

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC with 'A' Grade

CHOICE BASED CREDIT SYSTEM

Syllabus For

**B.Sc. Part – I
INDUSTRIAL MICROBIOLOGY**

SEMESTER I AND II

(Syllabus to be implemented from June, 2018 onwards.)

B. Sc. Part – I Semester – I
INDUSTRIAL MICROBIOLOGY

Theory: 60 hrs. (75 lectures of 48 minutes)
Total Marks-100 (Paper I and II, **Credits: 04**)

Paper I: DSC –27A: Introduction to Industrial Microbiology

Marks-50 (**Credits: 02**)

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

Paper II: DSC -28A: Basics of Fermentations

Marks-50 (**Credits: 02**)

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

SHIVAJI UNIVERSITY, KOLHAPUR
CBCS SYLLABUS WITH EFFECT FROM JUNE 2017

B. Sc. Part – I Semester – II

INDUSTRIAL MICROBIOLOGY

Theory: 60 hrs. (75 lectures of 48 minutes)
Total Marks-100 (Paper III and IV, **Credits: 04**)

Paper III: DSC –27B: Introduction to Fermentation Technology

Marks-50 (**Credits: 02**)

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

Paper IV: DSC- 28B: Microbial Fermentations and Economics

Marks-50 (**Credits: 02**)

Unit/Credit – 1 (15 hrs.)

Unit/Credit – 2 (15 hrs.)

B.Sc. I Industrial Microbiology

Semester I

Paper I:	DSC –27A: Introduction to Industrial Microbiology (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	History and Basic Concepts of industrial microbiology	15
	<p>A. Historical developments of industrial microbiology</p> <ol style="list-style-type: none"> 1. Definition and scope of Industrial Microbiology. 2. Contributions of various scientists to Industrial Microbiology. <ol style="list-style-type: none"> a) Louis Pasteur b) Antony Van Leeuwenhoeck c) Alexander Fleming d) Selman Waksman 3. Introduction to Industrially important products <ol style="list-style-type: none"> a) Pharmaceutical products – <ol style="list-style-type: none"> i) Vitamins – Vit B₁₂ ii) Antibiotics–Penicillin b) Agricultural products – <ol style="list-style-type: none"> i) Biofertilizers – <i>Azotobacter</i> ii) Biopesticides – <i>Bacillus thuringiensis</i>. c) Food products – <ol style="list-style-type: none"> i) Fermented milk products – Curd ii) Pickles – Sauerkraut d) Other Industrial products – <ol style="list-style-type: none"> i) Enzymes – Amylase ii) Organic acid -Citric acid <p>B. Concepts of Fermentation</p> <ol style="list-style-type: none"> 1. Fermentation – Definition 2. Primary and secondary metabolites 3. Types of fermentation <ol style="list-style-type: none"> a) Batch and continuous fermentations b) Dual and multiple fermentation c) Solid state and liquid state fermentation 	
Unit II/ Credit II	Isolation & Study of industrially important microorganisms	15
	<p>A. Screening of industrially important microorganisms</p> <ol style="list-style-type: none"> 1. Primary Screening of <ol style="list-style-type: none"> a) Antibiotic producers b) Organic acid producers c) Amylase producers 2. Secondary screening 	

	<p>B Study of Industrially Important Microorganisms</p> <p>1. General characteristics and industrial importance of :</p> <p>a) Bacteria including actinomycetes</p> <p>b) Fungi (yeasts and molds)</p> <p>c) Algae</p>	
Paper II	DSC –28 A - Basics of Fermentations (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Fermentation media	15
	<p>A. Components of Fermentation media</p> <p>1. Basic components</p> <p>a) water,</p> <p>b) Sources of: carbon, nitrogen, minerals</p> <p>2. Special ingredients –</p> <p>a) growth factors</p> <p>b) buffers</p> <p>c) precursors, inhibitors, inducers,</p> <p>d) antifoam agents</p> <p>e) redox potential</p> <p>3. Types of media used-</p> <p>a) synthetic, semisynthetic</p> <p>b) crude</p> <p>B 1. Use of Wastes</p> <p>a) Industrial waste</p> <p>i) Molasses</p> <p>ii) Corn steep liquor</p> <p>iii) SWL</p> <p>b) Agricultural wastes</p> <p>i) Wheat bran</p> <p>ii) Rice husk</p>	
Unit II/ Credit II	Sterilization Techniques in Fermentation Industry	15
	<p>A. Sterilization Technique:</p> <p>1. Principles of Sterilization</p> <p>2. Sterilization of Equipments</p> <p>3. Sterilization of production media</p> <p>4. Sterilization of air.</p> <p>B. Validation of sterilization processes</p>	

B.Sc. I Industrial Microbiology

Semester II

Paper III:	DSC –27B: Introduction to Fermentation Technology (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Design of Fermentor & working system	15
	<p>A. Basic Fermentor design:</p> <ol style="list-style-type: none"> 1. Parts and their functions of Conventional Stirred tank fermentor 2. Fermentor Types <ol style="list-style-type: none"> a) Airlift Fermentor b) Fluidised bed fermentor c) Packed bed fermentor d) Bubble cap fermentor <p>B. Fermentor control system:</p> <ol style="list-style-type: none"> 1. Introduction & Importance of control systems 2. Designs, principles and working of systems for control of – <ol style="list-style-type: none"> a) temperature b) pressure c) foam d) pH. 	
Unit II/ Credit II	Factors affecting fermentation process	15
	<p>A. Production strains</p> <ol style="list-style-type: none"> 1. Concept 2. Preparation of inoculum 3. Concept of strain improvement 4. Stock culture maintenance 5. Culture collection centers <p>B. Factors Affecting fermentation process</p> <ol style="list-style-type: none"> 1. Temperature 2. pH 3. Aeration 4. Agitation 5. Foam 6. media composition 	

Paper IV	DSC- 28 B: Microbial Fermentations and Economics (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Microbial fermentations and microbial assay	15
	<p>A. Antibiotics:</p> <ol style="list-style-type: none"> 1. production of antibiotics <ol style="list-style-type: none"> a) Penicillin & semi-synthetic penicillins 2. Production of Vitamin <ol style="list-style-type: none"> a) Vitamin B₁₂ <p>B. Assay of fermentation products</p> <ol style="list-style-type: none"> 1. Microbiological assay of- <ol style="list-style-type: none"> a) Vitamins b) Antibiotics 	
Unit II/ Credit II	Purification and economics of fermentation products	15
	<p>A. Downstream processes</p> <ol style="list-style-type: none"> 1. Precipitation, filtration and centrifugation 2. Cell disruption 3. Liquid-liquid extraction 4. Chromatography – adsorption, ion exchange, gel, affinity 5. Distillation 6. Crystallization <p>B. Fermentation economics</p> <ol style="list-style-type: none"> 1. Raw material 2. Process 3. Recovery process 4. Product economics 5. Waste management 	

**B. Sc. I Industrial Microbiology
Practical Course**

Paper –I & Paper-II	Practical Course I: Introduction to Industrial Microbiology and Basics of Fermentations (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Introduction to Industrial Microbial Techniques	15
	<ol style="list-style-type: none"> 1. Biosafety in Microbiology Laboratory- <ol style="list-style-type: none"> a) Aseptic techniques: <ol style="list-style-type: none"> i)Table disinfection ii)Hand wash, iii) Use of aprons b) Proper disposal of used material c) Cleaning and sterilization of glasswares 2. Studying parts of Light compound microscope and its use and care. 3. Study of the principle and applications of instruments used in the microbiology laboratory: <ol style="list-style-type: none"> a) Biological safety cabinets b) Autoclave c) Incubator d) Hot air oven e) Seitz filter f) Colony counter and bacteriological filter assembly. g) Centrifuge h) pH meter i) Spectrophotometer j) Distillation Unit 	
Unit II/ Credit II	Preparation of Media for the Study of Microorganism in Fermentation	15
	<ol style="list-style-type: none"> 1. Preparation of liquid and solid culture media and their sterilization. <ol style="list-style-type: none"> a) Preparation of - agar plates, buts and slants. 2. Preparation of media suitable for the growth of: 	

	<ul style="list-style-type: none"> a) Bacteria – <ul style="list-style-type: none"> i. Nutrient broth ii. Nutrient agar iii. Soil extract agar b) Molds – <ul style="list-style-type: none"> i. Potato Dextrose Agar ii. Czapek Dox agar c) Yeasts – <ul style="list-style-type: none"> i. Glucose Yeast Extract Agar ii. Sabouraud’s agar d) Actinomycetes – <ul style="list-style-type: none"> i. Glycerol Asparagine Agar <p>3. Sterilization of culture medium using Autoclave and assessment for sterility.</p> <p>4. Sterilization of glassware using Hot Air Oven and assessment for sterility</p>	
Paper –III & Paper-IV	Practical Course II: Introduction to Fermentation Technology and Microbial Fermentations and Economics (CREDITS: 02; TOTAL HOURS: 30)	No. of Hours per Unit/Credit
Unit I/ Credit I	Study of Industrially Important Microorganism	15
	<p>1. Isolation and study of microorganisms:</p> <ul style="list-style-type: none"> a. Bacteria – Isolation, colony characters, Gram staining & motility. b. Fungi – <i>Aspergillus</i> and <i>Penicillium</i> mounting & identification. c. Yeasts – <i>Saccharomyces cerevisiae</i>, monochrome staining. d. Actinomycetes –cultivation using coverslip technique and direct microscopic observation <p>2. Study of Growth curve of Bacteria]</p> <p>3. Sub culturing of Microorganism by using solid media</p> <p>4. Demonstration of antimicrobial activity of actinomycetes by the Giant Colony Technique.</p>	

Unit II/ Credit II	Microbial Fermentations	15
	<ol style="list-style-type: none"> 1. Primary screening of – <ol style="list-style-type: none"> a) Amylase producers b) Organic acid producers c) Antibiotic Producers 2. Chemical assay of Penicillin 3. Separation of amino acids by paper chromatography. 4. Separation of sugars by paper chromatography. 	

Books Recommended for Theory

1. General Microbiology – R. Y. Stanier and others. Macmillan Press Ltd.
2. Principles of Fermentation Technology – Stanbury and Whitaker. Pergamon Press.
3. Industrial Microbiology – L. E. Casida Jr. John Wiley and Sons.
4. Microbial Technology, Volumes I & II – H. J. Peppler. Academic Press
5. Microbiology by Pelczar, Reid & Chan
6. Isolation Methods for Microbiologists, Volumes I & II – Gibbs and Shapton. Academic Press
7. Quantitative Bioassay – D. Hancroft, T. Hector and F. Rowell. John Wiley & Sons for
8. Industrial Microbiology by A.H.Patel
9. Industrial Microbiology – Prescott & Dunn.
10. Industrial Microbiology – Agarwal & Parihar.
11. Principles & Techniques of Biochemistry and Molecular Biology – Wilson & Walker.
12. Industrial Microbiology – Prescott & Dunn.
13. Principles of Bacteriology – A.G. Salle
14. Biofertilizers – Arun Sharma.
15. Fundamentals of Microbiology – Frobisher et al.

Books Recommended For Practical

1. Experimental Microbiology – R. J. Patel and K. R. Patel, Aditya Publishers, Ahmedabad
 2. Laboratory Fundamentals of Microbiology – Alcamo I.E
 3. Stains and Staining Procedures – Desai & Desai
 4. Introduction to Practical Biochemistry – D. Plummer, J. Willey and sons
 5. Introduction to Microbial Techniques – Gunsekaran.
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List of minimum equipments

- 1) Hot air oven - 1
- 2) Incubator - 1
- 3) Autoclave - 1
- 4) Refrigerator - 1
- 5) Medical microscopes - 10 nos. for one batch
- 6) Chemical balance - 1
- 7) pH meter - 1
- 8) Seitz filter - 1
- 9) Centrifuge - 1
- 10) Spectrophotometer - 1
- 11) Distilled Water Plant - 1
- 12) Colony counter.- 1
- 13) Water bath.- 1
- 14) Computer - 1
- 15) One separate sterilization room attach to the laboratory (10' x 15')
- 16) At least one wash basin for a group of five students
- 17) Arrangements for gas supply and fitting of two burners per table
- 18) One working table of 6' x 2.' for two students
- 19) One separate instrument room attached to lab (10' x 15')
- 20) One laboratory for one batch including working tables (6' x 2.') per two students for one batch
- 21) Store room (10' x 15')

PRACTICAL EXAMINATION

- A) The practical examination will be conducted on two consecutive days for not less than three hours and fifteen minutes on each day of practical examination.
- B) Each candidate must produce a certificate from the Head of the Department in his/her college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.
