Shiksha Mandal's
Bajaj College of Science, Wardha

SYLLABUS-BIOTECHNOLOGY-B. Sc. Part I – Semester I -
FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES

UNIT I

Introduction to Biotechnology

A) Definition, Historical overview of Biotechnology National & International

B) Scope of Biotechnology :

Biotechnology in Agriculture,
Biotechnology in Health & Biopharmaceuticals
Biotechnology in Industry
Biotechnology in Environment & Biodiversity
Brief introduction to generic engineering, bioinformatics and nano-biotechnology

UNIT II

Microbes in Biotechnology and microbial nutrition

A) Bacteria: general morphology of bacteria, shapes and sizes, typical bacterial cell.Cell wall of gram +ve and Gram -ve cells.
Viruses: General characteristics of viruses, structure, different shapes and symmetries with one example of each type, classification of viruses LHT system cultivationBrief idea of lytic cycle and lysogeny.

B) 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, Enrichment media.

UNIT III Microscopy and staining technique

A) Definition: Magnification, Resolution, Numerical aperture, chromatic aberration

• principle, construction, working and applications of :

Compound microscope, SEM and TEM

B) Stains : Concept, aims of staining, smear preparation, principle and procedure ofstaining for

Bacteria ; Simple (monochrome & negative staining); differential(Gram staining) Hanging drop method : bacterial motility

Fungi : Lacto phenol cotton blue method•.

UNIT IV

Nucleic Acids

A) 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).

B) Structure ofRNA(mRNA , tRNA, rRNA)

UNIT V

Chromosomes, Concept of Genes and Nucleosomes

A) Concept of prokaryotic genes and eukaryotic genes: Definition of a gene, concept of split genes, introns, exons, spacers, C-value and C-value paradox, basic idea of Cot curves.

B) Chromatin structure: Nucleosome structure (10 nm fibre, experiments leading to discovery of nucleosomal structure, types of histones, arrangement of histones in the octamer, H1 histone and its role, role and length of linker DNA), 30 nm fibers (arrangement of nucleosome in a helical structure), domain and loop structure (further compacting of 30 nm fibre, role of scaffolding proteins). Role of telomere and centromere, telomeric and centromeric repeat sequences.

UNIT VI

Amino acids and protein structure

A)Amino acids: Classification, Properties, reactions (ninhydrin), rare amino acids, and separation techniques

B) Primary structure of proteins: peptide bond, use of peptidase specificity, Fibrous proteins, globular proteins
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.

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BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
B. Sc. Part I Sem II
BIOTECHNOLOGY
(With effect from academic session 2017-18)

The examination shall comprise of two theory papers, one in eachsemester and one practical in each Semester. Each theory paper will be of 3Hrs. duration and carry 80 marks. The internal assessment will carry 20marks. The practical examination will be of atleast 4 hours duration in oneday and shall carry 50 marks(30 marks for practical examination and 20 marks for practical internal assessment).The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-II (8 marks)

B. Sc. Part I – Semester II
MICROBIOLOGY, CELL BIOLOGY& ENZYMOLOGY

UNIT I
Microbial Growth
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), P^Hetc. Pure cultures and Axenicculture.Maintenance of pure culture.

UNIT II:
B. 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, replication, 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. Antibiotics and chemotherapeutics agents .Concept of biological control.

UNIT III
Eukaryotic cell
A) Eukaryotic Cell –difference between plant and animal cell Structure and function of the following: nucleus, mitochondria, ribosomes, Golgi complex, endoplasmic reticulum, plastids lysosomes, peroxisomes, glyoxisomes and vacuoles.

B) Plant cell wall.
Cytoskeleton (microtubules, intermediate filaments (IF) and microfilaments) and cell locomotion. Mitosis and meiosis.Brief idea of cell cycle. Muscle and nerve cell structure, synaptic transmission and neuromuscular junctions.

UNIT IV
Carbohydrates and Lipids

Definition, classification, nomenclature of carbohydrates, structures of monosaccharides(glucose and fructose), disaccharides(sucrose , lactose, maltose) , trisaccharide (raffinose) and polysaccharides (structures of cellulose ,starch and glycogen as examples of homopolysaccharides). Concept and examples of heteropolysaccharides.

Types of lipids, structures of saturated and unsaturated fatty acids, triglycerides**,** simple and mixed triglyceridesphospholipids, glycolipids (ganglioside and cerebrosides) and sphingolipids. . Concept of acid value, saponification value and iodine value.Terpenoids and isoprenoids - definition and representative structures, steroids. Definition, Classification and representative structures (Cholesterol).

UNIT V
Introduction to Enzymes
Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc. Enzyme nomenclature and classification(IUBMB) with example

Concept of isoenzymes (example Lactate Dehydrogenase) and multienzymes (example pyruvate dehydrogenase)
Substrate Specificity (bond specificity, group specificity, absolute specificity, stereo-specificity, lock and key and induced fit models.
Concept of allosteric enzymes (brief idea of AT Case as an example)
Mechanisms of catalysis: Acid-base, covalent and metal ion catalysis.

UNIT VI
Enzymes Kinetic
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),
Enzyme kinetics: Michaelis-Menten equation and its modification (Lineweaver-Burke plots
Factors affecting enzyme activity: Enzyme concentration, Substrate concentration, pH, Temperature, Activators and Inhibitors,

enzyme inhibition kinetics (reversible inhibition types – competitive, uncompetitive and non-competitive), kinetics of allosteric enzymes
Industrially significant enzymes: amylase, protease, and lipase
Immobilization techniques**.**

B. Sc. Semester Pattern Syllabus
B. Sc. Part II
BIOTECHNOLOGY
(With effect from academic session 2017-18)

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3Hrs. duration and carry 80 marks. The internal assessment will carry 20marks. The practical examination will be of atleast 4 hours duration in oneday and shall carry 50 marks(30 marks for practical examination and 20 marks for practical internal assessment).The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-III (8 marks)

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Bajaj College of Science

Syllabus-Biotechnology-B. Sc. Part II – Semester III

METABOLISM AND BIOPHYSICAL TECHNIQUES I

UNIT I

Bioenergetics and carbohydrate metabolism

A) Concept of free energy, Entropy, Enthalpy & Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate.

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

Gluconeogenesis: Bypass reactions.

C) TCA cycle: Detailed account, regulation, amphibolic nature and anaplerosis. Electron Transport Chain: Components of the chain, sites of ATP synthesis,

UNIT II

Lipid Metabolism

A) β-oxidation of fatty acids, role of carnitine, oxidation of unsaturated fatty acids & odd carbon fatty acids. Regulation. Ketogenesis, Ketosis & ketoacidosis in physiology & pathology.

B) Biosynthesis of fatty acids, fatty acid synthase complex, regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids.

UNIT III

Metabolism of Nitrogenous Compounds

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

Urea cycle: Detailed account, linkage of urea & TCA cycle, compartmentation of urea cycle, regulation, metabolic disorders of urea cycle.

B) Transmethylation& Decarboxylation, physiologically important products of decarboxylation.Biosynthesis of purines and pyrimidines: Salvage pathways.

UNIT – IV:

A) Spectrophotometry: Concept of electromagnetic radiation, spectrum of light, absorption of electromagnetic radiations, Concept of chromophores and auxochromes, Absorption spectrum and its uses, Beer's law - derivation and deviations, extinction coefficient.

B)

Difference between spectrophotometer and colorimeter.
Instrumentation and Applications of UV and visible spectrophotometry Double beam spectrometer; dual-wavelength spectrometer.

UNIT V:

A) Principle instrumentation and application of IR and Mass spectrometry

B) Spectrofluorometry: principle, instrumentation and applications. Absorption & emission flame photometry: principle, instrumentation and application.

UNIT VI:

A) 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.

B) 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.

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SYLLABUS-BIOTECHNOLOGY- B. Sc. Part II – Semester IV

MMUNOLOGY AND BIOPHYSICAL TECHNIQUES II

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.
Vaccination: Discovery, principles, significance. Concept of autoimmunity.

UNIT II

Antibody structure and classes.
Cell mediated immunity: TC mediated immunity, NK cell mediated immunity, ADCC, delayed type hypersensitivity, cytokines and brief idea of MHC.
Hypersensitivity and vaccination : General features of hypersensitivity, various types of hypersensitivity,.

UNIT III

Immunological Techniques:Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA.
Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.

UNIT – IV:

Migration of ions in electric field, Factors affecting electrophoretic mobility.
Paper electrophoresis: - Electrophoretic run, Detection techniques, Cellulose acetate electrophoresis, High voltage electrophoresis.
Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels, Detection, Recovery & Estimation of macromolecules.

UNIT V

SDS-PAGE Electrophoresis: - applications (determination of molecular weight of proteins, determination of subunit stoichiometry, molecular biology applications).
Isoelectric focussing, Principle, Establishing pH amd density gradients, Procedures & applications. Pulsed-field gel electrophoresis.

Centrifugation:

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

UNIT –VI:

Isotopic tracer technique: -

Radioactive & stable isotopes, rate of radioactive decay. Units of radioactivity.
Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique), Cerenkov radiation.
Measurement of Stable isotopes: Falling drop method for deuterium measurement, Mass spectrometry.
Principles of tracer technique, advantages and limitations, applications of isotopes in biotechnology (distribution studies, metabolic studies, isotope dilution technique, metabolic studies, clinical applications, autoradiography).

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B. Sc. Semester Pattern Syllabus
B. Sc. Part III
BIOTECHNOLOGY
(With effect from academic session 2019-20)

The examination shall comprise of one theory paper, one in each semester and one practical in each Semester. Each theory paper will be of 3Hrs. duration and carry 100 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry30 marks. The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 14 marks & one compulsory question covering all the syllabus of Semester-V (16 marks)

B. Sc. Part III –Semester V
MOLECULAR BIOLOGY & rDNA TECHNOLOGY

UNIT I

DNA Replication and Gene Mutations:

Types of DNA Replication: Semi conservative, Conservative and Discontinuous. Proof of semi conservative DNA replication, Mechanism of DNA replication and enzyme of DNA replication, Model of DNA Replication: rolling Circle model, unidirectional replication model, Bidirectional replication model.

Definition of mutation, Types of mutation,

Mutagens: Physical and Chemical Mutagens

Repair: Mismatch repair, NER, BER, Light Induced, SOS repair

UNIT II

Genetic Code

Defination and Characteristic of Genetic code: start and stop codons, universality, degeneracy and commaless nature of codons, Non overlapping, Triplet Nature of Code,

The decoding system: aminoacyl synthetases, brief structure of tRNA, the adaptor hypothesis, Codon-anticodon interaction - the wobble hypothesis.

Selection of initiation codon - Shine and Dalgarno sequence and the 16S rRNA.

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UNIT III

Transcription

Structure of RNA polymerase (core enzyme and holoenzyme, Role of sigma factor), concept of promoter.

Transcription in prokaryotes and eukaryotes: Initiation, elongation and termination

Brief idea of reverse transcription.

Regulation of Transcription in Prokaryotes: Basic idea of lac- and trp-operons.

UNIT IV

Translation

Activation of Amino Acids, Translation in prokaryotes and eukaryotes: formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, Termination of Translation.

UNIT V

rDNA Technology

DNA cloning: Basics of genetic engineering, restriction endonucleases, other enzymes of DNA manipulation.
Vectors: Plasmid vectors (pBR322 and pUC 18/19)
Phage vector: Lambda replacement and insertion vectors
Cosmids, phagemids, and YAC.
Cutting and joining DNA (cohesive end ligation, methods of blunt end ligation). Transfection and transformation. Selection of transformed cells. Screening methods.

UNIT VI

Genomic DNA library and cDNA library – concept and methods of creating these libraries. Advantages and disadvantages of cDNA library over genomic DNA library.
Principle and application of of Polymerase chain reaction, designing of primers for PCR. DNA Fingerprinting, Expression of cloned genes: General features of an expression vector.
Expression of a eukaryotic gene in prokaryotes – advantages and problemsProducts of RDNA technology.

B.Sc. III
SEMESTER V PRACTICALS
(Molecular Biology & rDNA technology)

1. To measure concentration of DNA & RNA by UV spectrophotometry
2. Estimation of proteins by Bradford method
3. Isolation of genomic DNA from Bacterial/ Animal/ Plant cell.
4. Isolation of Plasmid DNA.
5. Isolation of RNA from bacteria /plant cells
6. Isolation of chloroplast DNA.
7. Restriction digestion of DNA.
8. Demonstration of Replica plating technique
9. Identification of Lac+ bacteria by blue white screening using IPTG
10. Ligation of DNA
11. Demonstration of Southern blotting
12. Demonstration of western blotting
13. Chemical mutagenesis and production of microbial mutants.
14. Amplification of DNA Fragment by PCR
15. GFP Cloning in *E.coli*
16 AMES Test

Note: - Mandatory to perform atleast 6 practical

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