DEPARTMENT OF BIO-TECHNOLOGY

MIRZA GHALIB COLLEGE,GAYA

(MAGADH-UNIVERSITY BODH-GAYA)

SYLLABUS

B.Sc.(Hons.)Bio-Technology

Part - I

(URDU COMPOSITION- 50 MARKS)

There shall be half paper of Urdu composition and shall carry 50 marks. This paper along with Hindi composition of 50 marks shall be of three hours duration.

Distribution of Marks:

(a) Summary and substances of text prescribed - 30 marks.

(1) Question of marks each one from prose selection and one from poetry selection will be compulsory.

(b) Essay 10 marks (c) Grammar (Azdad. Gins, Mohavrat - 10 marks.)

Books Prescribed.

(a) Sarmaya-e-Adab by Prof. Mumtaz Ahmad, Dr. Aslam Azad, Dr. Ajaj Arshad, Dr. I.Raza

(b) Tarz-e-Nigarish by Sachidanandan Sinha.

BOTANY (Subsidiary Course)
(Theory)

Time - 3 Hours Full Marks- 75

(Microbiology, Thallohyta, Bryophyta, Pteridophyta, Gymnosperms, Cytology. Genetics and Economic Botany.)

A total of ten questions to be set out of which candidates are required to answer five questions.

1. A general account of Bacteria, Viruses and their economic importance.

Role of Microbes in Fermentation and Nitrogen Fixation.

2. Structure, function & diagnostic features of Algae, Fungi and Lichens based on the types wherever mentioned. The developmental cycles on comparative bases should reflect evolutionary sequence: The students should be acquainted with economic importance of these groups.

Thallophyta :

Algae - Nostoc, Oedogonium, Chara, Vaucheria, Fucus and Batrachospermum

Fungi - Albugo, Peziza, Puccinia

Lichens - General account and economic importance.

Bryophyta: Marchantia, Anthoceros and Sphagnum.

Pteridophya: Selaginella, Equisetum and Marselia

Gymnosperms: Pinus.

Cytology, Genetics and plant breeding.

(a) Structure of the cell as seen under Electron Microscope.

(b) Mitosis and Meiosis.

(c) Structure of Chromosome, Crossing over, Mutation.

(d) Nature, structure and replication of genetic material (DNA)

Economic Botany: Botany of under noted plants belonging to the following groups:

(a) Cereals - Wheat, Maize and Rice

(b) Oils - Mustard, Ground nut, Linseed

B.Sc Part -I (Subsidiary Course & Composition)

स्नातक परीक्षा अनिवार्य-पत्र हिन्दी रचना (हिन्दी भाषियों के लिए)

पूर्णांक - 100

समय - 3 घंटे

(अ) पद्य एवं गद्य- 80 अंक (आ) हिन्दी व्याकरण 15 अंक (इ) वाक्य संशोधन, मुहावरे लोकोक्तियों 5 अंक।

निर्धारित पाठ्य ग्रन्थ :-

(क) काव्य के सोपान - स०डॉ० लक्ष्मण प्र०सिन्हा अथवा सरल हिन्दी काव्य-स०डॉ० नेपालनाथ मिश्र।

(ख) कथान्जली-स०डॉ०सत्यदेव नारायण शर्मा
निर्धारित कहानियाँ - उससे कहा था, सच का सौदा, मूर्ख क्रोध, सुभान खाँ, सती, संबंध अथवा कथा पथ - राम विनोद सिंह

(ग) सप्त तरंगिनी - स०डॉ०दिवाकर अथवा गद्य के रूप डॉ० वंशीधर लाल।

(घ) हिन्दी व्याकरण - 15 अंक।
लिंग, वचन, कारक, सन्धि, समास, उपसर्ग, प्रत्यय, वाक्य शोधन, मुहावरे, लोकोक्तियाँ - 5 अंक।

HINDI COMPOSITION (50 MARKS)

अनिवार्य पत्र हिन्दी रचना (अहिन्दी भाषियों के लिए)
(पास तथा ऑनर्स दोनों वर्गों के लिए)
अंकों का विभाजन

पूर्णांक - 50

(अ) खण्ड काव्य-कर्ण- केदार नाथ मिश्र 'प्रभात' 10 अंक

(आ) गद्यगवाक्ष-सं०डॉ०दिवाकर 10 अंक

(इ) व्याकरण - संज्ञा, सर्वनाम, कारक के भेद, क्रिया और वचन 10 अंक

(ई) रचना, लिंग-निर्णय, लोकोक्तियाँ, वाक्य शोधन, विपरीतार्थक शब्द। 15 अंक

(e) Beverges - Tea.
(f) Drugs - Rauwolfia
(g) Fibres - Cotton and Jute.

BOTANY (Subsidiary Course)
(Practical)

Time - 3 Hours

Full Marks- 25

1. Morphological and Structural details of Algae, Fungi and Bryophytes included in the syllabus and their temporary stained microscopic- slide preparation.
2. Morphological and Anatomical study of Pteridophytes/Gymnosperms included in the syllabus and their microscopic slide preparation (Temporary/Permanent).
3. To identify and comment upon spots.
4. Class record.

Chemistry (Subsidiary Course)
(Theory)

Time- 3 hours

Full marks - 75

questions will have to be answered selecting at least one question and not more than two from group. Four questions will be set from each group.

GROUP-A

PHYSICAL CHEMISTRY

1. (a) **Gaseous State** - Kinetic theory of gases, derivation of kinetic gas equation, deduction of gas laws, calculation of gas constants and kinetic energy.
(b) ***Types of solid*** - Crystal forces, law of constancy of angles, seven crystal systems, law of rational indices, Bragg's law, Latice Energy, Born Haber Cycle.
Thermochemistry: Heat in Chemical reactions, reaction enthalpy, standard enthalpy, changes, Hess Law, Kirchoff's Law, Bond energies and determination.
Ionic Equillibrium : Ionic product of water. pH, pK_a, pK_b and pK_w. Buffer solution. Idea of role of buffer solution in day to day life.
Solubility product and its applications in salt analysis. Common ion effect.
Conductance, specific, equivalent and molar.
(a) **Chemical Kinetics :** Rate of reaction, order of reaction, molecularity, expression for specific rate constant of first order reaction, half life period, unit.
(b) **Colligative Properties :** Colligative properties, Osmosis, Osmotic pressure and its detemination, Vapour pressure, Roult's law of lowering of vapour pressure. Relation between osmotic pressure and lowering of vapour pressure.

Bio-Technology
Paper I (75 Marks)

Biochemistry

- Introduction to Biochemistry
- Nature of Biological material
- Brief mention of various micro and macro compounds
- General properties of organic and inorganic compounds
- Molecules involved in generation of mechanical stability : peptidoglycans, polysaccharides and membrane lipids
- Molecules involved in information storage and retrieval : nucleic acids
- Molecules executing mediator and catalytic functions : the proteins
- The signal molecules.
- Enzymes : Introduction, classification, protein and non-protein enzymes, role of enzymes in biosynthetic and degradative cellular functions, mechanism and mode of action of enzymes, inhibition and regulation of enzyme action, Enzyme Kinetics.
  In vitro activity of purified enzymes, application of enzymes in industry, food processing and medicine.

Cell Biology

- Cells as basic unit of living systems. The cell theory.
- Precellular evolution. : Artificial creation of cells.
- Broad classification of cell types : PPLOs, 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.
- Ecological amplitude of cell in high altitude, Sediments, arctic, hot spring, arid, brackish and fresh water enviroments. :
- Biochemical composition of cells : Proteins, Lipids, Carbohydrates, nucleic acids and the metabolic pool.
- Ultra structure of the cell membrane.
- Structure and function of cell organelles, Ultra structure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.) Mitochondria, chloroplast, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin). Chromosome
- Cell - cell interaction.
- Cell locomotion. : amoeboid, flagellar and ciliar.
- Muscle and nerve cells
- Cell senescence and death
- Cell differentiation in plants and animals

Microbiology

- Development of Microscopy (Optical, TEM and SEM)
- Contribution of eminent microbiologists.
- Concept and methods of sterilization.

GROUP-B
INORGANIC CHEMISTRY

1. **Atomic Structure and Bonding :** Features of H-spectra and Bohr's theory, shapes of orbitals and their labellings, idea of quantum numbers, Pauli's exclusion Principle, Hund's rules. Aufbau principle, Electronic configuration of elements.
Idea of Ionic and covalent bonds, Ionisation potential, E.N.(Electro Negativity) and E.A,(Electron affinity) Fajan's rule.
2. Chemistry of the following elements : Li, Sn, Fluorine, Chlorine, Iodine.
3. Prinicple involed in the volumetric and gravimetric estimations of Cu++ and iron.
4. Isotopes : Brief idea of detection and separation, tracer techniques, radio carbon dating.

GROUP-C
ORGANIC CHEMISTRY

1. Structure and Mechanism : Hybridization, Bond angle, bond length, idea of sigma and pie bonds, inductive effect, electromeric effect and iosomeric effect, bond fission and fission products, elementary idea of reagents and types of reactions.
2. Nomenclature : Acquaintance with IUPAC nomenclature of aliphatic and aromatic compounds.
3. (a) Alcohols -monohydric.
(b) Grignard's reagent.
4. Idea of purification of compounds, criteria of purity, Chromatography.

CHEMISTRY (SUBSIDIARY COURSE)
PRACTICAL

TIME - 3 HOURS FULL MARKS- 25

1. Volumetric Analysis:
(a) Acidimetry and alkalimetry
(b) Use of $KMnO_4$ & $K_2Cr_2O_7$, Iodometry.

2 Organic Detection : Detection of N,S, halogen in Organic Compounds.
Detection of the following functional groups of organic compounds
(i) Phenolic (-OH) (ii) -CHO (iii) -C=O (iv) -COOH
(V) $-NH_2$ and (vi) $-NO_2$ (aromatic).
3. Record of class work and viva-voce.

****

DEPARTMENT OF BIO-TECHNOLOGY

MIRZA GHALIB COLLEGE,GAYA

(MAGADH-UNIVERSITY BODH-GAYA)

SYLLABUS

B.Sc.(Hons.)Bio-Technology

Part - II

(b) Idea of complex formation: double salts and complexes. Werner's postulates.

2. Introductory transition metal chemistry:
General features including variable oxidation states, idea of complexes, magnetism of transition metals.

3. Chemistry of group 14 elements: C, Si, basic introduction to fullerenes and zeolites, idea of major chemical pollutants in environment.

4. Chemistry of the following elements and their important compounds:
(a) Fe, Co, Ni. (b) Cr (c) Mn

Group C (Organic Chemistry)

1. Structure and mechanism:
Different types of isomerism, idea of E-Z notations, electrophilic substitution in benzene nucleus and mechanism of nucleophilic substitution at saturated carbon (general idea).

2. Natural products:
(a) Carbohydrates: nomenclature, classification, non-detailed structure of glucose and fructose, elementary idea of glycosides.
(b) Elementary idea of alkaloids and terpenes (no structural elucidation needed).

3. (a) Structure of benzene, preparation and uses of benzene diazonium chloride
(b) Lactic acid, citric acid.

4. (a) Test of common functional groups.
(b) Brief idea of polymers, resins, proteins and sulfa drugs.

Chemistry practical (25 marks)

Group A: 12 marks

1. Qualitative inorganic analysis of mixture containing four radicals.
Basic radicals: Ag^{+}, Hg_2^{+2}, Pb^{+2}, Cu^{+2}, Hg^{+2}, Bi^{+3}, Cd^{+2}, Sb^{+3}, Sn^{+2}, Sn^{+4}, Fe^{+2}, Fe^{+3}, Al^{+3}, Cr^{+3}, Ni^{+2}, Co^{+2}, Zn^{+2}, Mn^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+}
Acid Radicals: CO_3^{-2}, SO_3^{-2}, S^{-2}, SO_4^{-2}, NO_2^{-}, NO_3^{-} and halides.

Group B: 8 marks

2. Organic preparation: Preparation of organic compounds by using the following reactions:
(a) acetylation of aniline and p-toluidine.
(b) nitration of nitrobenzene.
(c) oxidation of benzaldehyde.
(d) hydrolysis of esters like ethyl benzoate and methyl salicylate.

3. Record of Class – Work and Viva – Voce.

Botany Practical (25 marks)

1. To comment upon a plant physiology experiment set up from the following experiments (5 marks)
   (a) T / A ratio
   (b) Ganong's potometer: rate of transpiration
   (c) Farmer's potometer: rate of transpiration
   (d) Unequal transpiration by $CaCl_2$ method
   (e) Oxygen evolution during photosynthesis
   (f) Rate of photosynthesis by Wilmott's bubbler
   (g) Moll's experiment
   (h) Anaerobic respiration
2. Description and identification of plants of families studied (5 marks)
3. Microscopic preparation of anatomical specimens (5 marks)
4. To identify and comment upon spots covering the courses (5 marks)
5. Practical record based on class work and field studies (5 marks)

Chemistry II Theory (75 marks) = CHEMISTRY =

Group A (Physical chemistry)

1. States of Matter

(a) Gaseous state:

Vander Wall equation (no derivation), critical constants, collision number, collision frequency, mean free path.

(b) Solid state:

Bravais lattices and lattice planes, elementary idea of types of lattices, stoichiometric and non-stoichiometric defects in simple ionic solids.

2. Thermodynamics

Definitions of terms: system, extensive, intensive properties, first and second law of thermodynamics, Carnot theorem and Carnot cycle.

3. (a)Ionic equilibrium: Ostwald's dilution law, conductance measurement of dissociation constant of acetic acid, salt hydrolysis, idea of theory of acid-base indicators.

(b)Phase rule: Terms, equation (no derivation required), H_2O system, S-system.

4. Chemical kinetics:

Second order reaction, expression for specific rate constant of second order reaction, half life period and its unit, effect of temperature on reaction rate, Arrhenius equation, idea of catalytic activity at surfaces and catalytic processes such as hydrogenation, oxidation, cracking and reforming.

Group B (Inorganic chemistry)

1. (a) Atomic structure and bonding;

Idea of duality and matter waves, de Broglie relation, Schrodinger equation (no derivation) and idea of its applications, idea of orbital overlap hybridization of orbitals, Vander Wall forces, metallic bonding.

B.Sc. Part II Hons.

Botany II Theory (75 marks)

Students are required to answer two questions from group A and group B each and one from group C out of total ten (four from group A and Group B each and two from group C).

Group A: (Angiosperms)

(A) Morphology and taxonomy: Importance of classification of angiosperms with reference to Bentham and Hooker and Hutchinson systems. Naming of genus and species. Diagnostic features, affinities and economic importance of *Ranunculaceae, Cucurbitaceae, Euphorbiaceae, Amranthaceae, Acanthaceae, Lamiaceae, Apocynaceae, Poaceae* and *Cyperaceae.*

(B) Anatomy: Cell structure and tissue systems. Meristems. Root stem transition Initiation and activity of cambium including abnormal behaviour, primary and secondary growth in roots and stems.

(C) Embryology: Life cycle of a typical flowering plant based on the major events in the development of anther, microspore, ovule, embryo sac, fertilization, endosperm, embryo and seed.

Group B: (Plant physiology)

- Water relation, absorption of water and salts
- Transpiration
- Mineral nutrition -- role of major and minor elements
- Enzymes – nature properties and classification
- Photosynthesis – photophosphorylation, Calvin cycle and factors affecting photosynthesis
- Translocation of organic substances
- Respiration – glycolysis, Krebs' cycle and factors affecting respiration
- Nitrogen metabolism – nitrogen fixation and protein synthesis

Group C (Environmental biology)

- Pollution
- Soil – types, water holding capacity, reclamation
- Plant communities and ecosystem
- Succession (Hydrosere and xerosere)

B.Sc. Part II Hons.

Paper III (75 Marks)

Molecular biology:

- Molecular basis of life.
- Structure of DNA.
- DNA replication in prokaryotes and eukaryotes.
- DNA recombination molecular mechanisms in prokaryotes and eukaryotes.
- Insertion elements and transposons.
- Structure of prokaryotic genes.
- Prokaryotic transcription.
- Prokaryotic translation.
- Prokaryotic gene expression (lac, *his*, *trp*, catabolic repression)
- Structure of eukaryotic genes.
- Eukaryotic transcription.
- Eukaryotic translation.
- Eukaryotic gene expression. Transcription factors and translation factors
- Gene expression in yeast.
- Gene expression in protozoan parasites
- Gene organization and expression in mitochondria and chloroplasts.
- Post translation regulation of gene expression.
- Developmental and environmental regulation of gene expression.

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 and c-DNA, RT enzymes and other reagents techniques. laboratory requirement.
- Safety measures and regulations for recombinant DNA work.
- Choice and selection of the tools and techniques.
- Vehicles: Plasmids and bacteriophages, available phagemids, cosmids viruses.
- Purification of DNA from bacterial, plant and animal cells.
- Manipulation of purified DNA.
- Introduction of DNA into living cells.
- Cloning vectors for *E.coli*
- Cloning vectors for organisms such as yeast, fungi, for plants – *Agrobacterium* sps. And plant viruses, animal viruses.
- Application of cloning in gene analysis (How to obtain a clone of a specific gene? Studying gene location and structure, studying gene expression).
- Gene cloning and expression of foreign genes in research and biotechnology (Production of protein from cloned genes).
- Gene cloning in medicine (Pharmaceutical compounds, artificial insulin gene recombinant vaccine, diagnostic reagents).

B.Sc Part III Hons.

Paper V (100 marks)

ANIMAL CELL CULTURE :

- History of development of cell cultures
- The nature surroundings of animal cells
- Metabolic capabilities of animal cells
- Simulating natural condition for growing animal cells
- Importance of growth factors of the serum
- Primary cultures anchorage dependence of growth. Non-anchorage dependent cells
- Secondary cultures Transformed animal cells Established/continuous cell lines
- Commonly used animal cell lines - their origin and characteristics
- Growth kinetics of cells in culture
- Application of animal cell culture for studies on gene expression/Organ culture
- Transfection of animal cells Selectable markers HAT selection ant biotic resistance etc
- Cell fusion
- Transplantation of cultured cells
- Differentiation of cells

ANIMAL CELL BIOTECHNOLOGY :

- General metabolism
- Special secondary metabolites/products insulin growth hormones interferon t-plasminogen activator factor VIII etc.
- Expressing cloned proteins in animal cells over production and processing of chosen protein
- The need to express in animal cells
- Production of monoclonal antibodies
- Growth factors promoting proliferation of animal cells EFG, FGF, PDGF, IL-1, IL-2, NGF erythroprotein etc.
- Bioreactors for large scale culture of cells
- Transplanting cultured cells

Paper - VI (100 marks)

PLANT BIOTECHNOLOGY :

- Introduction to in vitro methods Terms and definitions Use of growth regulators (Auxin, Gibberellin, Cytokinin)
- Beginning of in vitro cultures in our country ovary culture in vitro, pollination and fertilization
- Embryo culture, embryo rescue after wide hybridization and its application
- Introduction to processes of embryogenesis and organogenesis and their practical applications
- Clonal multiplication of elite species (micropropagation), axillary bud, shoot tip and meristem culture
- Haploids and their applications. Somacional variations and applications (Treasure your exceptions)
- Endosperm culture and production of triploids
- Practical applications of tissue and organ culture (summarizing the practical application of all the above techniques)
- Single cell suspension cultures and their applications in selection of variants / mutants with or without mutagen treatment (of haploid cultures preferably)
- Introduction to protoplast isolation principles and applications

Paper VII (*100 Marks*)

Environmental Biotechnology:

- Renewable and non-renewable resources
- What is renewable should be bioassimilable / biodegradable
- Major consumer items: food, fuel and fibers
- Conventional fuels and their environmental impact: firewood, plant / animal wastes, coal, gas and animal oils

Modern fuels and their environmental impact: methanogenic bacteria and biogas, microbial hydrogen production, conversion of sugar to ethanol, the gasohol experiment, solar energy converters -- hopes from the photosynthetic pigments, plant based petroleum industry, cellulose degradation for combustible fuel

Biotechnological inputs in producing good quality natural fibers: transgenic sheep and transgenic plants

Microbiological quality of food and water

Treatment of municipal waste and industrial effluents

Degradation of pesticides and other toxic chemicals by microorganisms

Thuringiensis toxin as natural pesticide

Biological control of other insects swarming the agricultural fields

Enrichment of ores by microorganisms

Biofertilizers. Nitrogen fixing microorganisms enrich the soil with assimmilable nitrogen

Paper VIII -- Practicals (*100 Marks*)

Molecular & Cellular Biology:

- Separation of cell types from blood

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

- Mechanical rupture of cells: Ultrasonic vibrations, French pressure cell followed by centrifugation for cell organelles
- Separation of 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

- Initiating plant tissue culture: dedifferentiation of explants
- Growth of plant cell into undifferentiated mass .
- Large cultivation of plant cells in suspension
- Induction of differentiation by modulating the hormonal balance
- Culture of lymphocytes from blood samples: Preparation of media, filter sterilization, monitoring microbial contamination (bacteria, fungi and mycoplasma), cloning of animal cells by cell and colony purification
- Fusion of cultured cells with myeloma cells
- Production of monoclonal antibodies at a large scale
- Demonstration / operation of large scale fermenters