Shiksha Mandal's

Bajaj College of Science, Wardha
(Autonomous)
B. Sc. Semester Pattern Syllabus
B. Sc. Part I (Semester I and II)
(DSC- I and II)
BIOTECHNOLOGY
(With effect from academic session 2024-25)

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

B. Sc. Part I – Semester I

FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES
DSC-I [Credits 4T+2P=6]

Course Objectives:

1. To study the application of Biotechnology, genetic engineering and Nano-technology in various important allied fields.
2. To study the ultrastructure, nutrition of prokaryotic cells and viruses.
3. To study the microscopy and various staining techniques.
4. To study the chemical composition and structure of nucleic acid.
5. To study the concept and structure of gene, nucleosome and chromosome.
6. To study the amino acid and proteins structural level.

Course Outcomes

1. Students will be able to discuss and explain application of Biotechnology, Genetic Engineering and Nano-technology in various important allied fields.
2. Students will be able to discuss bacterial morphology and nutrition, classify viruses according to taxonomic system and describe life cycle of viruses.
3. Students will be able to describe various macroscopic techniques and demonstrate various type of staining techniques used for bacteria and fungi.
4. Students will be able to illustrate structure and chemical composition of nucleic acid.
5. Students will be able to describe the structure of gene, nucleosome and chromosome.
6. Students will be able to describe classification of amino acid, various separation technique use for amino acid and illustrate primary, secondary, tertiary and quaternary structure of protein.

B.Sc. I (Semester I)	FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES (DSC-I)	
Unit Nos.	**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 staining (monochrome & negative staining); • Differential staining (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**	**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

B. Sc. Part I – Semester II
MICROBIOLOGY, CELL BIOLOGYAND ENZYMOLOGY
DSC- II [Credits 4T+2P=6]

Course Objectives:

1. To study the various factors associate with microbial growth.
2. To study the various mechanism and factors involve in microbial control.
3. To study the eukaryotic cell structure, cell cycle and various type of specialized cell.
4. To study the classification, nomenclature and structure of carbohydrates and lipids.
5. To study the classification of enzyme and various important types of enzymes.
6. To study the enzyme assay, enzyme kinetics and various factor affecting enzyme activities.

Course Outcomes:

1. Students will be able to discuss various phase of microbial growth curve, classification of microbes on the basis of physical condition and explain various techniques for measurement of microbial growth.
2. Students will be able to discuss various mechanism of cell injury and demonstrate various physical and chemical technique use in microbial control.
3. Students will be able to compare plant and animal cell structure and discuss cytoskeleton, cell cycle and various specialized cell.
4. Student will be able to classify carbohydrates and lipids and describe their structure.
5. Students will be able to explain classification of enzyme and various important types of enzymes.
6. Students will be able to describe enzyme assay, kinetics and identify factor affecting enzymatic activities.

B.Sc. –I Semester -II	MICROBIOLOGY, CELL BIOLOGY AND ENZYMOLOGY DSC- II	
Unit Nos.	**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 Kinetics** 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**	**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

Shiksha Mandal's

Bajaj College of Science, Wardha
(Autonomous)
B. Sc. Semester Pattern Syllabus
B. Sc. Part I (Semester I and II)
Minor I and II
BIOTECHNOLOGY

(With effect from academic session 2024-25)

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

B. Sc. Part I – Semester I

FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES
Minor-I [Credits 4T+2P=6]

Course Objectives:

1. To study the application of Biotechnology, genetic engineering and Nano-technology in various important allied fields.
2. To study the ultrastructure, nutrition of prokaryotic cells and viruses.
3. To study the microscopy and various staining techniques.
4. To study the chemical composition and structure of nucleic acid.
5. To study the concept and structure of gene, nucleosome and chromosome.
6. To study the amino acid and proteins structural level.

Course Outcomes

1. Students will be able to discuss and explain application of Biotechnology, Genetic Engineering and Nano-technology in various important allied fields.
2. Students will be able to discuss bacterial morphology and nutrition, classify viruses according to taxonomic system and describe life cycle of viruses.
3. Students will be able to describe various macroscopic techniques and demonstrate various type of staining techniques used for bacteria and fungi.
4. Students will be able to illustrate structure and chemical composition of nucleic acid.
5. Students will be able to describe the structure of gene, nucleosome and chromosome.
6. Students will be able to describe classification of amino acid, various separation technique use for amino acid and illustrate primary, secondary, tertiary and quaternary structure of protein.

B.Sc. I (Semester I)	FUNDAMENTALS OF BIOTECHNOLOGY AND BIOMOLECULES (Minor-I)	
Unit Nos.	**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 staining (monochrome & negative staining); • Differential staining (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**	**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:

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4. Biotechnology, Fundamentals and applications- S. S. Purohit and S. K. Mathur. Agrobotanica publications. Gene Cloning and DNA analysis. - T. A. Brown. Blackwell Publication
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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

B. Sc. Part I – Semester II
MICROBIOLOGY, CELL BIOLOGYAND ENZYMOLOGY
Minor- II [Credits 4T+2P=6]

Course Objectives:

1. To study the various factors associate with microbial growth.
2. To study the various mechanism and factors involve in microbial control.
3. To study the eukaryotic cell structure, cell cycle and various type of specialized cell.
4. To study the classification, nomenclature and structure of carbohydrates and lipids.
5. To study the classification of enzyme and various important types of enzymes.
6. To study the enzyme assay, enzyme kinetics and various factor affecting enzyme activities.

Course Outcomes:

1. Students will be able to discuss various phase of microbial growth curve, classification of microbes on the basis of physical condition and explain various techniques for measurement of microbial growth.
2. Students will be able to discuss various mechanism of cell injury and demonstrate various physical and chemical technique use in microbial control.
3. Students will be able to compare plant and animal cell structure and discuss cytoskeleton, cell cycle and various specialized cell.
4. Student will be able to classify carbohydrates and lipids and describe their structure.
5. Students will be able to explain classification of enzyme and various important types of enzymes.
6. Students will be able to describe enzyme assay, kinetics and identify factor affecting enzymatic activities.

B.Sc. –I Semester -II	MICROBIOLOGY, CELL BIOLOGY AND ENZYMOLOGY Minor- II	
Unit Nos.	**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 Kinetics** 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**	**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.
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