

**RANI DURGA VATI VISHWA VIDYALAYA, JABALPUR**  
**SYLLABUS PRESCRIBED FOR THE**  
**DEGREE OF THE BACHELOR OF SCIENCE**  
**(From 2011-12 onwards)**  
**B.SC FIRST SEMESTER**  
**BIOTECHNOLOGY**  
**Paper-Essentials of Biotechnology & Biochemistry**  
**(MM Theory 70 + CCE 30)**

**UNIT I**

Definition, scope, potential & achievements of biotechnology. Biotechnology in India, Global trends need for future development. General idea of microorganisms of Biotechnological importance, Intellectual Property Rights (IPR).  
Cell as the fundamental unit of life. Molecules, macromolecules & cell organelles.  
Water as universal solvent, H<sub>2</sub>O- structure & properties having bearing on life, pH & buffers.

**UNIT II**

**Basic Building Blocks**

Biochemistry as molecular logic of living being; Axions of living matter; Major organic compounds of animate objects- a general view.  
Chemical elements, Structure of atoms; Molecular and Chemical Bonds: Ionic, Covalent, Coordinate and Hydrogen bonds; Structure, function and properties of Water, Water as universal solvents; Acids, Bases, Salts, pH and Buffers.

**UNIT III**

**Carbohydrates**

Definition, Classification of Carbohydrates; Chemical structure and properties of Monosaccharide, Disaccharides, Oligosaccharides and Polysaccharides; Starch, Cellulose and Glycogen.  
Purines and Pyrimidines: Structure and properties.

**UNIT IV**

**Proteins & Lipids**

Definition, structure and classification of Amino acids, essential and non essential amino acid, Acid-base properties and solubilities, Amino acid sequencing of proteins; Sanger and Edman's method: Structure, properties and functions of primary, secondary and tertiary proteins.  
Lipids:  
Definition, Classification and properties of lipids; Saturated and Unsaturated Fatty Acids and their role and functions in microorganisms; structure and properties of waxes, steroids, lipo-proteins and lipo-polysaccharides

**UNIT V**

**Enzymology**

Definition, structure and properties of enzymes, Classification of enzymes; Co-enzymes and Co-factors; Introduction to Active site and Enzyme specificity; Factors affecting the enzyme action: temperature, pH, activators, substrates; Enzyme-substrate interaction: Fisher lock-key hypothesis and Koshland induced fit hypothesis.

**List of Practicals (MM: 50)**

1. Detection of water alkalinity and acidity.
2. To find out normality of acid with alkali.
3. To find out normality of alkali with acid.
4. To determine the pH of a given solution.
5. Estimation of glucose by Cole's method
6. Identification of biological compound, Carbohydrates - Molisch's test, Protein - Biuret test, Lipid - Saponification test
7. Qualitative analysis for amino acid- Color reaction for amino acid, Biuret test, Ninhydrine test.
8. Quantitative analysis of fat- Test for oil, Solubility test, Emulsion test, Absorption test.
9. Estimation of protein by Folin Lowry method.
10. Estimation of total lipid by dichromate method.

**List of recommended books:**

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand & Company.
4. Principles of Biochemistry, Author- A.L. Lehninger
5. Fundamentals of Biochemistry, Author- J. L. Jain
6. Biochemistry, Author- Voet and Voet.
7. Microbial Genetics, Authors- Freifelder.
8. Textbook of Microbiology, Authors- Dubey and Maheshwari.
9. Powar C. B. and G. R. Chatwal (1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.
10. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.I; Himalaya Publishing House

**B.Sc. SECOND SEMESTER  
BIOTECHNOLOGY  
Paper-Techniques in Biotechnology**

**(MM Theory 70 + CCE 30)**

**UNIT I**

**Isolation and maintenance of Microorganisms:**

Sterilization- definition, principle, types, Pure, axenic, mixed culture, strain, isolate, clone- Definitions; Pure culture techniques: Dilution, Plating- pour plate method, spread plate method, streak plate method; Enrichment culture and micromanipulator, Maintenance and preservation of pure cultures: subculturing, overlaying, cultures with mineral oils, lyophilization, sand cultures, storage at low temperature; Major Microbial Culture Collection Centers in India.

**UNIT II**

**Microscopy:**

Invention of Microscope; History; Light Microscopy: Principle, Construction; Theory and applications of Bright Field Microscopy (Simple and Compound); Dark Field Microscopy; Phase Contrast Microscopy; UV and Fluorescent Microscopy; Electron Microscopy: Types of Electron Microscope (TEM & SEM); Preparation of Specimen, Advantages, Limitations and Applications; Use of Software in Microscopy.

**UNIT III**

**Instrumentation Techniques**

Basic principle, construction and applications of Autoclave, Oven, Incubator, BOD, Laminar Air Flow, Colorimetry and Spectrophotometer; Centrifugation: Basic principles of sedimentation, methods and applications; Chromatography: General introduction, definition and types of chromatography, General principles underlying chromatographic technique, Working and applications of Thin Layer Chromatography.

**UNIT IV**

**Micrometry and Staining**

Ocular and Stage Micrometry: principle and application; Cell Count: Haemocytometry- principle and applications, Use of Camera Lucida; Stains and Staining Techniques: Necessity of staining, Chemistry of dyes and stains, Fixation of Smears, Mordents and Intensifiers, Decolorizers; Theory of Staining: physical and chemicals; Types of Staining: Simple staining, Negative staining, Differential staining, Flagella, Cell-wall, Gram staining, Acid Fast staining.

**UNIT V**

Basic cytological techniques- Squash, smear, fixation, dehydration, embedding & staining of animal & plant tissues  
Mitotic & meiotic chromosomes, temporary & permanent slides  
Cationic & anionic stains, chromatophores, auxochromes & mordents.

**List of Practicals (MM: 50)**

1. Write the principle and use of dissecting microscope.
2. Write the principle and components of Bright field compound microscope.
3. Demonstration of principles and working of basic instruments: autoclave, incubator, hot air oven, pH meter, laminar air flow, spectrophotometer and centrifuge.
4. Preparation of smear and microscopic examinations of Fungi – *Mucor* spp., *Aspergillus* spp., *Penicillium* spp. & *Alternaria* spp. Bacteria – *Staphylococcus* spp. *Lactobacillus* spp. *Escherichia* spp. *Vibrio* spp. & *Leptospira* spp.
5. Staining techniques – Simple staining, Differential staining (Gram's, Ziehl-Neelsen), Spore and Capsular staining methods
6. Paper and Thin layer chromatography.
7. SDS-PAGE electrophoresis.
8. Maintenance and preservation of pure cultures: Paraffin method, Glycerol method
9. Control of mites in fungul cultures by fumigation
10. To study the principle of Camera lucida

**List of recommended books:**

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand & Company.
4. Fundamental Principles of Bacteriology, Author- A.J. Salle.
5. Introduction to Microbiology, Authors- Ingraham and Ingraham.
6. Microbial Physiology, Authors- Moat and Foster.
7. Tools and techniques in microbiology by Nath and Upadhyay
8. Powar C. B. and H. F. Dagainawala (2003).General Microbiology Vol.II; Himalaya Publishing House.
9. Dubey R. C. and D. K. Maheshwari (2004). A Text book of microbiology, 1<sup>st</sup> Edition; S.Chand and Company Ltd.
10. H.C. Dube (2005) A Textbook of Fungi, Vikas Publishing House.

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1. Board of Studies in Biotechnology on 16/07/11 & Faculty of Life Science on 16/07/11

**B.Sc. THIRD SEMESTER  
BIOTECHNOLOGY  
Paper-Physiology & Metabolism**

**(MM Theory 70 + CCE 30)**

**UNIT I**

**Utilization of Energy:**

Sources of carbon and energy for microbial life, ATP cycle, Occurrence and properties of ATP and AMP.

Biomass: Photosynthesis, Sources and utilization of biomass, production of alcohol from biomass, production of biogas from biomass. Hydrogen: a new biofuel.

**UNIT II**

**Energy production in Anaerobic and Aerobic process and Metabolism:**

Glycolysis; Pentose phosphate pathway; Entner Duodoroff pathway; fermentation; TCA cycle; catabolism of lipids:  $\alpha$  and  $\beta$ -oxidation; Glyoxylate cycle; catabolism of proteins; Aerobic respiration.

Brief outline on carbohydrate, protein, lipid and nucleic acid metabolism in plants and microorganisms.

**UNIT III**

**Bioenergetics**

Principles of Bioenergetics;  $\Delta G$ , Standard free energy change, endergonic and exergonic reactions; oxidation-reduction reaction; Redox-potential; oxidative phosphorylation: hypothesis; inhibitors of oxidative phosphorylation. Transfer potential of the phosphate group.

**UNIT IV**

**Growth and Growth Measurement**

Definition of growth; mathematical nature and expression of growth; growth curve; growth yield; factors affecting growth: nutrient, temperature, oxygen, pH, osmotic pressure, Measurement of growth by measuring cell number, cell mass and cell activity, Cell constituent, Cell count- direct and indirect method, dry weight and wet weight method; synchronous culture; continuous culture; and batch culture.

**UNIT V**

**Photosynthesis**

Photosynthesis in higher plants and animals: Harvesting light energy, Oxidative photophosphorylation and photophosphorylation, General features of photophosphorylation, Light absorption, Light driven electron flow, ATP synthesis by photophosphorylation, Comparison of photosynthesis in higher plants and microorganisms.

**List of Practicals (MM: 50)**

1. Enumeration of bacterial colony using colony counter.
2. Enumeration (counting) of bacteria by plate count or serial dilution agar plate technique.
3. Study of bacterial growth curve.
4. Demonstration of O<sub>2</sub> evolution during photosynthesis.
5. Determination of bacterial growth by turbidity measurement (spectrophotometric method).
6. Determination of fungal growth by mycelia weight determination method.
7. Effect of temperature on bacterial growth (TDP & TDT).
8. Effect of pH on bacterial growth.
9. Effect of osmotic pressure (salt and sugar concentration) on bacterial growth.
10. Demonstration of active and passive transport mechanism.
11. Production of ethanol by using different substrates.

**List of recommended books:**

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand & Company.
4. Murray R. K., D. K. Granner, P.A. Mayes and V.W. Rodwell (2003) 26<sup>th</sup> edition. Harper's Illustrated Biochemistry.
5. Moat and Foster. Physiology and Metabolism.
6. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.
7. Davis. Immuno
8. Powar C. B. and H. F. Daginawala (2003).General Microbiology Vol.II; Himalaya Publishing House
9. Tortora G.J., B.R. Funke and C.L. Case, 5<sup>th</sup> edition. Microbiology: An Introduction. The Benjamin/ Cummings Publishing Co., Inc.
10. Powar C.B. Cell Biology.

**B.Sc. FOURTH SEMESTER  
BIOTECHNOLOGY  
Paper-Cell Biology & Microbiology**

**(MM Theory 70 + CCE 30)**

**UNIT I**

Cell as a basic unit of living system.

Broad classification of cell types & their general account:- PPOs, bacteria, eukaryotic microbes ( fungi & protozoa ), plant & animals; The development of cell theory, levels of cellular organization.

A detailed classification of cell types within an organ taking mammalian histology as an example.

**UNIT II**

Cellular Interaction

1. Differentiation of cell membrane
2. Intercellular communication and gap junction
3. Cell coat and cell recognition
4. The cell surface of the cancerous cells

**UNIT III**

Concept of microbial species & strains- characterization & naming of species, strains, phylogenetic approach to taxonomy, numerical taxonomy, Classification of microorganisms based on nutrition.

New approaches to bacterial taxonomy- G: C composition of DNA- its determination & significance.

**UNIT IV**

General idea of microbial biodiversity- microbes in extreme environments & their use.

Ecological amplitude of cells in high altitude, arctic, brackish & fresh water, environment, pressure, temperature & salts as environmental factors in cells; Cell senescence (death)

Nature of microbial cell surface- of gram +ve & gram -ve bacteria.

Brief idea of serotypes with species reference to *Salmonella*, *shigella*, *Vibrio*

**UNIT V**

Brief idea of bacterial & viral diseases- Diphtheria, Cholera, Typhoid, Syphilis, Polio, Hepatitis & AIDS.

Brief idea of the following fungal diseases- Candidiasis, Dermatophytosis, Aspergillosis

The process of infection- Pathogenicity, virulence & infection, Microbial adherence & penetration – Virulence factors.

**List of Practicals (MM: 50)**

1. To study the growth phase of Mitosis of plant cell
2. To study the growth phase of Meiosis of plant cell
3. Microscopic examination of free living protozoa of a pond
4. Microscopic examination of parasitic protozoa
5. Hanging drop technique demonstrating motility of bacteria
6. Staining of mycoplasma (PPLO)
7. Primary isolation of bacterial pathogen (*Vibrio*)
8. Primary isolation of fungal pathogen (*Aspergillus*)
9. Agglutination test: Widal test
10. Scotch tape preparing for studying morphology of fungi
11. Cover slip culture technique for preparing permanent fungus mounts

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1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand & Company.
4. Powar C. B. and G. R. Chatwal(1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.
5. Powar C. B. and H. F. Dagainawala (2003).General Microbiology Vol.I; Himalaya Publishing House
6. Jain, J.L., S. Jain and N. Jain (2005) 6th Edition. Fundamental of Biochemistry. S. Chand and Co.
7. Rama Rao, A.V.S.S. (2000) 8th Edition. Textbook of Biochemistry. UBS Publisher Ltd.
8. Principles of Biochemistry, Author- A.L. Lehniger
9. Fundamentals of Biochemistry, Author- J. L. Jain
10. Biochemistry, Author- Voet and Voet.

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1. Board of Studies in Biotechnology on 16/07/11 & Faculty of Life Science on 16/07/11



**B.Sc. FIFTH SEMESTER  
BIOTECHNOLOGY  
Paper-Genetics & Genetic Engineering**

(MM Theory 70 + CCE 30)

**UNIT I**

**Genetic Material**

Nucleic acid as genetic material, Evidence; Physical and chemical structure of DNA;- Watson & Crick model (B-form, Z-form, D-form); Nature of gene structure and functions; Melting curve of DNA and  $T_m$  value determination; Buoyant density of DNA and its relationship with mole (G+C) content in DNA; Types of RNA: mRNA, rRNA, tRNA; Organization of Eukaryotic chromosome and mechanism.

**UNIT II**

**DNA Replication**

Types of DNA replication: Conservative, Semi-conservative and Dispersive mode of replication; Mechanism of replication, Messelson and Stahl experiment; DNA topology: Supercoiling of DNA and linking number Enzymes involved in replication of DNA; Replication of DNA in prokaryotes and eukaryotes; Molecular Mechanism of Chromosomal replication, Models of chromosomal replication- Cairns model, Rolling Circle model; Future practical applications.

**UNIT III**

**Transcription, Translation and Gene regulation**

Enzymatic synthesis of RNA; Transcription signals; Mechanism of transcription in prokaryotes and eukaryotes; Post transcriptional modification- basic concepts

**Translation and Gene regulation**

Outline of translation; Requirements of translation; Genetic Code: Basic features of genetic code, Wobble hypothesis, Poly cistronic RNA, Overlapping genes, deciphering of genetic code; gene translocation, Ribosomes: their general nature and role in protein synthesis, charging of tRNAs, initiation, elongation and termination of protein synthesis in prokaryotes; post translational modification of polypeptides; regulation of protein synthesis; Lac operon.

**UNIT IV**

**DNA mutation and repair**

Types of mutation; evidence of spontaneous nature of mutation: fluctuation test, new comb's experiment and replica testing; mode of action of physical, chemical and biological mutagens-UV rays, nitrous acid, 5-bromouracil, 2-aminopurine, EMS. Reversion in mutation, true reversion, suppression and types of suppressor mutation; DNA repair mechanism, Photo reactivation, Excision, Mismatch, SOS repair and Dealkylation repair

**UNIT V**

**Genetic engineering**

Recombinant DNA Technology- Definition, principle, Molecular tools of genetic engineering: Cutting and joining of DNA, Cloning Vectors, Techniques of genetic engineering, Gene library-genomic library and cDNA library. Application of PCR technology (Diagnosis of pathogen, DNA fingerprinting.)

**List of Practicals (MM: 50)**

1. Demonstration on isolation of DNA.
2. Demonstration of agarose gel electrophoresis.
3. To study qualitative estimation of DNA by gel electrophoresis.
4. Quantitative estimation of DNA by DPA method.
5. Quantitative estimation of RNA by Orcinol method.
6. To study conjugation in bacteria.
7. To transfer bacterial colonies by replica plating method.
8. Effect of UV light on growth of bacteria.
9. Effect of mutagen on the growth of bacteria.
10. To study antibiotic resistance in bacteria.
11. To study the photoreactivation repair mechanism of mutation.

**List of recommended books:**

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand & Company.
4. Principles of Biochemistry, Author- A.L. Lehninger
5. Fundamentals of Biochemistry, Author- J. L. Jain
6. Biochemistry, Author- Voet and Voet.
7. Microbial Genetics, Authors- Freifelder.
8. Textbook of Microbiology, Authors- Dubey and Maheshwari.
9. Powar C. B. and G. R. Chatwal (1994). Biochemistry, 3rd Edition; Himalaya Publishing House, New Delhi.
10. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.I; Himalaya Publishing House

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*1. Board of Studies in Biotechnology on 16/07/11 & Faculty of Life Science on 16/07/11*

**B.Sc. SIXTH SEMESTER  
BIOTECHNOLOGY  
Paper-Biotechnology and Applications**

**(MM Theory 70 + CCE 30)**

**UNIT I**

**Environmental Biotechnology**

Microbial interaction: Neutralism, Commensalism, Synergism. Liquid waste disposal, characteristics of solid and liquid waste; Sewage treatment: Primary, Secondary and tertiary treatment. Bioremediation- Definition, principle and types, Biodegradation of Xenobiotics- definition and mechanism.

**UNIT II**

**Plant/Agriculture Biotechnology**

Plant tissue culture- History and scope, preparation and sterilization, terms used in tissue culture, types of culture, basic technique of plant tissue culture, plant tissue culture media. An introduction to transgenic plants- definition, gene transfer methods, Agrobacterium mediated gene transfer.

**UNIT III**

**Animal Biotechnology**

Animal cell culture- fundamentals, Organ culture- Technique, advantages, limitations. Immunology- Immune system: definition, organization of immune system, cells of immune system, Immunoglobulin- definition, structure, An introduction to transgenic animals.

**UNIT IV**

**Industrial Microbiology**

Fermentation- Definition, equipments and production process; Industrial production of alcohol and acetic acid. Microbes as source of microbial and single cell proteins (SCP) and its production and applications.

Food spoilage: Physical and microbial spoilage of food and food products, spoilage of stored products, fruits and vegetables, microbial spoilage of milk, milk products and meat. Food born diseases. Food preservation methods, asepsis, pasteurization, canning, desiccation, low temperature, anaerobiosis, filtration, chemical preservation of food- salt and sugar, organic acids, use of sulphur dioxide, ethylene and propylene oxides, wood smoke.

**UNIT V**

**Medical /Pharmaceutical Biotechnology**

Zone phenomenon (Lattice hypothesis); Characteristics of Serological reactions; Neutralization, Precipitation: ring test, slide test and tube test, Agglutination: widal test, passive agglutination, Hemagglutination, Bacterial agglutination, Agglutination inhibition, Flocculation and Complement Fixation; Principle and applications of Radial immunodiffusion, Double immunodiffusion and Radioimmunoassay (RIA).

Gene therapy: Definition, approaches, Recombinant vaccines- definition, Monoclonal antibodies- Principle, hybridoma technology.

**List of Practicals (MM: 50)**

1. Sterilization of plant material: surface sterilization
2. Preparation of tissue culture media
3. To study the formation of callus from explants
4. To study the concentration of DO (Dissolved oxygen) in sewage sample
5. To study the concentration of BOD (Biological Dissolved oxygen) in sewage sample
6. Blood collection and plasma/serum separation.
7. Blood grouping – Rh typing – cross matching.
8. Estimation of hemoglobin content of human blood
9. Estimation of total leukocyte count of human blood
10. Estimation of deferential leukocyte count of human blood

**List of recommended books:**

1. Biotechnology, Author- U. Satyanarayan, 2007, Books and Allied Pvt. Ltd.
2. Biotechnology, Author- B.D.Singh, 2010, Kalyani Publishers.
3. Biotechnology, Authors- R.C.Dubey, 2006, S.Chand & Company.
4. Soil microbiology by Subba Rao
5. Food microbiology by James M.J
6. Dairy microbiology by Parihar and Parihar
7. Introductory food microbiology by H.A Modi.
8. Soil and microbes by Waksman and Starkey.
9. Plant pathology by Mehrotra.
10. Food Microbiology by Frazier.
11. Industrial Microbiology by A.H Patel.

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*1. Board of Studies in Biotechnology on 16/07/11 & Faculty of Life Science on 16/07/11*