertilizers : Classification, production and applications.

### **PAPER [XX] CULTURE METHODS**

Initiating plant tissue culture : (Dedifferentiation of explants).

Growth of plant cell into undifferentiated mass.

Large scale cultivation of plant cells in suspension.

Induction of differentiation by modulation of the hormonal balance.

Culture of lymphocytes from blood samples.

Preparation of media, filter sterilization , monitoring, microbial contamination (bacteria, fungi & mycoplasma), cloning of animal cells by cell & colony purification.

Demonstration / operation of large scale fermenters.

### **PAPER [XXI] PROJECT WORK**

The students will be assigned to generate data on certain research projects and /or available information from literature on a given topic of biotechnology relevance. The project work will span over a period of three months under the supervision of chosen faculty members.

### **PAPER [XXII] ENTREPRENEURSHIP DEVELOPMENT**

The students will be delivered lectures on how to select for product line, design and develop processes, economize on material & energy requirement, stock the product and release the same for marketing etc. The basic regulations of excise also should be appraised to the candidates. In parallel the students will be asked to survey the demand for a given product, feasibility of its production under the given constraints of raw material, energy input, financial situation, export potential etc. Procedural details on how to select process, how to move for loans, how to operate and how to repay the loans in a phasic manner should also be highlighted during the lectures. The semester should end with submission of a draft project by the students.

#### **THEORY : 60 Marks**

1. Need, Scope & Characteristics of Entrepreneurship.
2. Identification of opportunities.
3. Exposure to Demand based, Resource based, Service based, Import Substitute and Export Promotion Industries.
4. Market Survey Techniques.

5. Need, Scope and Approach for Project Formulation.
6. Criteria for Principles of Product Selection and Development.
7. Structure of Project Report.
8. Choice of Technology, Plant and Equipment.
9. Institutions, Financing Procedure and Financial Incentives.
10. Financial Ratio and their Significance.
11. Books of Accounts, Financial statements and Funds Flow Analysis.
12. Energy Requirements and Utilization.
13. Resource Management – Men, Machine and Materials.
14. Critical Path Method (cpm), Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI.
15. (a) Creativity and Innovation (b) Problem Solving Approach.  
(c) Strength Weakness Opportunity and Threat (SWOT) Techniques.
16. Techno-Economic Feasibility of the project.
17. Plant Layout and Process Planning for the Product.
18. Quality Control / Quality Assurance and Testing of Product.
19. Elements of Marketing and Sales Management.
20. (a) Nature of Product and Market Strategy.  
(b) Packaging and Advertising After sales Service
21. Costing and Pricing.
22. Management of self and understanding human behavior.
23. Sickness in Small Scale Industries and their Remedial measures.
24. Coping with uncertainties, Stress Management and Positive Reinforcement
25. (a) LICENSING Registration.  
(b) Municipal bye Laws and Insurance Coverage.
26. Important Provision of Factory.
27. (a) Dilution (b) Social Responsibility and Ethics.
28. Income Tax, Sales Tax and Excise Tax.

**PRACTICAL : 40 Marks**

Conduct of mini market survey (one day exercise) : Data collection through questionnaire and personal visits.

Entrepreneurial Motivation Training: Through games, role playing, discussions and exercise:

- (a) Working capital assessment and management : Practice
- (b) Exercise on working capital and fixed capital calculation : Practice
- (a) Analysis of simple project report : Practice
- (b) Break even analysis : Practice.

**BOTANY (General and Subsidiary)**

Each year there shall be two theory paper of marks 75 each of three hour's duration and practical (4 hours duration) in the 1<sup>st</sup> year and second year.

The course for 1<sup>st</sup> year/2<sup>nd</sup> year for pass and Subsidiary examinees are the same.

Four question are to be set from each of the three groups. Out of which the candidates will be required to answer FIVE questions attempting at least one question from each group. Question no. 1 will be objective and compulsory 25% questions may be repeated.

**1<sup>st</sup> year : General and Subsidiary**

**Paper – I**

(Theory paper)

Time : 3 Hrs

Full Marks : 75

**GROUP 'A' : Cryptogames**

Structure, reproduction , classification and economic importance of Algae, Fungi and Lichens.

- a) Algae : Nostoc , Chlamydomonas, Volvax, Oedogonium, Chara, Sargassum, Batrachospermum.
- b) Fungi : Phytophthora, Albugo, Peziza, Puccinia, Alternaria.
- c) Lichens : General account and economic importance of

different types.

### **GROUP : 'B'**

Structure, reproduction, classification and phylogeny of

- a) Bryophyta : Marchantia, Anthoceros, Sphagnum.
- b) Pteridophyta : Lycopodium, Selaginella, Equisetum, Marsilea, Rhynia.
- c) Gymnosperm : Pinus

### **GROUP : 'C'**

Taxonomy, Anatomy and Embryology of angiosperms

- 1. TAXONOMY OF ANGIOSPERMS
- a) Classification of angiosperms with special reference to the systems of Bentham and Hooker nomenclature.
- b) Important role of plant nomenclature.
- c) Diagnostic features and economic importance of the following families.

### **Part -I**

#### **Subsidiary**

The examination of each part shall consist of Two papers – Theoretical paper carrying 75 marks of three hours duration and practical paper carrying 25 marks of three hours duration.

### **Part -1**

Time : 3 Hrs.

Full Marks : 75

Paper – 1 (Theory)

Ten questions are to be set and five to be answered. Objective type question number 1 shall include portions of all the three groups and shall be compulsory. Three questions of equal marks are to be set from each group. Examinees shall be required to answer four questions selecting not more than two questions from any group. 25% questions may be repeated.

### **GROUP 'A' : Inorganic**

1. Atomic Structure : Determination of electronic charge and  $e/m$ , Moseley's finding-atomic number – fundamental properties of elements. Bohr's theory of H-atom, interpretation of spectra of H-atom, successes and limitations of Bohr's theory. Bohr's-Sommerfeld theory, shapes of orbitals and their labeling, idea of quantum numbers, Pauli's Exclusion, Principle Hund's rule, Aufbau principle, electronic configuration of elements.

2. Periodic table and Periodicity of properties : The long form of periodic table(s,p,d,f block), detailed study of the following including periodicity; Atomic radii, Ionic radii, Ionization energy, Electronegativity oxidation state.

3. Chemical Bonding : (a) Ionic Bond : energetics involved in ionic bond formation, Born-Haber cycle, Radius ratio rule, different type of crystal lattice Fajan's rule, Ionic potential, Inert pair effect. (b) Covalent bond : Orbital overlap, Hybridization of orbitals and shapes of simple molecules variable covalency, expansion of orbitals, formation of Sigma, Pi, Delta and Tau bonds. Idea of valence bond theory, Vander Waal's force, Hydrogen bond.

4. The Chemistry of individual elements and their compounds including the aspects mentioned below (in groups and periods)-be made with special reference to

- a) Electronic configuration
- b) Oxidation state
- c) Acid-base character
- d) General chemical reaction of the elements and their compounds. Tests for ions and radicals formed by the elements (Shapes of covalent compounds not needed)

Group 1:  $H_2O_2$  preparations, properties, structure, strength.

Group 2 : General group properties of Gr. 2 and 12. Radium occurrence, isolation, properties and uses.

Group 13: Boron –preparation, properties and uses of Boron  $B_2O_3$ ,  $H_3BO_3$  and Borax, Borazine, Diagonal relationship with silicon, hydrides of Boron (non-detailed).

Group 11: Silver and Gold-occurrence, properties uses, metallurgy, comparative study of coinage metals.

Group 14 : Silicon,  $SiO_2$ ,  $SiF_4$ ,  $H_2SiF_6$  Silanes, Silicic acid of coinage metals.

### **Group 'B' : Organic Chemistry**

- 1. Classification and nomenclature of organic compounds.

2. (a) Qualitative and Quantitative analysis of C,H,N,S and halogen in organic compounds.  
(b) Determination of molecular weight of Organic –  
i) Acids by their silver salt and ii) Bases by platonic chlorice method.
3. Shape and Bondin – Tetravalency of carbon, hybridization of carbon, Sigma and Pi bond.
4. Polarisation of covalent bonds – Inductive mesomeric electomeric and Hyperconjugative effects.
5. Bond fision and reaction intermediates : Homolytic and heterolytic bond fission, introduction to reaction intermediates – Formation , stability; shape and some important reactions of carbocations, carbanions, carbenes, nitrenes and carbon radicals.
6. Elementary idea of the following : Electrophile, nucleophile, electrophilic addition and substitution reaction, nucleophilic Substitution reactions (SN1, SN2 reaction), elimination (E1 & E2) reactions.
7. General methods of preparation of compounds belonging to he following groups their important reactions, and their important mechanism :  
a) Alcohols : Primary , secondary and tertiary alcohols, their distinction, Glycerol.  
b) Aldehydes and Ketones : Their comparison, electronic nature of >C=O group.  
c) Carboxylic acids and their derivatives : Origin of acidic properties in Carboxylic Acid group.

### Group 'C' : Physical Chemistry

1. Gaseous state : Kinetic theory of gases, verification of gas Laws, calculation of gas constant and kinetic energy, Maxwell's distribution Law of velocities (derivation not needed), distribution curves at different temperatures, calculation of the most probable, average and root mean square velocities of molecules.
2. Chemical equiliberium : Equiliberium constant for homogeneous and heterogeneous reactions, relationship among Kc , Kp and Kx Lechatelier's principle and its applications.
3. Dilute solution :  
a) Colligative properties, Osmosis and Osmotic pressure, Osmosis and diffusion , Theory of dilute solution application Application of osmotic pressure in molecular weight determination, Abnormal Osmotic Pressure, association, dissociation and Vant Hoff's factor.  
b) Lowering of Vapour Pressure : Raoult's Law, relative lowering of vapour pressure determination of molecular weight.

### PAPER – I ORGANIC PRACTICAL

Time : 3 Hrs.

Full marks : 25

#### GROUP 'A'

1. Detection of Nitrogen, Sulphur and Halogen in organic compounds : [10 Marks]  
a) Phenolic – OH                      b) Aldehydic                      c) Ketonic  
d) Carboxylic                      e) Primary f) Aromatic amino                      g) -NO<sub>2</sub> (aromatic), and  
h) Amide

#### GROUP 'B'

2. Preparation of Pure samples of the compounds (including their mpt. Determination ) using the following reactions : [10 Marks]  
a) Acetylation : Aniline and p-toluidine  
b) Benzoylation : 2-naphthol and p-toluidine  
c) Oxidation : Benzaldehyde  
d) Nitration : Nitrobenzene  
e) Hydrolysis : Ethyl benzoate, Benzamide.
3. Record – Viva. [5 Marks]

Books Recommended :

*Modern Degree Experimental Chemistry : Dr. R. Y. Prasad.*

**M.I.L. BENGALI****PART I**TIME : 1<sup>1/2</sup> Hrs.

Full Marks : 50

Two critical questions one from each book	: 10 x 2
Two explanations one from each book	: 5 x 2
Grammar	: 10
Objective questions	: 10
Total	:50 Marks.

Books Prescribed :

1. Narakbas – R.N. Tagore.
  2. Prabhat Kumar Chhotogalpa ed. By Dr. S.K. Chatterjee & Dr. C.R. Laha.
- Pieces prescribed – The first five stories.  
Grammar – Pray Samochcharita Bhinnarthak Shabda,  
Visistarthaka Bakyagsha.

**ALTERNATIVE ENGLISH**

B.A./B.Sc./B.Com. Part – I

(Pass and Hons.)

Time : 1<sup>1/2</sup> Hrs.

Full Marks : 50

1. Animal Farm : George Orwell,
2. Brighter English by C.E. Eckersley (Orient Longman),  
All the poems except – The Highwayman, are prescribed.
3. One Short Essay.

Division of marks :

1. One question from ‘Animal Farm’ out of 3 to be set, to be attempted (15)
2. One Critical appreciation of a Poem of 3 to be set (15)
3. One Short Essay (not exceeding 400 words) out of 4 topics to be set, to be attempted :  
(20)

**Part – I**

M.I.L. B.Sc. , URDU

There shall be half paper (50 marks) of URDU Composition M.I.L. carrying 50 marks. This paper along with Hindi Composition of 50 marks shall be of three hours’ duration.

The paper will comprise the following :

- a) Objective questions – 5 short answer type questions consisting of 5 marks covering the prescribed pieces both from prose and poetry sections will be compulsory.
- b) Substance of a passage from prose section with an alternative consistin of 10 marks.
- c) Grammar (Jins, Azdad, Mohawarat)- 10 marks.

Three questions, one each or Jins, Azdad and Mohawarat consisting of 8 words .

From Jins and Azdad each and 8 Mohwarat will be asked. The examinees will be required to answer only one question – five words from jins and Azdad each and five Mohawarat divided into 5 marks for definition and 5 for making sentences.

- d) Letter - 5 marks.

Books prescribed :

1. Prose section :
  - a) Asalee-Nasr-by Prof. Abuzar Osmani. Published by Veena Pustak Bhawan, Khazanchi Road , Patna – 800004.
  - b) Boar c) Hemagat d) Dekh Aakar Kooocnae chake gariban ki bahar
2. Poetry section :
  - a) Intekhabe-Mosaddas
  - b) Intekhabe Saqi Nama
  - c) Mustaq bal
  - d) Fasadat
3. Grammar Portion :
  - I. Tara-e-Nigarish
  - IV. Letter – 10 marks.

Altogether 8 short answer type questions (4 from poetry, pieces of prose and 2 pieces of poetry for summary and 2 prose passages for substance, 3 questions on grammar and one question on letter with an alternative will be set.

**Part II**  
**BOTANY (PASS/SUBS.)**  
**Paper II**

This paper setter are to set four questions from each groups out of which the candidates will be required to answer five questions attempting atleast one question from each group.

Group 'A' : Plant Physiology

Full Marks : 75

1. Physiology of the water and mineral absorption.
2. Transpiration – Mechanism of stomatal movement.
3. Photosynthesis – Mechanism and factors.
4. Respiration – Aerobic and anaerobic, glycolysis, Krebs' cycle, Electron transport system.
5. Phytohormones – Auxins, Gibberellins-discovery, structure and roles.
6. Enzyme – nature, mode of action, factors affecting enzyme activities.
7. Growth – general account.
8. Movement – general account.

**ENVIRONMENTAL BIOLOGY**

1. Plant Communities.
2. Ecosystem – grassland, waste and forest.
3. Succession – hydrosere and xerosere.
4. Pollution and its control.

Group 'B' : Microbiology

1. A general account of bacteria, cyanobacteria, virus and their economic importance.
2. Important plant diseases of Bihar : etiology, symptoms and control of the following :
 

(i) Late blight of potato	(ii) Rust of wheat	(iii) Red rot of Sugarcane
(iv) Citrus canker	(v) Tobacco Mosaic Virus.	

Group 'C'

1. Genetics : Mitosis, Meiosis, Mendel's law of inheritance, mutation, Polyploidy and its role in evolution of plants.
2. Economic Botany : Vegetables and Cereals yielding plants of Bihar.

**PRACTICAL : II YEAR (PASS AND SUBSI)**

Time : 4 Hrs.

Full marks : 25

- |   |     |
|---|-----|
| 1. Physiology experiment to be performed by examinee. | (5) |
| 2. Ecology anatomy                                    | (3) |
| 3. Study of vegetation by quadrat method or Mitosis   | (5) |
| 4. Identification of one disease out of three         | (2) |
| 5. Spotting   | (5) |
| 6. Record and viva-voce                               | (5) |

**B.Sc. Part II**  
**CHEMISTRY (Gen./Sub.)**  
**Paper II**

Then questions are to be set and five to be answered. Objective type question no. – 1 shall include portions of all the three groups and shall be compulsory. Three questions of equal marks to be set from each group. Examinee shall be required to answer four questions selecting not more than two questions from any group.

Group 'A'

1. Chemistry of D-Block Elements : ( With special reference to 3-d block elements). Electronic configuration, oxidation state, atomic & ionic radii, magnetic properties, ionization energy, colour of ions, complex formation & catalytic properties.
2. Coordination compound : Double salt & coordination compounds, Nomenclature, systematic approach to coordination compounds with special reference to cobalt ammines, Werner's theory, Elementary idea of Isomerism, Sidgwick EAM concept, Valence band theory.
3. Chemistry of the following transition elements : Chromium manganese, cobalt & nickel.
4. Sulphur : Sodium Thio sulphate, Peroxy acids of Sulphur & their Salt.
5. General discussions of Halogens, Oxides & oxy acids of chlorine, Chemistry of fluorine & HF.

### Group 'B'

1. Stereo isomerism – Geometrical Isomerism, optical isomerism, enantio & diastereomer, meso & racemic mixture.
2. Carbohydrates – Classification, nomenclature, open chain structure, reactions, conversions & tests of glucose & fructose, Estimation of glucose. Inadequacy of open chain structure, mutarotation, Mention of Pyranose & furanose forms, Establishment of configuration of asymmetric carbons of glucose.
3. Aromatic – Concept of aromaticity, general methods of preparation & properties of monosubstitution products of arene, methyl, chloronitro, amino, diazo, hydroxy, keto, carboxy, formyl & sulhonic acid derivatives of benzene.
4. Elementary – Idea of Electrophilic substitution in Benzene ring : Mechanism of nitration, sulphonation and chlorination reaction. Directive influence of  $-OH$ ,  $-Cl$ ,  $-CH_3$  and  $-NO_2$ .
5. Reactions – Statement and mechanism of the following reactions : Aldol Condensation, Perkin reaction, Claisen condensation and Knoevenagel reaction, Hofmann's bromamide reaction, Friedel Crafts reaction, Reimer-Tiemann reaction, Cannizzaro's reaction, Benzoin condensation, Sandmeyer's reaction, Cumyl hydroperoxide rearrangement.

### GROUP 'C'

#### PHYSICAL

1. Chemical Kinetics : Rate of reaction, order and molecularity of reaction, Expression for specific rate constant of 1<sup>st</sup> and 2<sup>nd</sup> order reactions, half-life time, units of K. Determination of order reaction, energy of activation, Arrhenius equation, determination of energy of activation.
2. Gaseous state : Real gases, compressibility factor, deviation from ideality, Vander Waal's equation of state and its application to the calculation of Boyle's temperature and molecular diameter, intermolecular forces and liquifaction of gases, critical states, relationship between critical constant and Vander Waal's constants. Continuity of state, law of corresponding states, derivation of reduced equation state.
3. Conductance : Strong and weak electrolytes, electrolytic conductivity, specific conductivity, equivalent conductivity and molecular conductivity, dilution, effect of dilution on different types of conductivities and their measurement Kohlrausch's Law, Ionic equilibria, Ostwald's Dilution Law, Application of conductance of determining solubility product, degree of ionization, ionic product of water and hydrolysis constant. Conductometric titrations.
4. Electrochemical cells – Reversible and irreversible electrodes, Galvanic cells, Electrode potential, Nernst equation, Electrochemical series, Determination of electrode potential. Concentration cell-definition, classification, working or concentration cells and their uses.
5. Catalysis : Characteristics of catalysis, acid-base catalysis, Theory of catalysis, Auto Catalysis Enzyme catalysis.

### Part II

(Subsidiary and General)

Time : 3 Hrs.

**Practical**

Full marks : 25.

1. Qualitative inorganic analysis of mixtures containing four radicals.

Basic radicals :  $Ag^+$ ,  $Cu^{++}$ ,  $Bi^{+++}$ ,  $Fe^{++}$   
 $Fe^{+++}$ ,  $Al^{+++}$ ,  $Cr^{+++}$ ,  $Co^{++}$   
 $Zn^{++}$ ,  $Ba^{++}$ ,  $Sr^{++}$ ,  $Mg^{++}$

$Na^+$ ,  $K^+$ ,  $NH_4^+$   
 $-Cl$ ,  $-Br$ ,  $I$

3 + 3 = 6

Acid radicals :  $CO_3^{--}$ ,  $SO_4^{--}$ ,  $NO_3^{--}$  2+2=4

### GROUP 'B'

2. Volumetric analysis :
  - a) Preparation of standard solutions
  - b) Acidimetry and alkalimetry :  $Na_2CO_3 + NaHCO_3$  mixture, their percentage determination,  $Na_2CO_3 + NaOH$  mixture. Their percentage determination, determination of equivalent weight of oxalic acid and Mg.
  - c) Oxidation-reduction Titration : Using  $KMnO_4$  – Estimation of iron in Mohr's salt. Estimation of  $H_2SO_4$  and Oxalic acid in their mixture.

Using  $K_2Cr_2O_7$  : Iron in Mohr's salt.  
Using sodium thiosulphate –  $Cu^{++}$  in a solution.

### OR

Gravimetric estimation of Cl;  $SO_4^{--}$  in soluble salt solution. (10)

3. N. B. & Viva (5)  
B.A./B.Sc./B.Com. Part II  
BENGALI

M.I.L. Bengali : Two Critical Questions one from each Book  
(10 x 2 = 20)

Two explanations one from each Book

(5 x 2 = 10)

One short essay

(10)

Objective questions

(10)

Book Prescribed :

1. Karna-Kunti Sanbad – R.N. Tagore
2. Prabhat kumar Chhotagalpa - Ed. By S.K. Chattarjee & Dr. C.R.
3. Pieces prescribed - last five stories.

B.A./B.Sc./B.Com. Part II

ENGLISH (M.I.L) Alternative English

Time : 1.30 Hrs.

Full Marks : 50.

1. Brighter English - C.E. Echersley (O.L.)
  - a) The following short stories are prescribed :
    - I. Somerset Maugham – The Luncheon.
    - II. Jerome K. Jerome – The Dancing Partner
    - III. Oscar Wilde - The Happy Prince.
    - IV. H.G. Wells – The Pearl of Love.
  - b) All four plays are prescribed.

2. Meaning of an unseen prose / verse passage

Division of marks :

- (18) i) One question from short stories , out of 3 to be set, to be attempted.
- ii) One question or the One-Act Plays compiled in ‘ Brighter English’, out of 2 to be set , to be attempted.  
(18)
- iii) Meaning of an unseen passage, to be set (One each from poetry and prose.)  
(14)

B.Com./B.Sc./B.A. Part – II

M.I.L. (URDU)

For All Faculties : 50 Marks.

There shall be 3 half paper of Urdu Composition (M.I.L.) carrying 50 marks. This paper along with hindi Composition of 50 marks shall be of 3 hours duration.

The paper will comprise the following :

1. Objective question – five objective questions consisting of 5 marks covering the prescribed pieces both from prose and poetry sections will be compulsory.
2. Summary or a piece of prose or poetry of 15 marks from the prescribed text books with alternative inclusive of question from prose and poetry sections will be compulsory.
3. Substance of a passage from prose section with an alternative consisting of 10 marks.
4. Essay – 20 marks.

An essay choosing anyone of the 4 topics given Literary , Informative and biographical.

Books Prescribed

1. ORISS SECTUIB :  
Asaleeb-e Nasr Abuzar Usmani, Published by Veen Pustak Bhavan, Khzanchi Road , Patna – 800004.

Prose pieces to be studied –

Bachelor of Arts, Mohmmmad Ali, Sudhaya huakutta,  
Lahor Ka Jo Zikar Kiya, Main-n a America Ko Kaissapaya.

**2. POETRY SECTION :**

Poems to be studied  
Noqoosn-e-Adao.

1. Lazzat-se naihinknati-Meer
2. Arz-O-Same Kahan teri-Dard

3. Dard minnat kasha dawe na hua-ghalib
4. Ta khaob Marge-zikar. Rasikh Azimabadi.

Altogether 8 short answer type question ( 4 from prose section and 4 from poetry section) 2 pieces of prose and 2 pieces of poetry for summary 2 prose passages for substance and 4 essays will be set.

\*\*\*\*\*THE END\*\*\*\*\*