Shiksha Mandal's

Bajaj College of Science, Wardha
(Autonomous)
B. Sc. Semester Pattern Syllabus
B. Sc. Part I
BIOTECHNOLOGY
(With effect from academic session 2021-22)

1. The examination shall comprise one theory papers, an internal assessment and a practical. Theory paper shall be of three hours duration and 100 marks. The practical shall be of 4 hours duration and carry 30 marks. Internal assessments carry 20 marks.

Theory Paper	100 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2. The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3. 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 (16 marks).

B.Sc. Part I- Semester I

Sr. No.	Units	Total Theories Required
1	Unit I	8
2	Unit II	12
3	Unit III	10
4	Unit IV	12
5	Unit V	12
6	Unit VI	12

B.Sc. Part I- Semester II

Sr. No.	Units	Total Theories Required
1	Unit I	10
2	Unit II	12
3	Unit III	10
4	Unit IV	12
5	Unit V	12
6	Unit VI	12

BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
(With effect from academic session 2020-21)
B. Sc. Part I – Semester I

The examination shall comprise of one theory paper, one in each semester and one practical in each Semester. Each theory paper will be of 3 Hrs. 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 carry 30 marks. 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 14 marks & one compulsory question covering all the syllabus of Semester-I (16 marks).

B. Sc. Part I – Semester I

FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES

Course Objectives:

1. Students gain comprehensive knowledge about Application of Biotechnology in various field.
2. Students gain basic idea of viruses and their life cycles, prokaryotic cell, microbial nutrition, microscopy and staining techniques.
3. Student gets comprehensive knowledge regarding nucleic acid, proteins, amino acid, genes and chromosomes.
4. Students will be aware about the microbes present in the environment and their impact on environment. Course will provide practical knowledge about different types of bacterial staining, morphological characteristics of microorganism and colorimetric estimation of DNA, RNA and Protein.

Course Outcomes

1. Students will be able to understand application of Biotechnology, Genetic Engineering and Nano-technology in various important allied fields.
2. Student will be able to understand nutritional requirement, isolation and cultivation of microorganisms and staining and microscopy.
3. Students will be able to understand classification, characteristics of viruses, and life cycles of viruses.
4. Students will be able to known about classification and structures of biomolecules.

B.Sc. I (Semester I)	FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES	UG-BT(09)-S1-T
Unit Number	**Topic**	**Total Theories Required**
I	**Introduction to Biotechnology** A) Definition, National and International historical overview of Biotechnology. B) Scope of Biotechnology : • Biotechnology in Agriculture, • Biotechnology in Health & Biopharmaceuticals • Biotechnology in Industry • Biotechnology in Environment & Biodiversity • General outline of Genetic Engineering, Bioinformatics and Nano-Biotechnology	**8**
II	**Microorganism and Microbial Nutrition** A) Prokaryotes: Bacterial morphology and sub-cellular structure of typical bacterial cell. Structural details of Cell Wall of Gram Positive and Negative Bacteria 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. C) Viruses: General characteristics of viruses, structure, different shapes and symmetries with one example of each type, classification of viruses LHT system, cultivation of viruses, Brief idea of lytic cycle and lysogenic cycle.	**12**
III	**Microscopy and Staining Technique** A) Definition: Magnification, Resolution, Numerical aperture, chromatic aberration, B) Principle, construction, working and applications of compound microscope, SEM and TEM C) Stains: Concept, aims of staining, smear preparation, principle and procedure of staining for :- • Bacteria ; Simple (monochrome & negative staining); • Differential (Gram staining); Bacterial motility by hanging drop preparation method • Fungal staining by lactophenol cotton blue method	**10**
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 of RNA(mRNA , tRNA, rRNA)	**12**
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.	**12**

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.	**12**

Sr. No.	**Practicals (UG-BT(09)-S1-P)**	**Minor/Major**
1	Introduction to Biotechnology Laboratory setup.	Major
2	Demonstration, use and care of biotechnology equipment	Major
3	Preparation and sterilization of microbial media.	Major
4	Isolation of bacteria and fungi from soil, water, plant and study of their cultural and morphological characteristics.	Major
5	Isolation of Bacteriophage from sewage / other sources.	Major
6	Demonstration of motility of Bacteria	Minor
7	Simple staining of Bacteria.	Minor
8	Gram's staining of Bacteria	Major
9	Endospore staining	Major
10	Demonstration of starch hydrolysis by bacterial cultures.	Minor
11	Fungal spore staining by lactophenol cotton blue method.	Major
12	Estimation of DNA by Diphenylamine method	Major
13	Estimation of RNA by Orcinol method	Major
14	Detection of Amino Acid by paper chromatography	Major
15	Quantitative Estimation of proteins by Biuret method	Major

Recommended readings:

1. Biotechnology, 5th edition, (2013), Singh BD., Kalyani Publication, Ludhiana.
2. Biotechnology, 4th edition, (2013), Satyanarayana U., Chakrapani U., Books and allied (p)
3. Biochemistry, 4 th edition (2013) Satyanarayana U, Chakrapani U., Elsevier
4. Biotechnology, Fundamentals and applications- S. S. Purohit and S. K. Mathur. Agrobotanica publications. Gene Cloning and DNA analysis. - T. A. Brown. Blackwell Publication
5. Textbook of Microbiology, (2006), Ananthanarayan and Paniker, University Press Publication.
6. General Microbiology, 5th edition, (1987), Stanier R.Y., Macmillan Publication, UK.
7. Prescott's Microbiology, 8th edition, (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, McGrawHil Science Enginering, USA
8. General Microbiology (Vol.1), (2012), Powar C.B, and Daginawala H.F., Himalya Publication house.
9. General Microbiology (Vol.2), (2012)Powar C.B, and Daginawala H.F., Himalya Publication house
10. Textbook of Biochemistry, Satyanarayana U., Books and Allied (P) ltd, Kolkata
11. Lehninger's Principles of Biochemistry, 5th edition, (2008), Nelson D. L. and Cox M. M., CBS Publications,
12. Fundamentals of Biochemistry, 3rd edition, (2008), Donald Voet and Judith Voet , John Wiley and Sons, Inc. USA
13. Biochemistry and Molecular Biology of Plants, 2nd edition, Bob Buchanan et al Wiley
14. Recombinant DNA - Genes and Genomes. - James D. Watson, Any A. candy, Richard M. M, Jan A Witkowski. W.H. Freeman and Company Publication.
15. Principles of Gene manipulation and Genomics. 7th edition, (2006), S. B. Primrose and R. M. Twyman. Blackwell Publication
16. Bioinformatics- Principle and application,1st edition, (2008), Gosh Z. and Mallic B., Oxford

BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
(With effect from academic session 2021-22)
B. Sc. Part I – Semester II

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 carry 30 marks. 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 14 marks & one compulsory question covering all the syllabus of Semester-II (16 marks)

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

Course Objectives:

1. To get the knowledge on various technique for growth and control of microorganisms.
2. To built a foundation knowledge of cell biology,
3. To get knowledge of the biomolecules, enzymes and mechanism of enzyme.
4. This course will aid students to acquire skills and competency in microbiological, enzymology and cell biology.

Course Outcomes:

1. Students apply the knowledge of microbial growth and microbial control methods while performing microbiological experiments.
2. Students apply the knowledge of antiseptic, disinfectant and their mode of action in their daily life and principle, working and applications of instruments viz, laminar air flow, autoclave and hot air oven in laboratories.
3. Students can develop an understanding of the cytoskeleton, cell membrane, microtubules, microfilaments and can differentiate the organisms by its cell structure
4. Students will be able to perform assay of various enzymes according to their properties and can analyze their kinetics.

B.Sc. –I Semester -II	MICROBIOLOGY, CELL BIOLOGY AND ENZYMOLOGY	UG-BT(09)-S2-T
Unit Number	**Topic**	**Total Theories Required**
I	**Microbial Growth** A) Growth: Definition- growth rate, generation time and generation period. Details of growth curve and its various phases. Concept of synchronous cultures, continuous and batch cultures (Chemostat and Turbidostat). Physical conditions required for growth: Temperature, p^H and Oxygen and outline of other miscellaneous factor. Classification of microorganisms on the basis of temperature, P^H and Oxygen requirement B) Techniques for measurement of bacterial growth. Pure cultures techniques and techniques used for obtaining axenic culture. Methods used for maintenance of pure culture	**10**
II	**Microbial Control** A) Terminologies - Sterilization, disinfection, antiseptic, sanitization, germicide, microbistasis, preservative and antimicrobial agents. B) Mechanism of cell injury: Damage to cell wall, cell membrane, denaturation of proteins, inhibition of protein synthesis, replication. C) Physical control: Temperature (moist heat, dry heat, and incinerators), dessication, surface tension, osmotic pressure, radiation, UV light, electricity, ultrasonic sound waves, filtration. D) Chemical control: Antiseptics and disinfectants (halogens, alcohol, gaseous sterilization. Antibiotics and chemotherapeutics agents. Concept of biological control.	**12**
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	**10**
IV	**Carbohydrates and Lipids** A) Definition, classification, nomenclature of carbohydrates, structures of monosaccharides (glucose and fructose), disaccharides (sucrose, lactose, and maltose), trisaccharide (raffinose) and polysaccharides (structures of cellulose, starch and glycogen as examples of homopolysaccharides). Concept and examples of heteropolysaccharides. B) 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).	**12**

V	**Introduction to Enzymes** A) Terminology: Active site, allosteric site, holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc. Enzyme nomenclature and classification (IUBM) with example. B) 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 ATCase as an example) Mechanisms of catalysis: Acid-base, covalent and metal ion catalysis.	**12**
VI	**Enzymes Kinetic** A) 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). B) Enzyme kinetics: Michaelis-Menten equation and its modification (Lineweaver-Burke plots) Factors affecting enzyme activity: Enzyme concentration, Substrate concentration, pH, Temperature, C) 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**.**	**12**

Sr. No.	**Practicals (UG-BT(09)-S2-P)**	**Minor/Major**
1	Qualitative Analysis of sugars and proteins.	Major
2	Quantitative estimation of sugars (Dinitrosalicylic acid method).	Major
3	Estimation of glucose by Benedict's quantitative method.	Major
4	Quantitative estimation of proteins by Lowry's method.	Major
5	Determination of saponification value of Fats/Acid Fast Value	Minor
6	Preparation of starch from Potato and its hydrolysis by salivary amylase.	Minor
7	Immobilization of enzymes/ cells by entrapment in alginate gel.	Major
8	Effect of temperature / pH on enzyme activity	Major
9	Isolation of pure culture by Pour Plate method (Serial dilution)/ Streak Plate method.	Minor
10	Anaerobic cultivation of microorganisms (Candle Jar Method).	Minor
11	Cultivation of yeast and moulds.	Minor
12	Antibiotic sensitivity assay (Disc diffusion).	Minor
13	Oligodynamic action of metals	Minor
14	To study germicidal effect of UV light on bacterial growth.	Minor
15	Demonstration on various stages of mitosis and meiosis	Major

Recommended readings:

1. Textbook of Microbiology, (2006), Ananthanarayan R. and Paniker, University Press Publication.
2. General Microbiology - 5th edition, (1987), Stanier R.Y., Macmillan Publication, UK.
3. Prescott's Microbiology, 8th edition, (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, McGraw-Hill Science Engineering, USA
4. General Microbiology (Vol.1), (2012), Powar C. B, and Daginawala H. F., Himalaya Publication house.
5. General Microbiology (Vol.2), (2012), Powar C. B, and Daginawala H. F., Himalaya Publication house. Mumbai
6. Cell Biology, 6th edition, (2010), Gerald Karp. John Wiley & Sons., USA
7. Cell Biology, (1989)Pawar.C. B., Himalaya Pub. House, Mumbai.
8. Cell Biology, 3rd edition (2005), Rastogi S. C., New Age International (P) Ltd.
9. Lehninger's Principles of Biochemistry, 5th edition, (2008), Nelson D. L. and Cox M. M., CBS Publications,
10. Principles of Biochemistry, 4th edition, (1997), Jeffory Zubey., McGraw-Hill College, USA.
11. Text of Biochemistry, 4th edition, (2013), Satyanarayana U., Books and Allied (P) ltd, Kolkata
12. Understanding Enzymes, 1st edition, (2018), Aray A., Kumar A. and Jha J., Drowing pin Publication.
13. Fundamental of Enzymology 1st edition, (2009), Meena M., Avishkar publication

B. Sc. Semester Pattern Syllabus
B. Sc. Part II
BIOTECHNOLOGY
(With effect from academic session 2018-19)

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 carry 30 marks. 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 14 marks & one compulsory question covering all the syllabus of Semester-III (16 marks)

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.

C) 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.

B.Sc. Part -II

SEMESTER III PRACTICALS
Biotechnology
Metabolism & 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/lipids.
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 diacetylemonoxime 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

Note: - Mandatory to perform at least 6 practical

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Recommended readings:

Lehninger's Principles of Biochemistry (5th edition) by Nelson DL and Cox MM, CBS Publications, 2008.

Biochemistry by Stryer L. (5th edition) W.H. Freeman & Co., New York, USA,Fundamentals of Biochemistry. 3rd Edition, (2008), Donald Voet& Judith Voet , John Wiley and Sons, Inc. USA

Satyanarayan U, " Biochemistry",Books and Allied (P) ltd,Kolkata.

Fundamentals of Biochemistry by Dr.J.L.Jain

Physical Biochemistry by D. Freifelder IINdEdition (1982)

Biophysical Chemistry by Upadhyay Upadhyay and Nath.

Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker.

Experimental Biochemistryby B. SashidharRao and Vijay M. Deshpande.

B. Sc. Semester Pattern Syllabus
B. Sc. Part II
BIOTECHNOLOGY
(With effect from academic session 2018-19)

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 atleast 4 hours duration in one day and shall carry30 marks. 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 14 marks & one compulsory question covering all the syllabus of Semester-IV (16 marks)

B. Sc. Part II – Semester IV
BIOTECHNOLOGY

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 and 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).

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. Paper electrophoresis of proteins
9. Gel electrophoresis of proteins.
10. SDS-PAGE of an oligomeric protein.

Note: - Mandatory to perform atleast 6 practical

Recommended readings:

R. A. Goldsby, T.J. Kindt, B.A. Osborne, “Kuby - Immunology”, 4th Edition.

Kuby immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition (2012), Freeman and Co., NY

Roitt Evan, Brostoff J. Male D. (1993) Immunology 6th Ed., Mosby & Co. London.

Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988

Physical Biochemistry by D. Freifelder IInd Edition
Freeman publication (1982)

Biochemical techniques by Wilson and Walker.

Biophysical techniques by Upadhye and Upadhye.

Shiksha Mandal's

Bajaj College of Science, Wardha

(Autonomous)

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 3 Hrs. 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 carry 30 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 of the 16S rRNA

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 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 problems Products 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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Recommended Books:

1. C.B.Powar (2012) Genetics Vol-I. Himalaya Publishing House.
2. C.B.Powar (2012) Genetics Vol-II. Himalaya Publishing House,
3. Verma P.S. and , Agarwal V.K. (2010) Molecular biology, S. Chand and company PVT.
4. Gerald Karp (2007) Cell and Molecular Biology: Concepts and Experiments, 5th edition Wiley
5. Lewin B. (2013) Gene XI, Pearson Prentice Hall, Pearson Education, Inc., NT, USA
6. Malacinski GM (2003) Essentials of Molecular Biology, 4th edn., Jones and Batiett, London.
7. Watson JD, Baker JA, Bell SP, Gann A, Lewin M, and Losick R (2004) Molecular Biology of the Gene, Benjamin Cummings- CSHL Press, USA.
8. Brown, TA (1995) Essential Molecular Biology, Vol. I, A Practical Approach, IRL Press, Oxford, UK.
9. Nelson DL and Cox MM (2005) Lehninger's Principles of Biochemistry, 4th edn., McMillan Worth Publ. Inc. NY.
10. Russell, PJ (1998) Genetics, 5th edn, Benjamin-Cummings Publ. Co. Inc., NY
11. Molecular Biology, 5th Edition (2011), Weaver R., McGrew Hill Science. USA
12. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press, India
13. Molecular Biology: Genes to proteins, 4th edition (2011), Burton E Tropp, Jones and Bartlett Learning, USA
14. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
15. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002
16. Sambrook, J and Russell, D.W. (2001) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor, N.Y.: Cold Spring Harbor Laboratory.
17. CB Powar and HF Daginawala"Genral Microbilogy Vol.I", Himalaya publication House.
18. Satyanarayan U "Biotechnology", Publisher: Books & Allied (P) Ltd.
19. TA Brwon "Essential of molecular Biology" Publisher: Cbs Publishers & Distributors, 2 nd Edition.

B. Sc. Semester Pattern Syllabus
B. Sc. Part III - Semester VI
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 3 Hrs. 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 carry 30 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-VI (16 marks).

B. Sc. Part III –Semester VI -
APPLICATIONS OF BIOTECHNOLOGY

UNIT I

Environmental Biotechnology

Water and waste water treatment process: Current community drinking water treatment process, disinfection of water (Chlorination and Ozonation), Sewage: definition and composition, primary, secondary and advanced treatment of sewage (domestic waste water).Assessment of water and wastewater quality: Concept of COD, DO and BOD. Define Coliform, indicators of fecal pollution and MPN and MF technique for coliforms. IMViC test.

Definition and concept: biodegradation, biodeterioration, biotransformation, Xenobiotic and recalcitrant compounds. Bio accumulation and process of biomagnifications.

UNIT II

Industrial Biotechnology

Introduction of Industrial Biotechnology: Important commercial products produced by microorganisms. GMOs and their applications, Design of typical fermentor. Isolation and screening of industrially important microorganisms – primary and secondary screening.

UNIT III

Food Biotechnology

Industrial awareness: Quality control and quality assurance in food and pharamaceutical industry, concept of current good manufacturing practices in pharmaceutical industry.

Types of Cheese and its production, microorganisms as food supplements – production of Mushroom and Spirulina, assessment of microbiological quality of packaged foods.

UNIT IV

Plant Tissue culture

Introduction and History, Design of typical Plant Tissue Culture Laboratory. Laboratory facilities, Tissue culture as a technique to produce novel plants and hybrids, Tissue culture media (composition and preparation). Plant growth substances: concept and role: hormone Auxin, Gibberllins, Cytokins, Ethylene, Abscisic acid.

Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.Tissue and micro- propagation, suspension culture, callus formation, regeneration, production of haploids, protoplast culture and somatic hybridization.

UNIT V

Animal Tissue Culture

History and development of cell culture-contribution of Ross Harrison, alex Carrel, Charles Lindbergh, Lanwilmut. Design of typical Animal Tissue Culture Laboratory and its management, laboratory facilities, Culture media, growth factors, Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors. Various techniques

of animal cell and tissue culture, Primary culture, immortal cells, cell lines. Maintenance of cell lines in the laboratory.

UNIT VI

Biotechnological products

Brief idea about recombinant DNA products in medicine (insulin, somatostatin, vaccines), Concept of Gene therapy, Production of recombinant vaccines – Hepatitis Vaccine. Concept of transgenic animals, In vitro fertilization and embryo transfer in humans and farm animals.

Concept of transgenic plants (Bt cotton). Cloning in plants- Ti plasmid, Applications of transgenic plants.

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B.Sc. III
SEMESTER VI
PRACTICALS
APPLICATIONS OF BIOTECHNOLOGY

1. Determination of chlorine demand of water.
2. Determination of fecal coliforms by MPN technique/MF technique.
3. Determination of COD/BOD.
4. IMViC test.
5. Microbiological quality assurance of any of the commercially available foods.
6. Sterility testing of injectibles
7. Preparation of Plant Tissue culture media.
8. Isolation of protoplast from different tissues using mechanical method / commercially available enzymes.
9. Callus Induction and Regeneration using different explants.
10. Anther culture, embryo culture, suspension culture.
11. Preparation of Balance Salt solution.
12. Separation of serum.
13. Establishing primary cell culture of chicken embryo fibroblasts.
14. Animal tissue culture – maintenance of established cell lines.
15. Animal tissue culture – virus cultivation.
16. Cell count by hemocytometer.
17. Bioassay of penicillin/vitamin B12.
18. Production of alcohol using *S. cerevisiae*.

Note: - Mandatory to perform atleast 6 practicals

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Recommended Books:

1. Industrial Microbiology Book by Lester Earl Casida.
2. Biotechnology by Satyanarayana U., Books and Allied (P) Ltd., Kolkata
3. Biotechnology Expanding horizons by B.D.Singh , kalyani publication.
4. An introduction to Plant Tissue culture by MK Razdan. M.K. 2003. Oxford & IBH Publishing Co, New Delhi, 2003.
5. Plant tissue culture by Bhojwani. S.S and Razdan. M.K 2004.
6. Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008.
7. Plant Propagation by Tissue Culture: Volume 1 & 2. EF George. Exegetics Limited, 1999.
8. Plant cell culture, A Practical approach, 2nd Edition, Edited by R.A. Dixon and R.A. Gonzales.
9. Reinert J.and Bajaj Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, By Springer - Verlag, Berlin.
10. Molecular Biotechnology by Glick, B.R. and J.J. Pasternak. Second Edition, ASM Press, Washington, 1998.
11. Experiments in Microbiology Plant Pathology and Biotechnology by K.R. Aneja New age International .Limited Publishers, 2010.
12. Animal Cell Culture – Practical Approach. Edited by John RW. Masters, Oxford.
13. Gupta P.K. (1995) Elements of Biotechnology, Rastogi and Company**.**
14. S.D.Kung and R.Wu (1993) Transgenic Plant Vol.1 & 2, Academic press, San Diego.
15. Modern Industrial Microbiology and Biotechnology Book by Nduka Okafor.

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