# B.Sc Biotechnology: Choice based Credit System

**SEE: Semester End Examination**

| Semester | Course Code | Title of course | Number of Credits | Number of teaching hrs | Marks | | |
|---|---|---|---|---|---|---|---|
| | | | | | Internal | SEE | Total |
| I | BT 101 | Microbiology and cell biology | 4 | 4 | 25 | 75 | 100 |
| I | BT 102 | Microbiology and cell Biology Lab | 2 | 3 | 25 | 75 | 100 |
| II | BT 201 | Biochemistry | 4 | 4 | 25 | 75 | 100 |
| II | BT 202 | Macromolecules and enzymology | 2 | 3 | 25 | 75 | 100 |
| III | BT 301 | Biophysical Techniques | 4 | 4 | 25 | 75 | 100 |
| III | BT 302 | Biochemistry and Biophysical Techniques | 2 | 3 | 25 | 75 | 100 |
| IV | BT 401 | Immunology | 4 | 4 | 25 | 75 | 100 |
| IV | BT 402 | Immunology Lab | 2 | 3 | 25 | 75 | 100 |
| V | BT 501 | Genetics and Molecular Biology | 4 | 4 | 25 | 75 | 100 |
| V | BT 502 | Gene expression and RDNA Technology | 4 | 4 | 25 | 75 | 100 |
| V | BT 503 | Molecular biology and RDNA technology | 2 | 3 | 25 | 75 | 100 |
| VI | BT 601 | Applications of Biotechnology | 4 | 4 | 25 | 75 | 100 |
| VI | BT 602 | Plant and Animal Biotechnology | 4 | 4 | 25 | 75 | 100 |
| VI | BT 603 | Animal, Plant, environmental, Industrial Biotechnology or Dissertation | 2 | 3 | 25 | 75 | 100 |

**BIOTECHNOLOGY**
**B. Sc. Semester Syllabus**
**Semester based credit system(CBCS)**
**B. Sc. Part II – Semester I**
**BIOTECHNOLOGY**
**(With effect from academic session 2015-16)**

1) The examination shall comprise one theory paper, an Internal assessment and a practical, in each semester up to fourth semester. Each theory paper shall be of three hours duration and carry 100 marks. The practical shall be of 6 hours duration and carry 100 marks. Internal assessment shall carry 25 marks.

| | |
|---|---|
| Theory Paper (Semester end examination, SEE) | 75 marks |
| Practical (Semester end examination, SEE) | 75 marks |
| Internal Assessment theory | 25 marks |
| Internal Assessment practical | 25 marks |
| | --- |
| | Total - 200marks per seven credits |
| | Or 300 marks per 11 credits |
| | --- |

2) The distribution of marks in practical shall be as follows.

| | |
|---|---|
| [A] Experiments (SEE) | 75 marks |
| [B] Practical record | 10 marks |
| [C] Viva | 05 marks |
| [D] Internal experiments | 10 marks |
| | --- |
| | Total - 100 marks |
| | --- |

3) The syllabus is based on four theory periods and three practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be two internal assessments based on theory paper for 25 Marks each. The average of the two tests shall made to average of 25 marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
6) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.
9) In the fifth and sixth semesters two theory courses and one practical course shall be opted by the students. The practical course shall consist of experiment of two theory courses.

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**B. Sc. I – SEMESTER I -**
**BT 101 MICROBIOLOGY AND**
**CELL BIOLOGY**

**UNIT I**

**History, Development and Microscopy**

History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner.

Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance, principles and applications of dark field, phase contrast, fluorescent microscopy.

Electron microscopy: Principle, ray diagram and applications, TEM and SEM, comparison between optical and electron microscope, limitations of electron microscopy.

Stains and staining procedures: Acidic, basic and neutral stains, Gram staining, Acid fast staining, Flagella staining, Endospore staining.

**UNIT II**

A. **Bacteria:**

Bacterial morphology and subcellular structures, general morphology of bacteria, shapes and sizes, generalized diagram of typical bacterial cell.

Slime layer and capsule, difference between the structure, function and the position of the two structures.

Cell wall of gram +ve and Gram -ve cells.

General account of flagella and fimbriae.

Chromatin material, plasmids; definition and kind of plasmids (conjugative and non-conjugative) F, R, and Col plasmids.

Endospores: Detailed study of endospore structure and its formation, germination, basis of resistance.

B. **Viruses**: General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids, phage and animal cell viruses, example of each and their importance. Brief idea of lytic cycle and lysogeny.

**UNIT III**

Nutrition: Basic nutritional requirements: Basic idea of such nutrients as water, carbon, nitrogen, sulfur and vitamins etc., natural and synthetic media, nutritional classification of bacteria. Selective and Differential media, Enriched media, Enrichment media.

**UNIT IV: Microbial growth and control**:

Growth: Growth rate and generation time, details of growth curve and its various phases.

Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat). Measurement of growth.

Physical conditions required for growth: Temperature (classification of microorganisms on the basis of temperature requirements), Ph etc. Pure cultures and cultural characteristics. Maintenance of pure culture.

Microbial Control: Terminologies - Sterilization, disinfection, antiseptic, sanitization, germicide, microbistasis, preservative and antimicrobial agents.

Mechanism of cell injury: Damage to cell wall, cell membrane, denaturation of proteins, inhibition of protein synthesis, transcription, replication, other metabolic reactions and change in supercoiling of DNA.

Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), dessication, surface tension, osmotic pressure, radiation, UV light, electricity, ultrasonic sound waves, filtration.

Chemical control: Antiseptics and disinfectants (halogens, alcohol, gaseous sterilization.

Concept of biological control.

**UNIT V Cell Biology**

Eukaryotic Cell - Structure and function of the following: nucleus, nuclear membrane, nucleoplasm, nucleolus, golgi complex, endoplasmic reticulum, lysosomes, peroxisomes, glyoxisomes and vacuoles.

Plant cell wall.

Cytoskeleton (actin, microtubules) and cell locomotion.

Mitosis and meiosis. Brief idea of cell cycle..

Cell and its life cycles: Mitosis and meiosis

**B.Sc. I**

**SEMESTER I PRACTICALS**

**Biotechnology**

**102 Microbiology & Cell Biology**

1. Demonstration, use and care of microbiological equipments.
2. Preparation of media, sterilization and isolation of bacteria.
3. Isolation of Bacteriophage from sewage / other sources.
4. Demonstration of motility of Bacteria.
5. Simple staining of bacteria
6. Gram staining of Bacteria
7. Acid fast staining of Bacteria
8. Endospore staining.
9. Demonstration of starch hydrolysis by bacterial cultures
10. Growth of fecal coliforms on selective media.
11. Isolation of pure culture by pour plate method
12. Isolation of pure culture by streak plate method.
13. Anaerobic cultivation of microorganisms.
14. Cultivation of yeast and moulds.
15. Antibiotic sensitivity assay.
16. Oligodynamic action of metals.
17. To study germicidal effect of UV light on bacterial growth.
18. Stages of mitosis.
19. Stages of meiosis.

**Note: - Mandatory to perform at least ten practical.**

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**B. Sc.I – Semester II**

**BT 201 Biochemistry**

**UNIT I**

**Nucleic Acids and Chromosomes**

Chemical structure and base composition of nucleic acids, Chargaff's rules, Watson Crick Model (B-DNA), deviations from Watson-Crick model, other forms of DNA (A- and Z-DNA), forces stabilizing nucleic acid structures, (hydrogen bonds and hydrophobic associations, base stacking). Maxam and Gilbert DNA sequencing, structure of t-RNA.

Chromatin structure: Nucleosome structure (10 nm fibre, experiments leading to discovery of nucleosomal structure, types of histones,. Role of telomere and centromere, telomeric and centromeric repeat sequences.

**UNIT II**

**Amino acids and Proteins**

Amino acids: Structure of amino acids occurring in proteins, classification of amino acids (pH based, polarity based and nutrition based), Physico-chemical properties of amino acids (solubility, boiling and melting points, reactions like Edman's, Sanger's, Dansyl chloride, ninhydrin). Titration curves of neutral, basic and acidic amino acids.

Primary structure of proteins: Determination of primary structure (end group analysis, cleavage of disulfide bonds, amino acid composition, use of endopeptidase specificity, sequence determination, assignment of disulfide position).

Secondary structure of proteins: The $\alpha$-helix, $\beta$-structures (parallel, antiparallel, mixed, $\beta$-turn).

Tertiary structure of proteins: Forces that stabilize the structure (electrostatic forces, hydrogen and disulfide bonds, hydrophobic associations), myoglobin as an example of tertiary structure, concept of domains, protein denaturation.

Quaternary structure of proteins: Forces stabilizing quaternary structure, advantages of oligomeric proteins.

**UNIT III:**

**Carbohydrates**

Definition, classification, nomenclature of carbohydrates, structures of monosaccharides, disaccharides and polysaccharides (structures of starch and glycogen as examples of homopolysaccharides). Concept and examples of heteropolysaccharides. Outlines of metabolism of carbohydrates and their in born errors of metabolism

**Lipids**

Types of lipids, structures of saturated and unsaturated fatty acids, triglycerides, phospholipids, plasmalogens, gangliosides and sphingolipids. Terpenoids and isoprenoids - definition and representative structures, steroids. Concept of acid value, saponification value and iodine value. Outlines of metabolism of fatty acids, cholesterol, steroids and products of poly unsaturated fatty acids.

**UNIT IV**

**Enzymes**

Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc.Classification and nomenclature. Concept of isoenzymes (example Lactate Dehydrogenase) and multienzymes (example pyruvate dehydrogenase) Substrate Specificity (bond specificity, group specificity, absolute specificity, stereo-specificity, proof-reading mechanism), lock and key and induced fit models.

Concept of allosteric enzymes (brief idea of ATCase as an example ,

Mechanisms of catalysis: Acid-base, covalent and metal ion catalysis.

Assay of Enzymes: Concept of activity, specific activity, turnover number, units of enzyme activity (katal, international unit), spectrophotometric methods of assay of enzymes (simple and coupled assay), very brief idea of other methods.

Enzyme kinetics: Michaelis-Menten equation, effect of substrate concentration, effect of enzyme concentration, effect of Ph and temperature, temperature quotient, single reciprocal( Eadie-Hoffstee equation) and double reciprocal plots( Lineweaver-Burke plots), enzyme inhibition kinetics (reversible inhibition types – competitive, uncompetitive and non-competitive), brief idea of irreversible inhibition.

**UNIT V**

**Bioenergetics**: Concept of free energy, Entropy, Enthalpy & Redox Potential. High energy compounds,.

Glycolysis (pathway, entry of other monosachharides and disaccharides, regulation, inhibitors)

Gluconeogenesis: Bypass reactions.

Structure of mitochondria.

**Metabolism of Nitrogenous Compounds**

Transamination (mechanism). Oxidative & Non-oxidative deamination.

Urea cycle: Detailed account, linkage of urea & TCA cycle, compartmentation of urea cycle, regulation,. . Biosynthesis and degradation of of purines and pyrimidines:.

**B.Sc. I**

**SEMESTER II PRACTICALS**

**Biotechnology**

**BT 202 Macromolecules & Enzymology**

1. Formol titration of glycine.
2. Quantitative Estimation of proteins by Biuret method
3. Determination of albumin & A/G ratio in serum.
4. Estimation of DNA by Diphenylamine method
5. Estimation of RNA by Orcinol method
6. Quantitative estimation of amino acids using Ninhydrin reaction.
7. Qualitative Analysis of sugars and proteins.
8. Quantitative estimation of sugars (Dinitrosalicylic acid method).
9. Estimation of glucose by Benedict's quantitative method
10. Quantitative estimation of proteins by Lowry's method.
11. Extraction and quantification of total lipids.
12. Determination of saponification value of Fats
13. Determination of Acid Value of Fats
14. Isolation of urease and demonstration of its activity
15. Assay of protease activity.
16. Preparation of starch from Potato and its hydrolysis by salivary amylase.
17. Assay of alkaline phosphatase
18. Immobilization of enzymes / cells by entrapment in alginate gel
19. Effect of temperature / pH on enzyme activity

*** Minimum of Ten practicals are mandatory**

**BSc II Semester III**

**Biotechnology**

**BT 301: BIOPHYSICAL TECHNIQUES**

**UNIT – I:**

Spectrophotometry: Concept of electromagnetic radiation, spectrum of light, absorption of electromagnetic radiations, Concept of chromophores and auxochromes, involvement of orbitals in absorption of electromagnetic radiations, Absorption spectrum and its uses, Beer's law - derivation and deviations, extinction coefficient. Difference between spectrophotometer and colorimeter. Instrumentation of UV and visible spectrophotometry

Double beam spectrometer; dual-wavelength spectrometer

a) Applications of UV and visible spectrophotometry.
b) Spectrofluorometry: principle, instrumentation and applications. Absorption & emission flame photometry: principle, instrumentation and application.
c) Principles of IR and Mass spectrometry

**UNIT II:**

Chromatography: Partition principle, partition coefficient, nature of partition forces, brief account of paper chromatography.

Thin layer chromatography and column chromatography.

Gel filtration: Concept of distribution coefficient, types of gels and glass beads, applications.

Ion-exchange chromatography: Principle, types of resins, choice of buffers, applications including amino acid analyzer.

Affinity chromatography: Principle, selection of ligand, brief idea of ligand attachment, specific and non-specific elution, applications.

Elements of high pressure liquid chromatography.

## UNIT III

a) Migration of ions in electric field, Factors affecting electrophoretic mobility.
b) Paper electrophoresis: - Electrophoretic run, Detection techniques, Cellulose acetate electrophoresis, High voltage electrophoresis.
c) Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels, Detection, Recovery & Estimation of macromolecules.
d) SDS-PAGE Electrophoresis: - applications (determination of molecular weight of proteins, determination of subunit stoichiometry, molecular biology applications).
e) Isoelectric focussing, Principle, Establishing pH amd density gradients, Procedures & applications.
f) Pulsed-field gel electrophoresis.

**UNIT – IV**:

**Isotopic tracer technique: -**

a) Radioactive & stable isotopes, rate of radioactive decay. Units of radioactivity.
b) Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique), Cerenkov radiation.

c) Principles of tracer technique, advantages and limitations, applications of isotopes in biotechnology istribution studies, metabolic studies, isotope dilution technique, metabolic studies, clinical applications, autoradiography.

**UNIT V**

**Centrifugation:**

a) Basic principles, concept of RCF, types of centrifuges (clinical, high speed and ultracentrifuges).
b) Preparative centrifugation: Differential and density gradient centrifugation, applications (Isolation of cell components).
c) Analytical centrifugation: Sedimentation coefficient, determination of molecular weight by sedimentation velocity and sedimentation equilibrium methods.

**Biostatistics**

Basic concepts of mean, median, mode, Standard deviation and Standard error

**B.Sc. II**

**SEMESTER III PRACTICALS**

**Biotechnology**

**BT302: Biochemistry & Biophysical Techniques**

1. Spectrophotometric analysis of DNA denaturation.
2. Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.
3. Protein estimation by E280/E260 method.
4. Paper chromatography of amino acids/sugars.
5. TLC of sugars/amino acids.
6. Cellular fractionation and separation of cell organelles using centrifuge.
7. Isolation of mitochondria and assay of marker enzyme.
8. Estimation of Urea by diacetyle monoxime method
9. Estimation of Sugars by Folin Wu method
10. Validity of Beer's law for colorimetric estimation of creatinine.
11. Absorption spectrum of NAD & NADH
12. Preparation of standard buffers and determination of pH of a solution
13. Titration of a mixture of strong & weak acid
14. Paper electrophoresis of proteins
15. Gel electrophoresis of proteins.
16. SDS-PAGE of an oligomeric protein.
17. Calculation of mean, median, and mode (manual/computer aided).
18. Calculation of standard deviation and standard error (manual/computer aided).
19. Biostatistical problem based on standard deviation.

**Note: - Mandatory to perform atleast 10 practicals**

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**B. Sc. II – Semester IV**

**BT401: IMMUNOLOGY**

**UNIT I**

Immune system, Organs and cells of immune system

Immunity, innate immune mechanism

Acquired immune mechanism, Antigen, Antigenecity (factors affecting antigenecity)

Humoral immunity, main pathways of complement system.

**UNIT II**

Antibody structure and classes, Antibody diversity, Genes of antibodies, Theories of formation of antibodies.

**UNIT III**

Cell mediated immunity: TC mediated immunity, NK cell mediated immunity, ADCC, delayed type hypersensitivity, cytokines and brief idea of MHC.

**UNIT IV**

Hypersensitivity and vaccination : General features of hypersensitivity, various types of hypersensitivity, Vaccination: Discovery, principles, significance. Concept of autoimmunity.

**UNIT V**

Immunological Techniques:Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA.

Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.

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**B.Sc. II**

**SEMESTER IV PRACTICALS**

**Biotechnology**

BT 402: **Immunology & Biophysical techniques**

1. Antigen – antibody reaction – determination of Blood group
2. Pregnancy test
3. Widal test
4. Ouchterloney immunodiffusion
5. Radial immunodiffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Production of antibodies and their titration

**Note: - Mandatory to perform at least 6 practicals**

# BSc I BIOTECHNOLOGY
# Semester II
# MODEL QUESTION PAPER
# COURSE CODE: BT 201
# COURSE NAME:Biochemistry

Time 3 Hrs Marks 75

**Attempt any *five* questions from Part A and *all* questions from Part B**

**PART A (5x3=15 Marks)**

Note: At least one question must be set from each UNIT

1. Structure of Purine
2. C Value paradox
3. Edman Reaction
4. Pka values
5. Structure of Galactose
6. Properties of terpinoids
7. Lock and Key hypothesis
8. Reduction of Oxygen

**PART B (5x12=60 Marks)**

**Answer the following**

9 (a) Explain the forces involved in DNA structure

Or

(b). What are histones? Discuss their nature

10 (a) Write on the titration curves of acidic aminoacids.

Or

(b) Describe the secondary structures of proteins.

11 (a) What is meant by in born error? Discuss at least two disorders related to carbohydrates.

Or

(b) Explain with suitable examples on classification of aminoacids.

12 (a) Define isoenzyme. Explain on the isoenzymes of LDH

Or

(b) Discuss on the derivation of Michaelis Menten Equation

13 (a) Write on energy conversion in chemical reaction. Write on energy rich molecules.

Or

(b), Discuss in detail on TCA cycle.

# BSc II BIOTECHNOLOGY
# Semester III
# MODEL QUESTION PAPER
# COURSE CODE: BT 301
# COURSE NAME:Biophysical techniques

Time 3 Hrs Marks 75

**Attempt any *five* questions from Part A and *all* questions from Part B**

**PART A (5x3=15 Marks)**

Note: At least one question must be set from each UNIT

1. Define Beer's law
2. Partition coefficient
3. Nature of resin
4. Principle of pressure pump
5. Concept of RCF
6. Half life
7. Tracer technique advantages
8. Svedberg unit

**PART B (5x12=60 Marks)**

**Answer the following**

9 (a) Describe the layout, principle and applications of Mass spectrophotometer.

Or

(b). Describe the layout, principle and applications of UV/VIS spectrophotometer

10 (a) Discuss the principle of gel permeation and add note on its advantages.

Or

(b) Explain the principle of thin layer chromatography and add note on Rf values.

11 (a) Define electrophoresis. Add note on paper electrophoresis and its applications.

Or

(b) What are the methods used to determine the pI values. Explain the techniques related to it.

12 (a) What are the precautions one has to take in while he is in Radioactive laboratory.

Or

(b) Discuss in detail on the principles and functioning of LSC.

13 (a) What is meant by centrifugation? Explain the mechanics involved in preparative centrifugation.

Or

(b) What are methods used to determine the molecular weight of proteins? Discuss any one method.

# BSc II BIOTECHNOLOGY
# Semester IV
# MODEL QUESTION PAPER
# COURSE CODE: BT 401
# COURSE NAME: Immunology

Time 3 Hrs Marks 75

**Attempt any *five* questions from Part A and *all* questions from Part B**

**PART A (5x3=15 Marks)**

Note: At least one question must be set from each UNIT

1. Define immunity
2. what is antigen?
3. Define antibody
4. Types of antibodies
5. NK Cell
6. hypersensitivity
7. Principle of Elisa
8. Vaccines uses

**PART B (5x12=60 Marks)**

**Answer the following**

9 (a) Discuss in detail on elements of complementation system

Or

(b). Explain the mechanisms involved in innate immunity and add note on advantages

10 (a) Write on IgG structure.

Or

(b) Discuss on formation of antibodies.

11 (a) Discuss in detail on delayed hypersensitivity reactions.

Or

(b) Explain the mechanics of MHC.

12 (a) What are vaccines? How are they produced?

Or

(b) Discuss about autoimmunity and add note on its advantages.

13 (a) Discuss the principles of antigen and antibody interactions..

Or

(b), what are monoclonal antibodies? How are they being prepared and used?