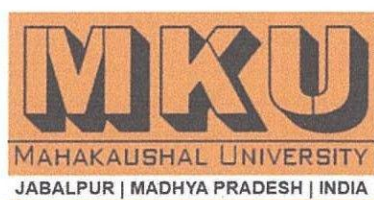


MAHAKAUSHAL UNIVERSITY JABALPUR

**As per model syllabus of U.G.C. New Delhi, drafted by
Central Board of Studies and Approved by Higher
Education and the Governor of M.P.**



Faculty of Science

Syllabus & Prescribed Books

Subject – Biotechnology

B.Sc. Yearly Examination

I, II & III Year

Department of Higher Education Govt. of M.P.
Syllabus for Under Graduate Classes
As Recommended by Central Board of Studies and approved by
the Governor of M.P.

Class	:B.Sc 1 st Year
Paper	: 1 st BBTC101-T
Subject	: Biotechnology
Title of Subject Group	: Cell Structure and Biology
Compulsory	: Compulsory :
Max. Marks	:40+10=50

Syllabus

Unit I	Introduction to cell biology Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models. Tools of cell biology Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for subcellular fractionation.
Unit II	Structure of different cell organelles Structure of nuclear envelope, nuclear pore complex. ER structure. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Zellweger syndrome..
Unit III	Protein trafficking Selective transport of proteins to and from the nucleus. Targeting proteins to ER, Protein sorting and export from Golgi. Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.
Unit IV	Cytoskeletal proteins Structure and organization of actin filaments. Treadmilling and role of ATP in microfilament polymerization, organization of actin filaments. Non-muscle myosin. Intermediate filament proteins, assembly and intracellular organization. Assembly, organization and movement of cilia and flagella. Unit 6 Cell wall and extracellular matrix Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cellcell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata
Unit V	Cell cycle, cell death and cell renewal Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell

Suggested Books :

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893300-6. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:9781-4641-0981-2 / ISBN:10: 1-4641-0981-8.
2. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8

Department of Higher Education Govt. of M.P.

Syllabus for Under Graduate Classes

As Recommended by Central Board of Studies and approved by
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Class	:B.Sc 1 st Year
Paper	: IInd BBTC102-T
Subject	: Biotechnology
Title of Subject Group	: Microbiology
Compulsory	: Compulsory
Max. Marks	: 40+10=50

SYLLABUS

Unit I	<p>Overview of history of Microbiology - Biogenesis and abiogenesis Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming [Penicillin], Scope of Microbiology.</p> <p>Classification of Microbes - Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms systematics of bacteria, Nutritional types [Definition and examples]. Classification on the basis of oxygen requirement.</p>
Unit II	<p>Concept of Sterilization - Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant.</p>
Unit III	<p>Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.</p>
Unit IV	<p>Microbes in Extreme Environment – Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space.</p> <p>Pathogenic Microorganisms – List of common bacterial, fungal and viral diseases of human beings [Name of the disease, causative pathogen, parts affected]</p>
Unit V	<p>Basic concepts of Virology - General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Capsids, complex (Bacteriophage, and Virion size, enveloped (Herpes), helical (TMV) and icosahedral (Polyoma), Capsids. environment.</p>

Suggested Books :

1. Prescott's Microbiology" by Joanne Willey.
2. Jawetz, Melnick & Adelberg's Medical Microbiology.
3. Brock Biology of Microorganisms (Madigan, Bender, Buckley, & Stahl)
4. Prescott's Microbiology (Willey, Sherwood, & Woolverton),
5. Microbiology: An Introduction (Tortora, Funke, & Case)
6. Foundations in Microbiology (Talaro & Chess)
7. Lippincott Illustrated Reviews: Microbiology.

Practicals (biotechnology lab-I) BBTC101-P

1. Microscopy – Light microscopy : principles, parts & function, Operation.
2. Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa
3. Sterilization: principles & operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow
4. Sampling and quantification of microorganisms in air, soil and water
5. Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution
6. Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, spore staining and motility
7. Observation of morphology - shape and arrangement of cells
8. Methods of inoculation of different microbes in selective media.

Department of Higher Education Govt. of M.P.

Syllabus for Under Graduate Classes

As Recommended by Central Board of Studies and approved by
the Governor of M.P.

Class	:B.Sc IInd Year
Paper	: I BBTC201-T
Subject	: Biotechnology
Title of Subject Group	: Biochemistry
Compulsory	: Compulsory
Max. Marks	: 40+10=50

SYLLABUS

Unit I	<p>Introduction to Biochemistry and Biomolecules Overview of Biochemistry: Scope and importance in biotechnology. Water and its Biological Importance: Properties and role in cellular processes. Carbohydrates: Structure, classification, and functions. Lipids: Structure, classification, and functions. Amino Acids and Proteins: Structure, classification, and functions. Nucleic Acids: Structure, types, and functions. Vitamins and Minerals: Their roles as cofactors and regulators.</p>
Unit II	<p>Bioenergetics and Metabolism: Thermodynamics and Bioenergetics: Laws of thermodynamics, free energy, and biochemical reactions. Enzyme Kinetics: Enzyme structure, mechanism, factors affecting enzyme activity, Michaelis-Menten equation. Metabolic Pathways: Overview of major metabolic pathways like glycolysis, Krebs cycle, and oxidative phosphorylation. Regulation of Metabolism: Hormonal and allosteric regulation.</p>
Unit III	<p>Molecular Biology DNA Replication: Mechanisms and enzymes involved. Transcription: Process of RNA synthesis and regulation. Translation: Protein synthesis and genetic code. Gene Expression: Regulation of gene expression in prokaryotes and eukaryotes. Recombinant DNA Technology: Basic techniques like restriction digestion, ligation, and transformation.</p>
Unit IV	<p>Advanced Biochemistry Membrane Structure and Function: Membrane lipids, proteins, and transport mechanisms. Signal Transduction: Receptor-ligand interactions and signaling pathways. Hormone Biochemistry: Hormone synthesis, action, and regulation. Immunology: Basic concepts of immune system and antibody structure. Metabolism of Xenobiotics: Detoxification pathways and drug metabolism</p>
Unit V	<p>Biochemistry in Biotechnology Enzymes in Biotechnology: Industrial applications of enzymes, enzyme engineering. Metabolic Engineering: Designing and optimizing metabolic pathways for specific products. Protein Engineering: Modifying protein structure and function for industrial applications. Bioreactors: Design and operation of bioreactors for biotechnological processes. Applications of Biochemistry in various Biotechnological fields: Food, pharmaceuticals, diagnostics, etc.</p>

Suggested Books :

1. Lehninger's Biochemistry
2. Lubert Stryer
3. Book on Biomolecular Interactions

Department of Higher Education Govt. of M.P.

Syllabus for Under Graduate Classes

As Recommended by Central Board of Studies and approved by
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Class	:B.Sc 2 nd Year
Paper	: IInd BBTC202-T
Subject	: Biotechnology
Title of Subject Group	: Molecular Biology
Compulsory	: Compulsory
Max. Marks	: 40+10=50

SYLLABUS

Unit I	Mendelian Genetics: Mendel's laws of inheritance, monohybrid and dihybrid crosses, extensions of Mendelian genetics. Gene Interactions: Epistasis, dominance relationships, multiple alleles, and gene interactions. Sex-linked Inheritance: Sex chromosomes, sex-linked traits, and sex-influenced traits. Linkage and Recombination: Linkage analysis, crossing over, and genetic mapping. Mutations: Types of mutations, mechanisms of mutation, and the effects of mutations on gene expression. Quantitative Genetics: Continuous and discontinuous variation, polygenic inheritance, and heritability.
Unit II	Basic Concepts of genome and its organization: Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Importance of Molecular Biology, Central Dogma of Molecular Biology, Model organisms for studying Molecular Biology. Structure and functions of Nucleic acids: Nucleosides & Nucleotides, purines and pyrimidines. Biologically important nucleotides, Watson and Crick model of DNA structure, A, B & Z forms of DNA, Supercoiled and relaxed DNA, denaturation and renaturation of DNA, melting temperature (T_m), hyperchromic effect.
Unit III	Genome and its organisation : (idea about gene, coding sequence, regulatory sequence, intron, exon, Nucleosome structure and packaging of DNA into higher order structures, brief idea of chloroplast DNA and Mitochondrial DNA) Replication of DNA in prokaryotes . Features of DNA Replication, Proof of semiconservative nature of DNA replication, Features of bidirectional DNA replication. Mechanism of bidirectional DNA replication. Gene expression. t
Unit IV	RNA structure and types of RNA, Transcription in prokaryotes with E. Coli as model system: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains, Genetic code, properties of genetic code, Wobble hypothesis. Components of Protein synthesis machinery : Messenger RNA, tRNA structure and function, Charging of tRNA, aminoacyl tRNA synthetases, ribosome structure and assembly , Mechanism of protein synthesis in prokaryotes : initiation, elongation and termination. Principles of gene regulation, negative and positive regulation, concept of operons, Regulation of gene expression in bacteria : lac operon

Unit V	Damage, Repair and Mutation Causes (spontaneous, chemical agent, radiation) and types of DNA damage Mechanism of DNA repair: Direct repair, base excision repair, nucleotide excision repair, mismatch repair, recombination repair. Molecular basis of mutation, types of mutation (missense mutation, nonsense mutation, silent mutation, point mutation, frameshift mutation).
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Suggested Books :

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10:1-4292- 3414-8.
- Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt.Ltd. (New Jersey), ISBN: 978-1180-25024.
- Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 8502

PRACTICAL (Biotech lab -II) BBTC201-P

1. DNA isolation - from Plant cell (leaf of cabbage / mustard), Animal cell (goat liver), Human Blood (Fresh / Stored / Frozen) & Microbes
2. Plasmid DNA isolation
3. Gel electrophoresis
4. Polymerase Chain Reaction
5. Gel documentation & photography.
6. Bacterial Antibiotic sensitivity
7. Preparation of Baker's Yeast from molasses

Department of Higher Education Govt. of M.P.

Syllabus for Under Graduate Classes

As Recommended by Central Board of Studies and approved by
the Governor of M.P.

Class	:B.Sc 3 rd Year
Paper	: I BBTC301-T
Subject	: Biotechnology
Title of Subject Group/	: Molecular Biology & Genetic engineering
Compulsory	: Compulsory
Max. Marks	: 40+10=50

SYLLABUS

UNIT 1	<p>Introduction to Techniques - Introductory history, Laboratory organization, Media, Aseptic manipulation. Basic concepts in cell culture - cell culture, Cellular Totipotency, Somatic Embryogenesis. In vitro culture : approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture.</p> <p>Tissue nutrition : Growth Hormones - Plant cells (Composition of culture media, Growth hormones, Vitamins, Unidentified supplements, selection of media); Animal cells (substrate on which cells grow, Feeder layer on substrate, gas phase for tissue culture, media and supplements).</p> <p>Tissue culture methodologies - Plant cells (Callus Culture, Cell Suspension Culture, Organ Micro-culture, plant micro-propagation, Somatic Embryogenesis); Animal cells (Source of tissue, primary culture, differentiation of cells, growth kinetics, animal cell lines and their origin and characterization).</p> <p>Cloning & Selection of specific cell types – cloning, somatic cell fusion and HAT selection, Medium suspension fusion, selection of Hybrid clone, production of monoclonal antibodies.</p> <p>Organ Culture - Culture of embryonic organs, whole embryo culture, culture of adult organs.</p>
UNIT 2	<p>DNA Typing : DNA polymorphisms: the basis of DNA typing, Minisatellite analysis, Polymerase chain reaction based analysis, Short tandem repeat analysis, Mitochondrial DNA analysis, Y chromosome analysis, Randomly amplified polymorphic DNA (RAPD) analysis.</p>
UNIT 3	<p>Gene Recombination and Gene transfer : Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser.</p> <p>Changing genes: site-directed mutagenesis and Protein engineering: Primer extension is a simple method for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene shuffling, production of chimeric proteins.</p>
UNIT 4	<p>Genetic engineering in animals: Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Using Yeast to study Eukaryotic gene function, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, Transgenic animals, Production of proteins of Pharmaceutical value.</p>

UNIT 5	Genetic engineering in plants: Use of <i>Agrobacterium tumefaciens</i> and <i>Arhizogenes</i> , Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.
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Suggested Readings :-

1. Principles of Gene Manipulation and Genomics by Primrose and Twyman:
2. Gene Cloning and DNA Analysis by T.A. Brown:
3. Molecular Biology of the Gene by J.D. Watson:
4. Lehninger Principles of Biochemistry by Nelson and Cox:
5. Molecular Cell Biology by Lodish et al.:

Department of Higher Education Govt. of M.P.
Syllabus for Under Graduate Classes
As Recommended by Central Board of Studies and approved by
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Class	: B.Sc 3 rd Year
Paper	: IInd BBTC302-T
Subject	: Biotechnology
Title of Subject Group	: Applied Biotechnology
Compulsory	: Compulsory
Max. Marks	: 40+10=50

SYLLABUS

Unit I	. Bioreactor / Fermenter – types & operation of Bioreactors, physico-chemical standards used in bioreactors, limitations of bioreactors, stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentation
Unit II	Cloning vectors for prokaryotes and eukaryotes Plasmids, classification, copy number and its regulation, incompatibility and curing, Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on E. coli plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene. Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adaptors. Synthetic oligonucleotides, synthesis and use.
Unit III	Global Environmental Problems – Green House Effect, Acid rain, El Nino, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards. Environmental pollution and degradation – Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas
Unit IV	Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals, Nutrient pollution. Environmental Management – Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases, health hazards due to pesticide and metal pollution, waste treatment, solid waste management, environmental standards and quality monitoring.

Unit V	Gene therapy – background, types of gene therapy (ex vivo & in vivo), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. Gene Delivery methods – Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering. Gene therapy Models – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. Vaccines – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. Synthetic therapy – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. Tissue Engineering – Skin, Liver, Pancreas. Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues. Cell Adhesion-based therapy – integrins, inflammation, cancer & metastasis. Drug delivery – conventional & new approaches to drug delivery.
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Suggested Books :

1. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.
2. Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK) ISBN:13: 978-1 4051-3544-3.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).
4. Recombinant DNA Technology by Watson
5. "Lehninger Principles of Biochemistry" by David L. Nelson
6. "Molecular Biology of the Gene" by J.D. Watson
7. "Principles of Gene Manipulation and Genomics" by Sandy B. Primrose and Richard M. Twyman
8. "Prescott's Microbiology" by Willey, Sherwood, and Woolverton
9. "Cell and Molecular Biology" by Gerald Karp
10. "The Cell: A Molecular Approach" by Geoffrey M. Cooper
11. "Kuby Immunology" by Kindt, Goldsby, Osborne, and Janis

PRACTICAL (Biotech lab -III) BBTC301-P

1. Antigen-Antibody reactions – Agglutination (Blood grouping testing).
2. Antibody titration (Ouchterlony Double Diffusion).
3. Antigen-Antibody reactions – Immuno-electrophoresis, Rocket immuno-electrophoresis.
4. Antigen-Antibody reactions – Coomb's test.
5. Antigen-Antibody reactions – ELISA.
6. In vitro Culture - Washing & Sterilization, Preparatory steps for tissue culture, surface sterilization of plant material, basic procedures for Aseptic tissue transfer, incubation of culture.
7. Preparation of Culture media & Reagents - Media composition, Nutrition, Hormones.
8. Tissue Culture – Callus culture, Cell suspension
9. Organ Micro-culture - Shoot tip, excised root, Leaf culture.
10. Plant micro-propagation - micro-culture of plants