

Shiksha Mandal's
Bajaj College of Science (Autonomous), Wardha
Department of Microbiology
B.Sc. Microbiology
Syllabus
B.Sc. Semester I (Microbiology)-NEP 2020
DSC –I Microbiology
History and Microbial Morphology
(UMB110T)

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: 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: 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

(UMB110P)

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)

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2) General Virology : Luria, S.E.

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5) Microbiology :Pelczar, Chan, Krieg.(TMH)

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- 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 (Neer ali Publication)

List of books for practical's

- 1) Microbes in Action : Seely, Wander Mark Tarporewala, Bombay
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Practicals Sem I

(UMB111P)

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9. Demonstration of antibiotic disc sensitivity test.

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

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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)

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- 3) Microbiology Methods : Collins
- 4) Bacteriological Techniques :F.J.Baker
- 5) Introduction to Microbial Techniques :Gunasekaran
- 6) Biochemical methods: Sadashivam&Manickam
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Bartlett Publishers

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

B.Sc. Sem I

General Elective-I (GE-I) course

Name of the course: Food spoilage and food safety

(UMBG111)

[2 lectures per week 15 weeks * 2 lectures = 30 L]

[Credits 2]

Course Description:

Food is fundamental to our existence. Therefore it is important to learn the science of food. Food Microbiology is the applied field of Microbiology that aims to study the role of microorganisms in diet and those contaminate/spoil food and food borne diseases.

Course Objectives:

To understand food microbiology with reference to food safety

To recognize the possible role of microorganisms to ensure public safety

Course Learning Outcomes:

Learner will acquire knowledge about food safety: The food Safety rules and regulations, Food safety Management System (FEMS) and Microbiological Risk assessment

Learner will acquire knowledge about food spoilage, Role of different microorganisms in spoiling food, food fermentation and food borne disease.

Unit I: Food safety

Food safety rules and regulations, Food safety Management System (FEMS) and Microbiological Risk assessment. Investigation Procedure for ensuring food safety and Hygiene. food safety law

Unit II: Food Spoilage

Introduction to Food Spoilage of Fruits, Vegetables and their products, Dairy Products. Microbial genera involved in food spoilage

Unit III: Food Poisoning and food born diseases

Introduction to microbial toxins that contaminate or spoil the food. Food born diseases.

References:

Food microbiology: fundamentals and frontiers. 2nd ed. Washington (DC): American Society for Microbiology MP, Beuchat LR, Montville TJ, editors. 2001.

Food Microbiology: Fundamentals and Frontiers, Third Edition, ASM Press Doyle, M. P. and Beuchat, L. R. 2007.

Food Microbiology by Westhoff, Fourth Edition, Tata McGraw-Hill Publishing company Ltd.

The microbiological safety and quality of foods. Volume 1 & 2. Gaithersburg (MD): Aspen Lund BM, Baird-Parker TC, Gould GW, editors. 2000

Food Microbiology R. Rajeshwari Anburaj Edited by Dr. P. F. Steffi ISBN 978-81-947191-6-8. published by Ryan publisher Tamilnadu.

Shiksha Mandal's
Bajaj College of Science, Wardha (Autonomous)
B.Sc. SEM I
VSEC-I (VSC I)
Name of the course: Elementary Microbiology
(UMB112P)

[4 hrs/week 15 weeks* 4 pract = 60 P]

[Credits 2]

Course Description: This course comprises basic practical aspects of microbiology which includes study of bacterial morphology, isolation of antibiotic and pigment producing bacteria.

Course objective

To provide hands on experience of potential of variety of metabolite producing microorganisms in the laboratory.

Course Outcome

PO1: Students will develop practical skills of tools and techniques used to study microbiology.

PO2: Students shall gain knowledge of microbial technology and its applications in the production of industrially important microbial products.

PO3: Students will understand the types of extracellular enzymes produced by bacteria and ferment variety of sugars.

PO4: The knowledge regarding the morphology of bacteria will be understood.

Practicals:

1. Study of morphology of bacteria
2. Isolation of antibiotic producing microorganism from soil
3. Isolation of pigment producing bacteria from soil
4. Screening of urease enzymes producing bacteria
5. Screening of pectinase enzymes producing bacteria
6. Study of carbohydrate fermentation by tube method
7. Demonstration of cultivation of mushroom

References

- Joanne Willey, Linda Sherwood, Chris Woolverton, Lansing Prescott, John Harley(2012) Prescott's Microbiology + Lab Exercises by Harley. 7th edition. Mc Graw Hill Publisher
- Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition Pearson Education (Singapore) Pvt. Ltd.(ISBN: 978-9332535190)
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition, New Age International Publishers, (ISBN: 978-9386418302)
- R C Dubey an D.K.Maheshwari (2010) Practical Microbiology. S Chand Publisher. ISBN 9788121921534
- Frank E. Berkowitz, Robert C. Jerris (2015) Practical Medical Microbiology for Clinicians. John Wiley & Sons, Inc.

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B.Sc. Semester II (Microbiology)-NEP 2020
DSC –II Microbiology
Microbial Techniques
(UMB120T)

Unit-I: Microscopy: Basic Principle and Applications

i) Bright field microscopy concept of Resolution, Magnification, Numerical aperture 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, Helmstetter Cummings Filterpad Technique
iv) Methods for 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. Applications of physical control agent.

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 control 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

(UMB120P)

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 of 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)

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Microbial Techniques
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B.Sc. SEM II

Generic Elective Course II (GE-II)

Name of the course: Basics of Soil Health

(UMBG121)

[4 hrs/week 15 weeks* 4 pract = 60 P]

[Credits 2]

Course Description

The course comprises the study of biogeochemical cycles of carbon, nitrogen, Phosphorous etc. It also focuses on nitrogen fixation and biofertilizers.

Learning Objectives

- Impart in-depth information on soil and agriculture
- Make the students understand the role of microbes in agriculture
- Understanding the key concepts in soil and agricultural microbiology
- Make the students understand the role of microbes in agriculture
- Give an overview on plant microbe interaction

Course Learning Outcome

- Make the students to know about various microorganisms involved in biofertilizers production
- To introduce the importance of biofertilizers
- Outline the physico- chemical aspects of the soil and its microbial diversity
- Evaluate the role of microbes in the different biogeochemical cycles and in agriculture
- Discuss biological nitrogen fixation in symbiotic and non symbiotic associations with plant

Syllabus:

Unit 1 Microbial transformations of minerals

Biogeochemical cycles-Carbon, Nitrogen, Phosphorous and Sulphur cycles.
Organic matter decomposition, humus formation and C:N ratio.

Unit 2 Biological Nitrogen fixation

Microorganisms in the Rhizosphere, Rhizoplane and Phylloplane-Biological nitrogen fixation, symbiotic and free-living nitrogen fixation, importance of nitrogen fixation

Unit 3 Biofertilizers and its Types

Biofertilizers – Importance and various types of Biofertilizer Rhizobium, Azotobacter, Azospirillum, Cyanobacteria, Phosphate solubilizing microorganism, Mycorrhizal biofertilizers, Concept of PGPR

References

- Subba Rao, N. S., 2019. Biofertilizers in Agriculture and Forestry, 4 Ed., Cbs Publ & Dist Pvt Ltd, New Delhi.
- Subba Rao, N. S. 1995. Soil microorganisms and plant growth. Oxford & IBHPublishing Co.Pvt.Ltd. New Delhi.
- Gupta, S.K., 2014 Approaches and trends in plant disease management. Scientific publishers, Jodhpur, India.
- Jamaluddin et al., 2013 Microbes and sustainable plant productivity. Scintific Publishers Jodhpur, India.
- Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
- Glick, B.R. AND Pasternak, J.J, 1994. Molecular Biotechnology, ASM Press, Washington DC.
- Purohit, S. S., Kothari, P. R. and Mathur, 1993. Basic and Agricultural Biotechnology, Agrobotanical Publishers (India). Bikaner.

Shiksha Mandal's
Bajaj College of Science, Wardha (Autonomous)
B.Sc. SEM II

Skill Enhancement Course I (SEC-I)

Name of the course: Biopreservation of Perishable Foods

(UMB123P)

[4 hrs/week 15 weeks* 4 pract = 60 P]

[Credits 2]

Course Description: Chemical preservation of foods proved to be harmful and responsible for various deleterious effects on health. This course will help the students to learn about significance of biological preservation of perishable foods.

Learning Objective:

1. To learn food contamination and spoilage of perishable foods.
2. To learn how to preserve perishable foods using Lactic acid bacteria.

Course Learning Outcome: The students will learn how to preserve the perishable foods by using Lactic acid bacteria. This skill will help him/her to enter in food processing industry.

Practicals:

1. Isolation and identification of food borne pathogens and spoilage organisms from perishable food samples .
2. Total viable count/ml (TVC) and proteolytic organisms from perishable food samples.
3. Isolation and Identification of Lactic acid bacteria (LAB).
4. Antimicrobial activity of bacteriocinogenic LAB by agar well diffusion method.
5. Biopreservation of Meat, Fish and Poultry by viable LAB.

6. Biopreservation of Meat, Fish and Poultry by cell free supernatant (CFS)

References :

1. Food microbiology by Frazier, W. C. (William Carroll)Publication 1988
Publisher New York : McGraw-Hill. Publishing company Pvt. Ltd.
2. Food Biopreservation (Springer Briefs in Food, Health, and
Nutrition) 2014th Edition, Kindle Edition.
3. Analytical Techniques for Food Biopreservation Hardcover – 30
November 2016 by Nguyen Minh Nhut (Editor), ISBN-13 : 978-
1680957488,Amazon. In

Shiksha Mandal's

Bajaj College of Science (Autonomous), Wardha

B.Sc. Semester III (Microbiology)

Chemistry of Organic Constituents, Enzymology and Metabolism

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

Unit I—Carbohydrates and its 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: hyaluronic 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, Structure of Protein, Primary, Secondary, Tertiary, Quaternary structure, 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), 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 acids DNA, RNA and Nucleotide 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, Eadiehofstee, 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

Practical's 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 by diphenylamine method.
6. Estimation of RNA by Orcinol reagent.
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&Daginawala
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. 3rded.Brooks/Cole, publishing company,California.
14. Jain J.L,Nitin Jain, Sunjay Jain (1979) Fundamentals of Biochemistry.7th edition, S.Chand publishers.
15. Satyanarayana U., Chakrapani U.(2014)Biochemistry ,4th 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 fermenter, parts of fermenter, types of fermenters, 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, Dairy 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

Practical's Semester IV (UG-MB (08)-S4-P)

1. Production and estimation of alcohol
2. Isolation of amylase producer from soil
3. Bacteriological analysis of water by MTFT & determination of MPN
4. Identification and differentiation of coliforms by IMViC Test
5. Determination of DO
6. Determination of BOD
7. Determination COD
8. Detection of Arsenic by bioassay
9. Determination of Chlorine demand
10. MBRT Test
11. Phosphatase test
12. Estimation of antibiotic Penicillin
13. 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
4. DifcoManual.

Shiksha Mandals

Bajaj College of science (Autonomous), Wardha

B.Sc. Semester V (Microbiology)

	SEMESTER – V	
Course Code	Title	Lectures
UG-MB(08)-S5-T	MEDICAL MICROBIOLOGY AND IMMUNOLOGY	
Unit-I	<p>Epidemiology and host–parasite relationship.</p> <p>1. Definitions:</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, pyemia, toxemia, Viremia.</p> <p>ii. Epidemic, Endemic, Pandemic, Zoonotic, Exotic, prosodemic sporadic disease.</p> <p>2. Dynamics of disease transmission:</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>3. Control of communicable diseases: Control of sources, blocking the channels of transmission, protecting the susceptible host.</p>	10

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

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

SEMESTER V (UG MB(08)-S5-P)		
Sr. No.	PRACTICAL	Lectures
1	Identification of bacteria: <i>E.coli</i> , <i>S.aureus</i> , <i>Salmonella</i> , <i>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	
Mandatory to Perform at least 8 practical		
<p>Scheme of practical examination-</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, 26th 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, 6th Edition, W H Freeman and Company
5. Pathak & Palan, Immunology: Essential & Fundamental, 1st& 3rd 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 20th 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.
19. Park and Park, Preventive and Social medicine. 2013, Publisher: BanarsidasBhanot, Jabalpur
20. David Greenwood, 1995, Antimicrobial Chemotherapy, 3rd Edition,Oxford University Press.
21. Franklin, T.J and Snow, G. A. 2012, Biochemistry of Antimicrobial Action. Springer Science & Business Media
22. Mukherjee, K.L 1988 Medical Laboratory Technology, Vol III, 10th Edition, Tata Mc. Graw-Hill Pub Co
23. Atlas, R. M. (1995), Microorganisms in our world, Mosby Year Book Inc.
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	MOLECULAR BIOLOGY, BIOINSTRUMENTATION AND BIOTECHNOLOGY	
Unit-I	Gene mutation and regulation. 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. Genetic recombination: 1. Definition, Basic concept of recombination 2. General types of recombination. 3. Transformation. 4. Conjugation 5. Transductions 6. Transposable genetic elements (Prokaryotic)	10
Unit-II	Genetic code and protein synthesis 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

Unit- III	Tools & Techniques of Genetic engineering 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
Unit- IV	Industrial Biotechnology 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
Unit -V	Bioinstrumentation-I (Principles and applications) 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.	

Unit –VI	Applied Biotechnology.	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, Diphtheria Toxoid, ATS, DNA Vaccine, Edible vaccines	
	7. Hybridoma technology, monoclonal antibody production.	
8. Gene Therapy.		

SEMESTER VI		
Sr. No.	PRACTICAL (UG-MB(08)-S6-P)	Lectures
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)	
Mandatory Perform at least 8 practical		
Scheme of practical examination-		
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
3. Chakraborty, P., 2003 A textbook of Microbiology, 2nd Edition New Central Book Agency, India.
4. Medical Microbiology edited by Samuel Baron. Fourth edition. (University of Texas Medical Branch of Galvesion)
5. Sherris, John C, Ed, Medical Microbiology: an Introduction to infectious diseases. Elsevier Publication IInd edition.
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8. Davis B.D., Delbacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY
9. Wolfgang K. Joklik, 1992, Zinsser Microbiology 20th Edition, McGraw-Hill Professional Publishing.
10. Dey, N.C and Dey, TK. 1988, Medical Bacteriology, Allied Agency, Calcutta, 17 Edition
11. Ananthnarayana, R. and C.E, JayaramPanikar, 1996 Text book of microbiology, 5th edition, Orient Longman.
12. Park and Park, Preventive and Social medicine. 2013, Publisher: BanarsidasBhanot, Jabalpur
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16. Bruce A. (2008), Molecular Biology of the Cell, 5th Edn. Publisher: Garland Science, New York.
17. David Freidfelder, (1987).Molecular Biology, 2ndEdn. Jones & Bartlett Pub.
18. Gardner, Simmons, Snustad. (2006), Principles of Genetics, 8thEdn.John Wiley & Sons. Inc. New York.
19. Gunther S. Stent, (1978), Molecular Genetics: An Introductory Narrative, 2 Edn. W.H.Freeman& Co.
20. Hayes, W. (1964), The Genetics of Bacteria and their Viruses, CBS Pub. New Delhi. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael
21. Levine, Richard Losick, (2013), Molecular Biology of the Gene, 7 Edn. Pearson Publishers.
22. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, (2012) Lewin's GENES XI , 11th Edn. Jones &Bartlett Learning
23. Lodish H. et al. (2012), Molecular Cell Biology, 7th Edn. W. H. Freeman & Company. New York.
24. Primrose, S. B. (2002).Principles of Gene Manipulation 6th Edn. Oxford: Blackwell Scientific Publications
25. Russel Peter. (2009), iGenetics: A Molecular Approach, 3rd Edn. Publisher BenjaminCummings
26. Russel, Peter, (1990), Essential Genetics, 7th Edn. Blackwell Science Pub.
27. Strickberger, M.W. (1985), Genetics, 3rd Edition Macmillan Pub. Co. NY.