

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

**Proposed Syllabus for Four Year Multidisciplinary UG Program with DSC as  
Major Microbiology**

**(e.g. Four Year B.Sc. Honors/Research Program)**

**Program: B.Sc. (Academic Session 2023-24) Syllabus under Autonomy**

**DSC –III offered by Department of Microbiology**

Name of the course: DSC –III Microbiology (**Chemistry of Organic  
Constituents, Enzymology and Metabolism**)

[4hrs/week= 15\*4 Th=60<sup>Th</sup> And 4 hrs/week= 15 weeks\* 4 pract = 60 P]

[Credits 4 T+2 P = 6]

**Course Description**

This course is designed in such a way that the students will gain insights of Chemistry of Organic Constituents, Enzymology and Metabolism. The students will also learn about concepts of metabolism, metabolic pathways, basics of enzymology etc.

**Course Objectives**

To learn the basics about Chemistry of Organic Constituents, Enzymology and Metabolism

**Course Learning Outcomes**

After successful completion of the course, the student is expected to

- |            |   |
|------------|---|
| <b>CO1</b> | The biochemistry and metabolic pathway of carbohydrates will be understood.   |
| <b>CO2</b> | Familiarise with amino acids and proteins chemistry and its metabolism.   |
| <b>CO3</b> | Students can understand the lipids and fats with its biochemistry and metabolism  |
| <b>CO4</b> | Students can understand hereditary units of life, the replication process mechanism. Students get knowledge of nucleotide metabolism with purines and pyrimidines biosynthesis. |
| <b>CO5</b> | Students will learn about the enzymes and enzyme kinetics   |

**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 Km and Vmax.
- 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 3 rd 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 Expreesion a Laboratory Manual: - Michael Kriegler
- 10) Concept in biotechnology: - D. Balasubramanium
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.

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(e.g. Four Year B.Sc. Honors/Research Program)  
Program: B.Sc. (Academic Session 2023-24) Syllabus under Autonomy**

**DSC –IV offered by Department of Microbiology**

Name of the course: DSC –IV Microbiology  
**(Industrial and Applied  
Microbiology)**

[4hrs/week= 15\*4 Th=60<sup>th</sup> And 4 hrs/week= 15 weeks\* 4 pract = 60 P]

[Credits 4 T+2 P = 6]

### **Course Description**

This course is designed in such a way that the students will gain insights of Industrial and Applied Microbiology. The students will also learn about fundamentals of industrial microbiology, various key processes and production of valuable products.

### **Course Objectives**

To learn the basics about Industrial and Applied Microbiology

### **Course Learning Outcomes**

After successful completion of the course, the student is expected to learn

- CO1**            The general concepts of fermentation, types of bioreactor, strain development will be emphasized.
- CO2**            Scale up process, inoculum development, control and maintenance of physical factors and downstream processing will be understood.
- CO3**            The industrial production, biochemistry, recovery and uses of important fermentative products will be understood.
- CO4**            Students will be familiarized with water microbiology and water treatment methods.

**CO5** This will give an overview of air, soil and food microbiology to students to increase the understanding of biofertilizer, biopesticides, pasteurization, and food intoxication.

### **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 :Stainner&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 :Pepller 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.