

**Shiksha Mandal's**  
**Bajaj College of Science (Autonomous), Wardha**

**Syllabus**

**B.Sc. Microbiology**

**B.Sc. Semester I (Microbiology)**

**History and Microbial Morphology**

(UG-MB (08)-S1-T)

**Unit-I: A. History of Microbiology**

- i) Discovery of microbe
- ii) Theory of biogenesis and abiogenesis.
- iii) Contributions of Louis Pasteur, Robert Koch, Sergei Winogradsky, Martinus Beijerinck, John Tyndal and Joseph Lister.

**B. Scope of Microbiology:** Basic Branches of Microbiology: Bacteriology, Mycology, Phycology, Virology Applied Branches Biotechnology: Medical Microbiology, Biotechnology, Geomicrobiology, Exobiology, Environmental Microbiology, Food and Dairy Microbiology

**Unit -II: Classification of Bacteria**

- i) Definition: Taxonomy, classification, Identification, Nomenclature.
- ii) Approaches in Bacterial Classification: Bacterial Classification, Whittaker Five Kingdom System, Intuitive Method of Classification, Numerical Taxonomy, Genetic Relatedness: GC: AT Ratio, DNA Hybridization, 16SrRNA Cataloguing
- iii) Bergey's Manual of Systematic and Determinative Bacteriology.

**Unit-III: A. Prokaryotic Cell structure**

- i) Concept and difference between Eukaryotes and Prokaryotes.
- ii) Typical Bacterial cell structure: Structure of cell wall (gram +ve, gram-ve), Cell membrane: Fluid mosaic model, Mesosomes, Ribosomes, Nucleoid, plasmids, Storage granule, Capsules, slime layer, Pili, Flagella (including types and structure).
- iii) Endospore structure, formation and germination
- iv) Exospores, Myxospores.
- v) Significance of Dormancy

**Unit-IV: Eukaryotic Microbes**

- i) Fungi and yeast: General characters, Asexual and sexual mode of reproduction, , slide culture techniques.
- ii) Algae: General characters and industrially important algal cells

iii) Protozoans: General characters of trypanosome & Giardia

### **Unit-V: Microbial Nutrition**

- i) Basic nutritional requirements. ii) Nutritional classification of bacteria
- iii) Types of culture media: selective, enriched, enrichment, synthetic, non synthetic, Differential, assay media.
- iv) Pure culture v) Axenic cultures, Diauxic cultures.

i) Isolation of pure culture: various techniques, Preservation of Pure cultures ii) Determination of C, N, P by auxanographic and replica plate technique.

### **Unit-VI: Acellular Microbes: Viruses**

- i) Discovery of viruses, General structure, symmetry and classification
- ii) Cultivation of viruses: chick embryo, tissue culture
- iii) Detection of viral growth iv) T4-Bacteriophages and Lambda viruses.
- v) lytic and Lysogeny cycle

## **Practicals Sem I** (UG-MB (08)-S1-P)

1. General Biosafety rules in Microbiology.
2. General concept of basic equipment's and apparatus
3. Preparation of media: Nutrient agar, nutrient broth, PDA, selective & differential media.
4. Demonstration of microbes from air, water, soil
5. Isolation of pure culture by streak plate, spread plate and pour plate method
6. Cultivation of fungi by slide culture technique
7. Staining of fungi
8. Isolation of bacteriophage from sewage
9. Demonstration of antibiotic disc sensitivity test.

**Note:** Minimum 8 experiments (4\*+4) should be performed in each semester.

Distribution of marks for practical exam (**Total: 30 Marks**)

- 1) Major one experiment (Marks **08**)
- 2) Minor two experiments (Marks **08**)
- 3) Spotting (Marks **04**)
- 4) Viva (Marks **05**)
- 5) Record book (Marks **05**)

**Duration of practical exam: 8 Hours (4 Hours each day)**

## **List of Books Recommended For Semester I and Semester II Microbiology**

- 1) General Microbiology : Stainer, Roger et. al.
- 2) General Virology : Luria, S.E.
- 3) Handbook of Genetics : Esser, K.
- 4) Fundamentals Principles of : A.J. Salle. bacteriology
- 5) Microbiology : Pelczar, Chan, Krieg.(TMH)
- 6) Fundamental of Microbiology : Frobisher
- 7) General Microbiology Vol. I & II : Power & Dagainawala. (Himalaya Publication)
- 8) Zinsser Microbiology : W.K. Joklik
- 9) General Microbiology : W.G. Walter
- 10) Elements of Microbiology : M.J. Pelozar & E.C.S. Chan
- 11) Essays in Microbiology : J.N. Norris & M.H. Richmond
- 12) Microbiology : L. Mckane & J. Kandel (Essentials & Applications)
- 13) Basic Microbiolgy : Volk
- 14) Chemical Microbiology : Rose
- 15) Microbiology : Paul A. Ketchum. (Introduction to Health of Professional)
- 16) Molecular Biology of the gene : J.D. Watson.
- 17) Elementary Microbiology : Modi (Akta Prakashan) Vol. I & II
- 18) Basic experimental : Ronald M., Atlas, & Alfred Microbiology Miller  
E.Brown, Kenneth  
W. Dobra, Lionas (1986) (Prentice Hall - 316 PP)
- 19) General Microbiology : Robert F.Boyd (1984) times mirror / mosby college,  
Pub.
- 20) Text Book of Microbiology : Dubey & Maheshwari (S.Chand, Publication)
- 21) Foundation in Microbiology:Ulhas  
Patil,A.B.Chaudhary,Dr.S.B.Chincholkar,J.S.Kulkarni(Neerali Publication)

## **List of books for practicals**

- 1) Microbes in Action : Seely, Wander Mark Tarporewala, Bombay
- 2) A Mannual of Microbiology : A.J. Salle.
- 3) Microbiology Methods : Collins
- 4) Bacteriological Techniques : F.J.Baker
- 5) Introduction to Microbial Techniques : Gunasekaran
- 6) Biochemical methods: Sadashivam & Manickam
- 7) Laboratory Fundamentals of Microbiology: Alcamo, I.E., Jones and  
Bartlett Publishers

# Shiksha Mandal's

## Bajaj College of Science (Autonomous), Wardha

### B.Sc. Semester II (Microbiology)

#### Microbial Techniques

(UG-MB (08)-S2-T)

#### **Unit-I: Microscopy: Basic Principle and Applications**

Concept of Resolution, Magnification, Numerical aperture

- i) Bright field microscopy ii) Dark field microscopy iii) Electron microscopy (TEM, SEM) iv) Confocal microscopy v) Phase contrast microscopy vi) Fluorescent microscopy.

#### **Unit-II: Staining Techniques**

- i) Stains and dyes, chromophore, auxochrome, chromogens, types of stains.
- ii) Staining techniques: simple, differential, gram staining, acid fast staining.
- iii) Staining of specific structure: flagella, spores, capsule (negative), Metachromatic granule staining.

#### **Unit-III: Microbial Reproduction and Growth.**

- i) Microbial Reproduction: Binary fission, Budding, Fragmentation, Sporulation
- ii) Microbial growth: Principle of growth curve, Different phases and mathematical expression of growth rate
- iii) Continuous culture: Dialysis, Turbidostat and Chemostat, Concept of Synchronous culture.
- iv) Quantitative measurement of bacterial growth
- v) Factors influencing microbial growth

#### **Unit-IV: Microbial Control.**

- i) General Terminologies: sterilization, disinfection, disinfectants, sanitizer, antiseptics, microbiostatic, microbiocidal, sanitizer, preservation, Pasteurization.
- ii) Physical methods: Heat, moist heat sterilization, Dry heat sterilization, Low temperature, Filtration, radiation, osmotic pressure.

#### **Unit-V: Chemical Control Agents**

- i) Characteristics of an ideal disinfectants, Phenolics, Alcohols, Halogens, Heavy metals, Quaternary ammonium compounds, Surface active agents, Aldehydes, Gaseous sterilization, Chemotherapeutic agents.
- ii) Mechanism of cell injury, Factors influencing antibacterial activity.

- iii) Phenol coefficient.
- iv) Applications of chemical & physical agents

### **Unit-VI: Microbial interaction**

- i) Positive and negative interaction: Commensalism, synergism, syntropism, mutualism, parasitism, predation, antagonism, competition
- ii) Protist-Protist Interaction: Bdellovibrio
- iii) Protist-Plant interaction: Root nodule bacteria
- iv) Protist-Animal interaction: Rumen bacteria, insect midgut bacteria, luminescent bacteria

### **Practicals Sem II (UG-MB (08)-S2-P)**

1. Simple, Grams, acid-fast, fungal and endospore staining
2. Determination of phenol coefficient
3. To Study the effect of salt concentration on bacterial growth
4. To perform membrane filtration
5. To cultivate anaerobic bacteria
6. Isolation of rhizobium from root nodules leguminous plants.
7. Performance of Oligodynamic action of metals
8. Enumeration of microorganisms by SPC
9. Demonstration of Micrometry
10. Determination of no. of cells by Breed method

**Note:** Minimum 8 experiments (4\*+4) should be performed in each semester.

Distribution of marks for practical exam (**Total: 30 Marks**)

- 1) Major one experiment (Marks **08**)
- 2) Minor two experiments (Marks **08**)
- 3) Spotting (Marks **04**)
- 4) Viva (Marks **05**)
- 5) Record book (Marks **05**)

**Duration of practical exam: 8 Hours (4 Hours each day)**

### **List of Books Recommended For Semester I and Semester II Microbiology**

- 1) General Microbiology : Stainer, Roger et. al.
- 2) General Virology : Luria, S.E.
- 3) Handbook of Genetics : Esser, K.
- 4) Fundamentals Principles of : A.J. Salle. bacteriology

- 5) Microbiology : Pelczar, Chan, Krieg.(TMH)
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- 8) Zinsser Microbiology : W.K. Joklik
- 9) General Microbiology : W.G. Walter
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- 11) Essays in Microbiology : J.N. Norris & M.H. Richmond
- 12) Microbiology : L. Mckane & J. Kandel (Essentials & Applications)
- 13) Basic Microbiolgy : Volk
- 14) Chemical Microbiology : Rose
- 15) Microbiology : Paul A. Ketchum. (Introduction to Health of Professional)
- 16) Molecular Biology of the gene : J.D. Watson.
- 17) Elementary Microbiology : Modi (Akta Prakashan) Vol. I & II
- 18) Basic experimental : Ronald M., Atlas, & Alfred Microbiology Miller E.Brown, Kenneth W. Dobra, Lionas (1986) (Prentice Hall - 316 PP)
- 19) General Microbiology : Robert F.Boyd (1984) times mirror / mosby college, Pub.
- 20) Text Book of Microbiology : Dubey & Maheshwari (S.Chand, Publication)

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- 4) Bacteriological Techniques : F.J.Baker
- 5) Introduction to Microbial Techniques : Gunasekaran
- 6) Biochemical methods : Sadashivam & Manickam
- 7) Laboratory Fundamentals of Microbiology: Alcamo, I.E., Jones and Bartlett Publishers

**Shiksha Mandal's**

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**B.Sc. Semester III (Microbiology)**

**Chemistry of Organic Constituents, Enzymology and Metabolism**

(UG-MB (08)-S3-T)

**Unit I—Carbohydrates and Metabolism**

- A) Definition of Carbohydrate, Classification of carbohydrates, Structure of monosaccharides: glucose, fructose. Structure of disaccharides: maltose, lactose, sucrose. Concept of glycosidic bond, Trisaccharide: raffinose. Homopolysaccharides: starch, glycogen, cellulose. Heteropolysaccharides: hyluronic acid.
- B) General strategy of metabolism, EMP pathway and its regulation, TCA cycle and its regulation, substrate level phosphorylation, Cyclic and noncyclic photophosphorylation, Oxidative phosphorylation.

**Unit II--- Proteins, Amino acids and Metabolism**

- A) Definition of protein, Classification of protein, Biological importance of protein, Protein degradation.
- B) Classification of amino acids, titration curve, acidic, basic and neutral amino acids, peptide bond theory, organizational levels of proteins, concept of oligomeric protein.
- C) Amino acid breakdown, deamination (alanine, tyrosine, methionine), urea cycle, gluconeogenesis and ketogenesis.

**Unit III---Lipid and Lipid Metabolism**

- A) Definition of lipids, Classification of lipids, structure of triglycerides, compound lipids, derived lipids, Biological functions of lipids.
- B) Definition of fatty acid, Beta oxidation, Omega oxidation, alpha oxidation, oxidation of odd number fatty acids, oxidation of branched chain fatty acids.

**Unit IV --- Nucleic acid and Metabolism**

- A) DNA, RNA and various forms of DNA & RNA, Structure of purines, pyrimidines, nucleosides & nucleotides, Replication of DNA, Modes of replication, general features, rolling circle & knife & fork model.

B) Nucleotide metabolism, biosynthesis of purine nucleotide & biosynthesis of pyrimidine nucleotides.

### **Unit V--- Enzymology**

A) General concept, Definition and nature of enzymes, classification, nomenclature, models of enzyme action, (Lock & key, Induced fit model, Strain model), primary concept of enzyme kinetics, MM equation, modifications of MM equations (LB plot, Eadie hofstee, Hill plot, Hanes woolf plot), activation energy, transition state, ES complex, enzyme activity, katal, specific activity, turn over number, Significance of  $K_m$  and  $V_{max}$ .

B) Enzyme inhibition and their types, enzyme regulation & their types, allosteric sites, allosteric modulators, functional diversity such as holoenzyme, apoenzyme, coenzyme, cofactor, prosthetic group, isoenzymes, membrane bound enzymes, multienzyme complex, zymogens.

### **Unit VI---Vitamins**

A) Classification on the basis of solubility, Water soluble vitamins, structure, function & chemistry of vitamin B1, B2, B12, vitamin C.

B) fat soluble vitamin: Structure, function & chemistry of vitamin A, D, E & K, Hyper and hypovitaminosis

### **Practicals Semester III (UG-MB(08)-S3-P)**

1. Qualitative analysis of carbohydrates, lipids and proteins.

2. Estimation of carbohydrates by DNS/ anthrone =method.

3. Detection of enzymes: amylase, catalase, gelatinase, lipase.

4. Estimation of proteins by Lawrys method.

5. Estimation of DNA.

6. Estimation of RNA.

7. UV absorption of Nucleic acid.

8. Effect of PH on enzyme activity

9. Effect of temperature on enzyme activity.

10. Effect of substrate concentration on enzyme activity.



## 11. Estimation of lipid/cholesterol.

### List of Reference Books for Sem III Microbiology:

1. Biochemistry: - Lehninger
2. General Microbiology. Vol 1 & II. : - Powar & Dagainawala
3. An Introduction to Biochemistry by Plummer 3rd Edition, Tata McGraw – Hill
4. Molecular Biology of the Cell: - J. D. Watson, D. Bray
- 5 The DNA Story: - J. D. Watson
- 6 Genetics of Prokaryotes: - Srivastava et.al
- 7 Genes: - Pramod Kumar
8. Genetic Engineering and its Applications -Joshi P.
- 9 Gene Transfer and Expression a Laboratory Manual: - Michael Kriegler
- 10) Concept in biotechnology: - D. Balasubramaniam
11. Essential Genetics: - Daniel. Hartl.
12. Nelson D.L and Cox M.M.(2002) Lehninger's Principles of Biochemistry, Macmillan Worth Pub.Co.New Delhi.
13. Garrett, R.H and Grisham,C.M (2004) biochemistry. 3<sup>rd</sup> ed.Brooks/Cole, publishing company,California.
14. Jain J.L,Nitin Jain, Sunjay Jain (1979) Fundamentals of Biochemistry.7<sup>th</sup> edition, S.Chand publishers.
15. Satyanarayana U., Chakrapani U.(2014)Biochemistry ,4<sup>th</sup> edition.

# Shiksha Mandals

Bajaj College of science (Autonomous), Wardha

B.Sc. Semester IV (Microbiology)

Industrial and Applied Microbiology

(UG-MB(08)-S4-T)

## Unit I---Fundamentals of industrial microbiology

Definition and scope of industrial microbiology, general concept, primary screening, secondary screening, strain development, types of fermentation processes, design of typical ferment, parts of fermentor, types of fermentors, sterilization of fermenters.

## Unit II ---Concept of upstream & downstream processes.

Raw materials for media preparation, sterilization of media, Inoculum development, scale up of fermentation process, Conditions required for fermentation, control of agitation, temperature, aeration, pH and dissolved oxygen.

## Unit III ---Industrial Production

Production, biochemistry, recovery and uses of: SCP, Bakers yeast, ethanol, penicillin, semisynthetic penicillin, citric acid, Vit B12 and beer and wine.

## Unit IV ---Water microbiology

A) Significance of bacteriological analysis of water, indicators of excretal pollution, collection and handling of water samples, Definition of coliforms, bacteriological analysis of water for coliforms and faecal streptococci (MTFT, MFT).

B) Water treatment using SSF and RSF, methods of chlorination.

## Unit V---Waste water treatment

Definition and composition of sewage, Sewage types, characteristics of sewage, BOD, COD, Treatments of sewage, Primary & secondary treatment, Trickling filter, activated sludge, RBC, sludge digester, oxidation pond, septic tank, imhoff tank.

## Unit VI--- Air, Soil and Food microbiology

A) Microbial analysis of air, composition of air, settling plate and Anderson sampler, Lemons sampler.

B) Symbiotic & non symbiotic nitrogen fixers examples in soil, biopesticides, biofertilizers, mycorrhiza, microbial leaching of copper and uranium.

Milk: Composition, Pasteurization of milk, Grades of milk

Food spoilage organisms, factors affecting food spoilage, canning process, pasteurization, food preservation, low temperature preservation, chemical preservation

Food borne diseases: salmonellosis and food intoxication: botulism

### **Practicals IV<sup>th</sup> Sem** (UG-MB(08)-S4-P)

1. Production and estimation of alcohol
2. Isolation of amylase producer from soil
3. Isolation & microscopic observation of organisms from water and sewage
4. Bacteriological analysis of water by MTFT & determination of MPN
5. Identification and differentiation of coliforms by IMViC Test
6. Determination of DO
7. Determination of Alkalinity of water
8. Determination of BOD
9. Determination COD
10. Detection of arsenic by bioassay
11. Determination of Chlorine demand
12. Isolation & microscopic observation of microorganisms from spoiled food.

### **List of Reference Books for Microbiology:**

1. Introduction to Soil Microbiology : Alexander Martin
2. Soil Microbiology: Subbaroa N.S.
3. Introduction to environmental Microbiology: Mitchell, Ralph
4. Sewage & Waste treatment : Hammer
5. Water Pollution : Zajic J.E.
6. Water Pollution Microbiology : Mitchell R.
7. Air Pollution : Perlins H.L.
8. Aquatic Microbiology : Stainer & Shewan
9. Introduction to Waste Water Treatment processes: Ramalhr R.S.
10. Fermented Foods (Vol.7): Rose A.A.
11. Industrial Microbiology: Prescott S.C. & Dunn C.G.
12. Industrial Microbiology : Miller B.M. & W. Litsky
13. Industrial Microbiology : A.H. Patel
14. Microbial Technology : Pepler H.J. (Vol. I & II)
15. Industrial Microbiology : Casida L.E.
16. Principles of Fermentation : Stanbury, Peter F. & Technology Allan.
17. Outlines of Dairy Bacteriology : Sukumar De
18. Modern Food Microbiology : Jay, Mames M.
19. Principles of Industrial : Rhodes & Fletcher. Microbiology
20. Industrial Fermentation : Under Kofler & Hick. Vol. I & II
21. Dairy Microbiology : Foster Etal
22. Industrial Microbiology : Rose

### **BOOKS RECOMMENDED FOR PRACTICALS :**

1. Microbes in Action : Seely, Wander Mark, Taraporewala, Bombay.
2. Manual of Microbiological : A.J. Salle, Methods
3. Microbiological Methods : Collins

## Shiksha Mandals

**Bajaj College of science (Autonomous), Wardha**

### B.Sc. Semester V (Microbiology)

SEMESTER – V		
Course Code	Title	Lectures
UG-MB(08)-S5-T	<b>MEDICAL MICROBIOLOGY AND IMMUNOLOGY</b>	
<b>Unit-I</b>	<p style="text-align: center;"><b>Epidemiology and host–parasite relationship.</b></p> <p><b>1. Definitions:</b></p> <p>i. Signs, symptoms and syndrome of disease, stages of infectious diseases-incubation period, prodromal phase, Invasive phase, decline phase and the period of convalescence, primary infection, secondary infection, acute infection, chronic infection local and systemic infection, iatrogenic infection, nosocomial infection, congenital infection, teratogenic infection, fulminating infection, atypical infection, latent infection</p> <p>ii. Bacteremia, septicaemia, pyamia, toxemia, Viremia.</p> <p>ii. Epidemic, Endemic, Pandemic, Zoonotic, Exotic, prosodemc sporadic deisease.</p> <p><b>2. Dynamics of disease transmission:</b></p> <p>i. Causative or etiological agents [list]</p> <p>ii. Sources of reservoir of infection. Exogenous Human(case and carrier) Non-living reservoir. Endogenous infections</p> <p>iii. Portal of exit</p> <p>iv. Mode of transmission-Contact, Vehicle,Vector,Air-borne,transplacental and laboratory/hospital infections.</p> <p>v. Portal of entry.</p> <p>vi. Susceptibility of host.</p> <p><b>3. Control of communicable diseases: Control of sources, blocking the channels of transmission, protecting the susceptible host.</b></p>	10

<p><b>Unit-II</b></p>	<p><b>Infectious Microbiology and Normal Flora</b></p> <ol style="list-style-type: none"> <li>1. Microbial mechanism of Pathogenicity: pathogenicity and virulence, exaltation and attenuation, MID, MLD, ID 50, LD50.             <ol style="list-style-type: none"> <li>i. Invasiveness:-adherence,capsule,enzymes.</li> <li>ii. Toxigenicity:-Exotoxins and Endotoxins.</li> </ol> </li> <li>2. Normal flora of healthy human host:             <ol style="list-style-type: none"> <li>i. Definition, origin, significance, Germ free and Gnotobiotic life.</li> <li>ii. Characteristics of normal flora</li> </ol> </li> <li>3. Infectious microbiology: Microbial diseases of skin, eye, digestive, respiratory, cardiovascular, lymphatic, urinary, reproductive and nervous systems. (Outline of structure of each system and lists of infectious diseases affecting the particular system).</li> </ol>	<p>10</p>
<p><b>Unit- III</b></p>	<p><b>Study of pathogenic organisms, Morphology, cultural characteristics, biochemical characteristics, pathogenesis, serology, lab diagnosis and disease control</b></p> <ol style="list-style-type: none"> <li>1. <b>Bacteria</b> <ol style="list-style-type: none"> <li>i. <i>Salmonella typhi</i> and <i>paratyphi</i> A &amp; B.</li> <li>ii. <i>Spirochetes-Treponema pallidum</i></li> </ol> </li> <li>2. <b>Viruses</b> <ol style="list-style-type: none"> <li>i. HIV</li> </ol> </li> <li>3. <b>Protozoa</b> <ol style="list-style-type: none"> <li>i. Plasmodium</li> </ol> </li> </ol> <p><b>Disease control</b></p> <ol style="list-style-type: none"> <li>1. Basic mechanism of action of drugs.             <ol style="list-style-type: none"> <li>i. Bacterial cell wall synthesis inhibitor: Penicillin</li> <li>ii. Bacterial protein synthesis inhibitor: Chloramphenicol</li> <li>iii. Bacterial DNA synthesis inhibitor: Nalidixic acid, Floxacin</li> <li>iv. Antimetabolites: Trimethoprim, sulfamethoxazole.</li> </ol> </li> <li>2. Nonautomated and automated in vitro drug susceptibility testing-Kirby-Bauer disc diffusion method and e-strip method.</li> <li>3. Various mechanisms of development of drug resistance</li> </ol>	<p>10</p>

<b>Unit-IV</b>	<p style="text-align: center;"><b>Immunity and Non specific defenses</b></p> <ol style="list-style-type: none"> <li>1. Immunity: Definition and general concept</li> <li>2. Haematopoiesis and Cells of immune system       <ol style="list-style-type: none"> <li>a) Diagram of Haematopoiesis</li> <li>b) General characteristics of           <ol style="list-style-type: none"> <li>i. B and Tcells,</li> <li>ii. Monocytes and macrophages,</li> <li>iii. Neutrophils, Eosinophils and basophiles.</li> <li>iv. Mast cells</li> <li>v. Dendritic cells</li> <li>vi. Natural Killer cells</li> </ol> </li> </ol> </li> <li>3. Non specific defenses of the host:       <ol style="list-style-type: none"> <li>a) Species, race and individual resistance.</li> <li>b) Age, sex, hormonal and nutritional influences.</li> </ol> </li> <li>4. Mechanism of non-specific defenses:       <ol style="list-style-type: none"> <li>a) First line of defense – Physical, chemical and biological barriers</li> <li>b) Second line of defense:           <ol style="list-style-type: none"> <li>i. Humoral components: Defensins, pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs), complement, kinins, acute phase reactants.</li> <li>ii. Cellular components: Phagocytic cells – PMNL, macrophages (reticulo-endothelial cell system) and dendritic cells</li> </ol> </li> </ol> </li> <li>5. Functions: Phagocytosis (oxygen dependent and independent systems), Complement activation (General concept), Coagulation system, Inflammation (cardinal signs, mediators, vascular and cellular changes, role of Toll-like receptors)</li> </ol>	10
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<p><b>Unit-V</b></p>	<p><b>1. Antigen:</b></p> <ul style="list-style-type: none"> <li>a) Concepts and factors affecting immunogenicity</li> <li>b) Antigenic determinants, haptens and cross-reactivity, Carriers, Adjuvants</li> <li>c) Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, Autoantigens, Isoantigens, Species specific antigens, Organ specific antigens, Heterophile antigens</li> </ul> <p><b>2. Immunoglobulins:</b></p> <ul style="list-style-type: none"> <li>a) Structure of basic unit, chemical and biological properties</li> <li>b) Characteristic of domain structure, functions of light and heavy chain domains</li> <li>c) Molecular basis of antibody diversity (kappa chain, lambda chain and heavy chain diversity)</li> <li>d) Classes of Immunoglobulins and their functions.</li> </ul> <p><b>3. Organs of immune system:</b></p> <ul style="list-style-type: none"> <li>a) Primary lymphoid organs (Thymus and Bursa): Thymus – structure, thymic education (positive and negative selection), Bone marrow</li> <li>b) Secondary lymphoid organs – Structure and function of spleen and lymph node, mucous associated lymphoid tissue and lymphatic system and lymph circulation</li> </ul>	<p>10</p>
<p><b>Unit- VI</b></p>	<p><b>1. Adaptive / Acquired Immunity (Third line of defense):</b></p> <ul style="list-style-type: none"> <li>a) Acquired immunity: Active and Passive immunity.</li> <li>b) Primary and secondary response and its significance in vaccination programs</li> <li>c) Clonal selection and clonal deletion (immunotolerance)</li> <li>d) B cell biology, role of cytokines in activation and differentiation of B-cells</li> </ul> <p><b>2. Cell Mediated Immune Response</b></p> <ul style="list-style-type: none"> <li>a) Activation and differentiation of T cells</li> <li>b) Mechanism of CTL mediated cytotoxicity, ADCC</li> <li>c) Applications of CMI</li> </ul> <p><b>3. T-cellbiology</b></p> <ul style="list-style-type: none"> <li>a) T-cell dependent antibody response. outline</li> <li>b) T-cell independent antibody response. outline</li> <li>c) Types of T-cells and Cluster of differentiation (CD)</li> <li>d) T-cell receptor (TCR)</li> </ul> <p><b>4. Major Histocompatibility Complex:</b></p> <ul style="list-style-type: none"> <li>a) Definition, Structure and functions of MHC class-I and class-II molecules</li> <li>b) Antigen presentation, endogenous and exogenous pathways (diagrammatic)</li> </ul> <p><b>5. Cytokines</b></p> <ul style="list-style-type: none"> <li>a) Definition and general characteristics</li> <li>b) Types- colony stimulating factor, Interleukins, Tumor necrosis factor</li> </ul>	<p>10</p>

<b>SEMESTER V</b> (UG MB(08)-S5-P)		
<b>Sr. No.</b>	<b>PRACTICAL</b>	<b>Lectures</b>
1	Identification of bacteria: <i>E.coli, S.aureus, Salmonella, Proteus vulgaris</i>	20*3
2	Study of permanent slides- T.S. of spleen, thymus, bursa of fabricius and lymph node	
3	Perform Quantitative WIDAL test	
4	Rapid plasma reagin (RPR) Test titre	
5	Blood Group Detection (Direct and Reverse typing)	
6	Perform Immunodiffusion	
7	ELISA Test	
8	Serum Protein Separation by electrophoresis	
9	Coomb's Direct test	
10	Perform VDRL test	
11	Antibiotic sensitivity test by Kirby-Bauer method and e -strip method	
<b>Mandatory to Perform at least 8 practical</b>		
<p><b>Scheme of practical examination-</b></p> <p>1) One long expt.-----10 Marks</p> <p>2) One short expt.----- 05 Marks</p> <p>3) Spotting----- 05 Marks</p> <p>4) Viva-voce-----05 Marks</p> <p>5) Record-----05 Marks</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">30 Marks</p>		

## Reference Books:

1. Jawetz, Melnick and Adelberg's Medical Microbiology, 26<sup>th</sup> Edition, Lange publication
2. Bacterial Pathogenesis –A molecular approach Abigail Salyer And Dixie Whitt 2nd Ed ASM press
3. Ananthanarayan and Panicker's, Textbook of Microbiology, 9 edition
4. Kuby Immunology, 6<sup>th</sup> Edition, W H Freeman and Company
5. Pathak & Palan, Immunology: Essential & Fundamental, 1<sup>st</sup>& 3<sup>rd</sup> Edition, Capital Publishing Company
6. Fahim Khan, Elements of Immunology, Pearson Education
7. Baron Samuel , Medical Microbiology, 4 edition
8. Tortora, G.J., Funke, B.R., Case, C.L, 1992. Microbiology: An introduction 5th Edition, Benjamin Pub. Co. NY
9. Roitt, P.I: Mims, C.J. Medical Microbiology
10. Chakraborty, P., 2003 A textbook of Microbiology, 2nd Edition New Central Book Agency, India.
11. Medical Microbiology edited by Samuel Baron. Fourth edition. (University of Texas Medical Branch of Galvesion)
12. Sherris, John C, Ed, Medical Microbiology: an Introduction to infectious diseases.



Elsevier Publication IInd edition.

13. Virulence mechanisms of bacterial pathogens (Second edition) by Roth, Bolin, Brogden Minion and Michael.
14. Ganti, A. Sastry.1975. Veterinary Pathology. Seventh Edition. Revised by P. Rama Rao.
15. Davis B.D., Delbacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY
16. Wolfgang K. Joklik, 1992, Zinsser Microbiology 20<sup>th</sup> Edition, McGraw-Hill Professional Publishing.
17. Dey, N.C and Dey, TK. 1988, Medical Bacteriology, Allied Agency, Calcutta, 17 Edition
18. Ananthnarayana, R. and C.E, JayaramPanikar, 1996 Text book of microbiology, 5th edition, Orient Longman.
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24. Prescott, L. M., Hartley, J. P. and Klein, D. A., (1993), Microbiology, 2nd Ed., W. M. C. Brown Publ, England
25. Banker, D (1980), Modern Practice in Immunization, 3rd Ed., Popular Prakashan Pvt. Ltd., Bombay.
26. Coleman, R. M, Lombard M F, Sicard, R. E., (1989), Fundamental Immunology, 2nd Ed., W. C. Brown Publishers,USA.
27. Glazier, A. M., Nikaido, H., (1995), Microbial Biotechnology, W. H. Freeman and Co., New York.
28. Kimball, J. W, (1990), Introduction to Immunology, MacMillan Publishing Company, New York.
29. Vyas, S. P. and Dixit, V. K. (1998), Pharmaceutical Biotechnology, CBS Publisher, New Delhi.
30. Weir, D. M., (1991), Immunology, Livingstone, ELBS and Churchill.

# Shiksha Mandals

## Bajaj College of science (Autonomous), Wardha

### B.Sc. Semester VI (Microbiology)

SEMESTER VI		
Course Code	Title	Lectures
UG-MB(08)-S6-T	<b>MOLECULAR BIOLOGY, BIOINSTRUMENTATION AND BIOTECHNOLOGY</b>	
<b>Unit-I</b>	<b>Gene mutation and regulation.</b> 1. Concept of gene, muton, recon, cistron, monocistronic and polycistronic gene, gene within gene, split gene. 2. Gene regulation: lac operon (detail) 3. Mutation: Definition, random vs directed mutation, type of mutation, base pair substitution, frameshift, point, nonsense, missense, and silent mutation. 4. Genetic suppression: Intergenic and Intragenic. 5. Molecular basis of mutation: Mechanism of spontaneous and induced mutation. <b>Genetic recombination:</b> 1. Definition, Basic concept of recombination 2. General types of recombination. 3. Transformation. 4. Conjugation 5. Transductions 6. Transposable genetic elements (Prokaryotic)	10
<b>Unit-II</b>	<b>Genetic code and protein synthesis</b> 1. Characteristics of genetic code: triplet code, nonoverlapping code, comma less, codons, anticodons, deciphering of code, wobble hypothesis, colinearity of gene structure & its polypeptide products. 2. Transcription: Central dogma of molecular biology. Components of transcription, process of transcription (prokaryotes), RNA Polymerases. 3. Protein synthesis: Outline, process of translation (Prokaryotes)	10

<b>Unit- III</b>	<b>Tools &amp; Techniques of Genetic engineering</b> 1. Introduction- Definition & scope of Biotechnology & Recombinant DNA technology. 2. Preparation of pure sample of DNA, enzymes used in DNA manipulation, analysis of DNA fragment size, joining of DNA fragments, vectors & their types 3. Introduction of rDNA into host cell, transformation of cells, identification of transformed cells, selection of clones – direct & indirect methods. 4. Expression of cloned genes, construction of gene library, cells for cloning, expression of prokaryotic genes. 5. PCR & its application, DNA finger printing.	10
<b>Unit- IV</b>	<b>Industrial Biotechnology</b> 1. Biosensors—General concept of construction, Applications, Glucose sensor as an example. Concept of Nanobiotechnology 2. Biochips- definition, example and applications 3. Enzyme technology- Applications of enzymes in industry, Production of industrial enzyme—amylase by deep tank & SSF, purification & recovery. Immobilized enzymes – applications & general methods of production- example invertase immobilization. 4. Ethics & hazards of biotechnology	10
<b>Unit -V</b>	<b>Bioinstrumentation-I (Principles and applications)</b> 1. Spectroscopy: Laws of absorption, limitations of Beer law, UV-Visible spectroscopy and its applications. 2. Centrifugation: Types of centrifuge, analytical and differential centrifugation. 3. Electrophoresis: Principle, agarose gel electrophoresis and SDS- PAGE. 4. Factors affecting electrophoresis mobility 5. Chromatography: Thin layer chromatography, ion exchange, gel filtration 6. Isotope tracer technique: Method and applications. 7. Detection and measurement of stable isotope: Mass spectrometry. 8. Detection and measurement of radioactive isotope: GM counter, scintillation counter.	

<b>Unit –VI</b>	<b>Applied Biotechnology.</b>	10
	1. Oriental Fermented food: Definition and production of soya sauce	
	2. Genetically modified foods- Definition and concept of golden rice	
	3. Transgenic plants— Definition and concept of BT Cotton	
	4. Production of hormones : Insulin	
	5. Production of Interferon	
	6. Production of vaccines : Conventional vaccines – BCG, Salk, Diptheria Toxoid, ATS, DNA Vaccine, Edible vaccines	
	7. Hybridoma technology, monoclonal antibody production.	
8. Gene Therapy.		

<b>SEMESTER VI</b>		
<b>Sr. No.</b>	<b>PRACTICAL</b> (UG-MB(08)-S6-P)	<b>Lectures</b>
1	Isolation of plasmid DNA	20*3
2	Demonstration of restriction digestion	
3	Estimation of creatinine by spectrophotometric method	
4	Perform gel filtration chromatography	
5	Perform paper chromatography of amino acids and sugars	
6	Perform TLC of amino acids and sugars	
7	Production of biopesticides	
8	Production of biofertilizer (Determination of Total viable count)	
9	Immobilization of yeast and demonstration of invertase activity	
10	Perform Transformation (Preparation of competent cell)	
<b>Mandatory Perform at least 8 practical</b>		
<b>Scheme of practical examination-</b>		
1) One long expt.-----10 Marks		
2) One short expt.----- 05 Marks		
3) Spotting----- 05 Marks		
4) Viva-voce-----05 Marks		
5) Record-----05 Marks		
----- 30 Marks		

## Reference Books:

1. Tortora, G.J., Funke, B.R., Case, C.L, 1992. Microbiology: An introduction 5th Edition, Benjamin Pub. Co. NY
2. Roitt, P.I: Mims, C.J. Medical Microbiology
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18. Gardner, Simmons, Snustad. (2006), Principles of Genetics, 8<sup>th</sup>Edn.John Wiley & Sons. Inc. New York.
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21. Levine, Richard Losick, (2013 ), Molecular Biology of the Gene, 7 Edn. Pearson Publishers.
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26. Russel, Peter, (1990), Essential Genetics, 7th Edn. Blackwell Science Pub.
27. Strickberger, M.W. (1985), Genetics, 3rd Edition Macmillan Pub. Co. NY.