

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC With 'B' Grade

Revised Syllabus For

Bachelor of Science

Part - I

INDUSTRIAL MICROBIOLOGY

Syllabus to be implemented from June, 2013 onwards.

Shivaji University, Kolhapur

Revised Syllabus For Bachelor of Science Part – I : Industrial Microbiology

1. TITLE : Industrial Microbiology

2. YEAR OF IMPLEMENTATION:- Revised Syllabus will be implemented from June, 2013 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Industrial Microbiology to undergraduate students at first year of three years of B.Sc. degree course.

Students learn Industrial Microbiology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Industrial Microbiology popular, interesting and encouraging to the students for higher studies including research.

The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER/ :

- 1) To make the students knowledgeable with respect to the subject and its practicable applicability.
- 2) To promote understanding of basic and advanced concepts in Industrial Microbiology.
- 3) To expose the students to various emerging areas of Industrial Microbiology.
- 4) To prepare students for further studies, helping in their bright career in the subject.
- 5) To expose the students to different processes used in industries and in research field.
- 6) To develop their ability to apply the knowledge of Industrial Microbiology.
- 7) To prepare the students to accept the challenges in life sciences.
- 8) To develop skills required in various industries, research labs and in the field of human health.

5. DURATION

- **The course shall be a full time course.**

6. PATTERN:-

Pattern of Examination will be Semester.

7. MEDIUM OF INSTRUCTION :

The medium of instruction shall be in English.

8. STRUCTURE OF COURSE-

(Note – The structure & title of papers of the degree as a whole should be submitted at the time of submission /revision of first year syllabus.

1)

FIRST SEMESTER ----- (NO.OF PAPERS 2)

Sr.No.	Subjects	Marks
1.	Paper – I	50
2.	Paper – II	50

SECOND SEMESTER----- (NO.OF PAPERS 2)

Sr.No.	Subjects	Marks
1.	Paper – III	50
2.	Paper – IV	50
3.	Practical	50
	Total of Semester I and II	250

2) Structure and Titles of Papers of B.Sc. Course :

B.Sc. I Semester I

Paper I : Fundamentals of Industrial Microbiology

Paper II : Basics of Fermentation.

B.Sc. I Semester II

Paper III : Fermentor Design and Instrumentation.

Paper IV : Fermentation Techniques.

3) EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)

Sr.No.	Title of Old Paper	Title of New Paper
1.	Semester I: Paper I : Fundamentals of Industrial Microbiology Paper II : Basics of Fermentation.	Semester I: Paper I : Fundamentals of Industrial Microbiology Paper II : Basics of Fermentation.
2.	Semester II: Paper III : Fermentor Design and Instrumentation. Paper IV : Fermentation Techniques.	Semester II: Paper III : Fermentor Design and Instrumentation. Paper IV : Fermentation Techniques.
3.	Practical – Old	Practical – New

4) OTHER FEATURES :

(A) LIBRARY :

Reference and Text Books, Journals and Periodicals, Reference Books for Advanced Books for Advanced studies. – List Attached

(B) SPECIFIC EQUIPMENTS : Necessary to run the Course.

OHP, Computer, L.C.D., Projector

(C) LABORATORY SAFETY EQUIPMENTS :

- 1) Fire extinguisher
- 2) First aid kit
- 3) Fumigation chamber
- 4) Stabilized power supply
- 5) Insulated wiring for electric supply.
- 6) Good valves & regulators for gas supply.
- 7) Operational manuals for instruments.
- 8) Emergency exits.

Industrial Microbiology

PAPER - I

FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY

	No. of lectures
Unit I Introduction to Industrial Microbiology:	
1. Definition and scope of Industrial Microbiology.	10
2. Contributions of various scientists to Industrial Microbiology.	
a) Louis Pasteur b) Antony Van Leeuwenhoek	
c) Alexander Fleming d) Beijerinck	
e) Selman Waksman	
3. Introduction to Industrially important products.	
a) Pharmaceutical products – i) Vitamins – Vit B ₁₂ , Vit. C. ii) Antibiotics – Penicillin, Streptomycin.	
b) Agricultural products – i) Biofertilizers – <i>Azotobacter</i> , <i>Rhizobium</i> . ii) Biopesticides – <i>Bacillus thuringiensis</i> .	
c) Food products – i) Fermented milk products – Butter, Cheese. ii) Pickles – Sauerkraut, Olives.	
d) Other Industrial products – i) Enzymes – Amylase, Cellulase. ii) Organic acids – Citric acid, Acetic acid.	
Unit II Study of Industrially Important Microorganisms.	8
General characteristics and industrial importance of :	
1. Bacteria including Actinomycetes	
2. Fungi (yeast & mold)	
3. Algae	
Unit III Microbial Growth:	
1. Introduction	10
2. Phases of growth.	
3. Batch cultures – Characteristics and Fed batch culture	
4. Continuous cultures – Characteristics, devices and maintenance.	
5. Diauxic growth, synchronous growth.	
Unit IV Effect of environmental factors on growth of microorganisms:	8
1. Temperature	
2. Osmotic pressure and hydrostatic pressure	
3. UV light	
4. pH	
5. Heavy metals	

NO. OF
lectures

1. Screening of industrially important microorganisms –	
a) Primary Screening of - i. Antibiotic producers	10
ii. Organic Acid producers	
iii. Amylase producers	
b) Secondary screening	
2. Methods of Stock Culture Maintenance	
3. Inoculum preparation	

1. Basic components – water, sources of energy - carbon, nitrogen, minerals
2. Special ingredients – growth factors, buffers, precursors, inhibitors, inducers, antifoam agents, redox potential.
3. Types of media used- synthetic, semisynthetic, crude
4. Use of Wastes – a) Industrial waste – Molasses, Corn steep liquor
b) Agricultural wastes – Wheat bran.

1. Fermentation – Definition
2. Types of Fermentations –
 - a) i) Traditional – Curd
 - ii) Contemporary – Gluconic acid
 - b) i) Batch and continuous fermentations
 - ii) Dual and multiple fermentations

1. Introduction
2. Principles of Sterilization
3. Sterilization of Equipments
4. Sterilization of Production Media
5. Sterilization of Air by Filtration.

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. Industrial Microbiology by A.H.Patel
6. Microbiology by Pelczar, Reid & Chan
7. Isolation Methods for Microbiologists, Volumes I & II – Gibbs and Shapton.
Academic Press
8. Fundamentals of Microbiology – Frobisher et al.
9. Industrial Microbiology – Prescott & Dunn.
10. Principles of Bacteriology – A.G. Salle
11. Biofertilizers – Arun Sharma.
12. Industrial Microbiology – Agarwal & Parihar.

B.Sc. Part – I Sem – II
Industrial Microbiology

PAPER – III
FERMENTOR DESIGN AND INSTRUMENTATION

	No. of lectures
Unit I Design of Fermentor	
1. Basic Fermentor design: Parts and their functions of Conventional Stirred tank fermentor	10
2. Fermentor Configurations –	
a) Airlift Fermentor	
b) Fluidised bed fermentor	
c) Packed bed fermentor	
d) Bubble cap fermentor	
Unit II Fermentor control:	
1. Introduction & Importance of control systems	10
2. Designs, principles and working of systems for control of – temperature, pressure, foam, pH.	
3. Medium composition analysis	
Unit III Principle, Working and Applications of Instruments in fermentation Process	
1. pH meter	8
2. Spectrophotometer	
3. Polarimeter	
Unit IV Computers in fermentation technology	
1. Introduction	8
2. Applications – data logging, data analysis, process control	
3. Practical implementation of basic computer control strategies for enzyme production.	

PAPER IV FERMENTATION TECHNIQUES

	No. of lectures
Unit I Microbial Fermentations:	
1. Concept of Primary and Secondary Metabolite	10
2. Industrial Production of –	
a) Baker's Yeast	
b) β carotene	
c) Penicillin	
Unit II Downstream processes:	
1. Precipitation, filtration and centrifugation	10
2. Cell disruption	
3. Liquid-liquid extraction	
4. Chromatography – adsorption, ion exchange, gel, affinity.	
5. Distillation	
6. Crystallisation	
Unit III Assay of fermentation products.	
1. Physical and Chemical assays	8
2. Microbiological assay of- a) Vitamins	
b) Antibiotics.	
Unit IV Fermentation Economics	
1. Fermentation economics with respect to –	8
a) Raw material	
b) Process	
c) Recovery process	
d) Product economics	
e) Waste management	

PRACTICAL COURSE FOR B. Sc. I

INDUSTRIAL MICROBIOLOGY

1. Demonstration of laboratory equipments:
 - a) Optical compound microscope
 - b) Incubator
 - c) Hot air oven
 - d) Autoclave
 - e) Centrifuge
 - f) Seitz filter
 - g) Spectrophotometer
 - h) pH meter
2. Preparation and sterilization of media suitable for the growth of:
 - a) Bacteria – Nutrient agar, Soil extract agar
 - b) Molds – Potato Dextrose Agar, Czapek Dox agar
 - c) Yeasts – Glucose Yeast Extract Agar, Sabouraud's agar
 - d) Actinomycetes – Glycerol Asparagine Agar
 - e) Lactic acid bacteria – Neutral Red Chalk Lactose (NRCL) agar
3. Isolation and study of microorganisms:
 - a) Bacteria – Isolation, colony characters, Gram staining & motility.
 - b) Lactic acid bacteria – Isolation, colony characters, Gram staining & motility
 - c) Fungi – *Aspergillus* and *Penicillium* mounting & identification.
 - d) Yeasts – *Saccharomyces cerevisiae*, monochrome staining.
 - e) Actinomycetes –cultivation using coverslip technique and direct microscopic observation.
4. Preparation of curd using Lactic Isolates.
5. Primary screening of:
 - a) Amylase producers
 - b) Organic acid producers
 - c) Antibiotic producers
6. Demonstration of antimicrobial activity of actinomycetes by the Giant Colony Technique.
7. Effect of temperature, pH, heavy metal and osmotic pressure on growth of bacteria.
8. Separation of amino acids & sugars by paper and thin layer chromatography.
9. Study of Growth curve.

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.

Books Recommended For Practicals

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.

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.

Nature of the question paper and distribution of marks for B.Sc. I Industrial Microbiology.

Q.1 Isolation of Bacteria/ Yeast on suitable medium, colony characters and staining.	15
Q.2 Study of Effect of environmental factors on growth of microorganisms.	10
Q.3 Mounting and identification of molds	05
OR	
Q.3 Determine the duration of lag phase	05
OR	
Q.3 Demonstrate the bacterial motility by hanging drop technique.	05
Q.4 Screening of Amylase producers/ Organic acid producers/ Antibiotic producers	10
Q.5 Spotting	05
Q.6 Journal	05

Nature of question paper and distribution of marks for B.Sc. Part I Industrial Microbiology

Theory Paper

Q.1 Objective type (The multiple choice – 10 questions)	10
Q.2 Attempt Any 2 out of 3 (A) Descriptive question (B) Descriptive question (C) Descriptive question	20
Q.3 Attempt Any 4 out of 6 (Short Notes)	20

Total	50